International Giant Otter Studbook Husbandry and Management Information and Guidelines (2005)

(Husbandry and Management of the Giant Otter *(Pteronura brasiliensis)*, 2nd Edition)

Updated December 2004

Compiled and Authored by:
Sheila Sykes-Gatz

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Sheila Sykes-Gatz

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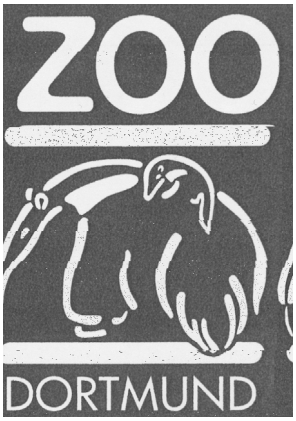

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Cover Photo: Kerby at Zoo Dortmund.. Photo by Sheila Sykes-Gatz

Dear reader,

With this, the second and extended edition of the „Husbandry Guidelines" for the Giant Otter, one of the most fascinating species in the world, Sheila Sykes-Gatz is providing us with the most extensive and detailed volume that has ever been written about Giant Otters and their management in captivity. Thus, the information given is essential for anybody interested in Giant Otters. Sheila Sykes-Gatz has not only focussed on the external factors of Giant Otter keeping but has also paid close attention to the "inside" of the animals themselves, trying to examine their basic needs and find out about the factors that are most influential in the lives of Giant Otters. She has accumulated a large amount of biological and ethological knowledge about a species whose future is quite unsure. The Giant Otter is still ranking among the most threatened mammal species in the world. The major reasons for that are all human-induced: the destroying of their environment (forests along the river systems) and they are still being hunted for their pelts and as rivals to the local fishing industries. Thus, any contribution to the welfare of Giant Otters in captivity will add to the conservation of the species as part of our natural heritage.
I would like to thank Sheila Sykes-Gatz for the immense work she has done. It is an important contribution to the quality management of Giant Otters in the zoo.

Dortmund, March 2005

Dr. Frank Brandstätter
Director of Dortmund Zoo

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Introduction

This manual is a second edition to the "Husbandry and Management of the Giant Otter *(Pteronura brasiliensis)"* (Sykes-Gatz 2001). **This revised, expanded, and updated version should be used as replacement for the 2004 manual that was distributed in the ISIS 2004 CD Library, the 2004/2005 version previously distributed with a similar name, as well as the 1st edition manual just aforementioned. The guidelines within this manual should be used instead of the recommendations for giant otters presented within the "Zoo Standards for Keeping Otters in Captivity" (2002, 2003 & 2004) AZA Otter Species Survival Plan (SSP).** Note: Sheila Sykes-Gatz is listed as a co-writer of this particular AZA document. Some specific information regarding only the care of giant otters within that publication is incorrect.

This manual is divided into multiple categories, parts, sections, and chapters that deal with specific areas of interest. *Within Chapter 2 some information overlaps in different sections and some crucial information has been made redundant on purpose for readers who wish only to refer to particular sections or parts rather than Chapter 2 or the manual in its entirety.*

It is hoped that this manual will stimulate communication and information sharing among all institutions holding giant otters, as well as increase awareness of the existent problems of this species in captivity and encourage actions needed to resolve them. A broad overview of husbandry and management information is included. It expands upon the recommendations that were presented within the 1st edition manual and covers a wider variety of topics. For example, the individual land to water area ratio necessary for each enclosure, as well as separable enclosure area, below 240 m² (2,583.4 ft²) in size and a minimum size for indoor enclosures that attach to outdoor enclosures in temperate climates are presented within this manual. (Note: each enclosure below 240 m² (2,583.4 ft²) in size, requires a different land to water area ratio based on its particular size.) Specific recommendations for these situations were not included within the 1st edition. Discussions on specific substrates necessary for all enclosure land and floor areas and the size of the area and depth needed for deep digging areas are expanded upon within this manual. (These issues are of great importance, so they are emphasized within the 2nd edition.)

These guidelines are based upon a compilation of the research, experiences and contributions from the zoos/institutions that have held giant otters in captivity world-wide and historically and from those who have studied this species in the wild. This information was gathered from published and unpublished papers/studies, survey results, conferences, lectures, and personal communications. In 1997 the "South American Giant Otter (*Pteronura brasiliensis*) Husbandry, Management, and Historical Census Survey" (Sykes 1997-99) was sent to 28 zoos and institutions that hold or held giant otters. These 4 and 8 page surveys gathered information on captive husbandry and management practices, basic life history data, reproduction, and behavior of giant otters at the corresponding institution. Sixteen or 57% of the institutions surveyed responded to the questionnaire. The continuation of information collection from the aforementioned and other institutions has been on-going during and since the completion of the original survey. This is vital so that knowledge about these animals can be increased and shared with all. **The invaluable information provided by the all of the aforementioned sources helped make these recommendations possible.** All of those who made contributions are credited within this manual for the specific information they provided. All are also listed under the section "Contributing Institutions". Any additional information that persons would like to contribute for future editions are most welcome and appreciated. Please contact the compiler/author of this manual. See below for the contact information.

Not all aspects of husbandry and management are presented within this manual or some have only been covered in brief. Quarantine, capture, anesthesia, biological (e.g. physiological) and natural history information has been gathered and is available currently by request. (Please contact the author/compiler of this manual for such information.) These topics will be presented or expanded upon in a future edition. Future editions will also include information on what zoos/institutions can do to further support conservation efforts and increase public awareness about this endangered species and its habitat. Both metric and U.S. units of measure are presented adjacent to each other. *P. brasiliensis* will be referred to as "giant otter" throughout the text.

Sheila Sykes-Gatz: International Giant Otter Studbook Keeper (Zoo Dortmund); IUCN/SSC Otter Specialist Group / Focal Point for Giant Otters in Captivity. Zoo Dortmund: Consultant for Giant Otter Husbandry, Management & Research; Affiliate of Philadelphia Zoo (U.S.).
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Contributing Institutions/Individuals and Acknowledgments

Without the information provided by the "South American Giant Otter (*Pteronura brasiliensis*) Husbandry, Management, and Historical Census Survey" (Sykes 1997-99) respondents and all those who contributed information in the years during and following the survey period, this manual and its guidelines would not have been possible. These persons and institutions are listed below. Their invaluable contributions and time are greatly appreciated.

South America

Argentina:
Buenos Aires Zoo: Information relayed by Dr. Lorenzo von Fersen and Lic. N. Luis Jacome.

Bolivia:
Santa Cruz Zoo: Information relayed by Nan Swannie, Jens Sigsgard, and Nicole Martinez.

Brazil:
CPPMA (**Aquatic Mammal Research Center**), UHE Balbina: Dra. Stella Maris Lazzarini. Information also relayed by Helen Waldemarin, Wedina Bareto, and Daniel Louzada da Silva.

Instituto Nacional de Pesquisas da Amazonia/Laboratório de Mamíferos Aquáticos (**INPA**): Dr. Vera da Silva; Dr. Fernando Rosas. Information also relayed by Daniel Louzada da Silva.

Jardim Zoologico de Brasília (**Brasilia Zoo**): (Staff until 1998: Daniel Louzada da Silva, Tatiana Lucena Pimentel (Veterinarian), Curator: Keila Macfadem Juarez, Marcelo Lima Reis, Adriona Sartori de Almeida Santos.) Current staff: Director: Raul Gonzales Acosta; Assistant Director: Clea Lucia Magalhaes; Curator: Adriana Bocchiglieri; Biologist and International Giant Otter Studbook Keeper: Marcelo Lima Reis; Wedina Bareto.

Museu Paraense Emilio Goeldi (MPEG) (**Belem Zoo**): Paulo Henrique Gomes de Castro (Former Veterinarian). Antonio Messias Costa (Current Veterinarian). Information also relayed by Helen Waldemarin, Wedina Bareto, and Daniel Louzada da Silva. Museu Goeldi also associated with **Criatorio Crocodilo Safari:** Director: Antonio Messias Costa. This private facility also held giant otters from Belem Zoo. Information also relayed by Helen Waldemarin.

Zoológico da Universidade Federal de Mato Grosso **(Cuiaba Zoo)**: Itamar Camaragibe Lisboa Assumpção. Information also relayed by Daniel Louzada da Silva.

Zoológico Municipal de Curitiba **(Curitiba Zoo)**: Maria Lúcia F. Gomes. Information also relayed by Daniel Louzada da Silva.

Parque Ecológico Municipal De Americana (**Americana Zoo**): Director: João C. Tancredi. Information also relayed by Daniel Louzada da Silva.

Parque Zoologico Municipal Quinzinho de Barros (**Sorocaba Zoo**): Veterinarian: Rodrigo Teixeira, Biologist: Cecilia Pessutti. Information also relayed by Daniel Louzada da Silva and Wedina Bareto.

Colombia:
Fundacion Zoologico de Cali (**Cali Zoo**): Director: Maria Clara Dominguez.; Biologist: German Corredor.

Fundación Zoológico de Barranquilla **(Barranquilla Zoo):** Information relayed by German Corredor.

Ocarre Zoo and Biological Park: General Curator: Ivan J Rubiano (DMV)

Guyana:
Karanambo Ranch (Giant Otter Rehabilitation Center): Director: Diane McTurk. Information also relayed by Karl Kranz and Dr. Nicole Duplaix.

Georgetown Zoo: Information relayed by Karl Kranz and Dr. Nicole Duplaix.

Peru:
Quistococha Zoo: Antony Taggart: Former Acting Director. Information also relayed by Jessica Groenendijk and Frank Hajek.

Pucallpa Zoo: Information relayed by Hugo Galvez Carillo.

Trinidad:
Emperor Valley Zoo: Kenneth Caesar; Assistant Director: Sayeed O. Ali. Information also relayed by Dr. Hélène Jacques.

Venezuela:
Information for the following zoos was relayed by Daryl Richardson and Dr. Jan Raines.
Aquarium J.V. Seijas de Valencia

Parque Zoológico y Botánico Bararida - Barquisimeto

Caracas – Parque del Este, Rómulo Betancourt Information also relayed by Peter Zwanzger.

Caracas – Zoologico El Pinar

Zoológico Municipal la Guaricha - Maturin

Turmero - Zoológico Leslie Pantin

Ciudad Guyana - Parque Loefling: Information also relayed by Dr. Hélène Jacques.

Europe

Germany:
Carl Hagenbeck Tierpark (**Hagenbecks Tierpark**): Director: Dr. Claus Hagenbeck; Veterinarian: Dr. Michael Flügger; Former Veterinarian: Dr. Klaus Wünnemann; Giant Otter Keeper: Peter Engel. (Note: Dr. Klaus Wünnemann is now the Director of Tiergarten Heildelberg in Germany.)

Dortmund Zoo: Current Director: Dr. Frank Brandstaetter; Former Director (until 2000): Dr. Wolf Bartmann; Biologist: Ilona Schappert; Veterinarians: Dr. Christine Osmann and Nicole Schauerte; Giant Otter Keepers: Volker Gatz, Michael Strugholz, Natascha Kuhrt. Volker Gatz: European Giant Otter Studbook Keeper (EEP). Sheila Sykes-Gatz: Consultant for Giant Otter Husbandry, Management & Research, International Giant Otter Studbook Keeper.

Duisburg Zoo: Director: Reinhard Frese; General Curator: Achim Winkler; Veterinarian: Manuel Garcia Hartmann.

Berlin Zoo: Information relayed by Dr. Heiner Klös.

Spain:
Zoo-Aquarium De La Casa De Campo, Madrid (**Madrid Zoo**): Technical Director: M. Lopez Gonzalez.

United Kingdom:
Chestnut Centre Conservation Park: Directors: Roger Heap and Carol Heap.

North America

United States of America:
Dallas World Aquarium: Director: Daryl Richardson; Veterinarian: Dr. Jan Raines; Conservation Biologist: Rudy Jara. Giant Otter Keeper: Gray Lang.

Philadelphia Zoological Society (**Philadelphia Zoo**): Sr. Vice President for Animal Affairs: Dr. Andy Baker; Former: Sr. Vice President for Animal Affairs: Karl Kranz; Senior Curator of Mammals: Kim (Whitman) Lengel; Chris Waldron: Assistant Curator for Carnivores; Barbara Toddes: Nutritionist; Current Giant Otter Head Keeper: Ann Hess; Michelle Jameison; Former Giant Otter Head Keeper: Sheila Sykes (now Sykes-Gatz). Sheila Sykes-Gatz: Affiliate of Philadelphia Zoo. Note: Karl Kranz is now Director of Biological Programs at Jacksonville Zoo in Florida.

ISIS: Information relayed by Laurie Bingaman Lackey.

Dortmund Zoo's continued dedication and many years of support for the formation and promotion of the international giant otter studbook and this husbandry manual and all of their efforts to help giant otters to one day become a self-sustaining captive population have been invaluable. Dortmund Zoo staff have given me the opportunity to conduct research and assist in their giant otter husbandry and management program. These first hand experiences provided additional invaluable input for these recommendations. I would like to give my sincere thanks and appreciation to Dr. Frank Brandstätter, Dr. Wolf Bartmann, Ilona Schappert, Dr. Christine Osmann, Nicole Schauerte, Michael Strugholz, and Volker Gatz for their support and this valuable opportunity and learning experience. Without Dr. Brandstätter's and Dr. Bartmann's support and efforts, these goals would not have been able to be accomplished and to them I am most especially grateful and indebted. Ilona Schappert, Dr. Christine Osmann, and Nicole Schauerte have also provided me with invaluable information and experience for giant otter handrearing and for this I am sincerely thankful and appreciative. I would also like to extend great thanks to the veterinarians at Dortmund Zoo, Dr. Christine Osmann and Nicole Schauerte,

for carrying out the actual ultrasounds via giant otter husbandry training and for helping/training us to correctly draw giant otter lactation milk samples (conducted via husbandry training). I have great appreciation for their continued support and research for these procedures and understanding of giant otter ways and patience. Without their interest, efforts, and support invaluable information would not be able to be attained. I would also like to thank Michael Strugholz for his continued support and Natascha Kuhrt for her assistance during some of the training sessions. Volker Gatz has given me continued inspiration and provided me with invaluable knowledge. His on-going assistance with the development of this manual and studbook and efforts to help giant otters to one day become a self-sustaining captive population have been most invaluable. He also began the giant otter husbandry training program at Dortmund Zoo and in allowing me to join in and work with him on this project, has provided me with invaluable husbandry training experience and information. This project would not have been possible without his efforts to initiate and continue it.

Duisburg Zoo (Reinhard Frese and Achim Winkler), Hagenbeck Tierpark (Dr. Claus Hagenbeck and Dr. Michael Flügger), and Brasilia Zoo (Raul Gonzales Acosta, Clea Lucia Magalhaes, Adriana Bocchiglieri, Marcelo Lima Reis, Wedina Bareto, and Daniel Louzada da Silva) have been instrumental in their support for the formation of the international giant otter studbook as well. Much thanks and appreciation go to them. Achim Winkler's particular efforts to these matters has been most helpful and sincerely appreciated. Dr. Flügger has also been particularly supportive and his support is much appreciated. We are also very grateful for all of Wedina Bareto's special attention to the details.

I would also like to give my sincere appreciation and thanks to the IUCN/SSC Otter Specialist Group, especially Claus Reuther, Jessica Groenendijk, Frank Hajek, Dr. Christof Schenck, Dr. Nicole Duplaix, Dr. Hélène Jacques, and Helen Waldemarin for their continuing support for the efforts to help giant otters to one day become a self-sustaining captive population and for the provision of invaluable knowledge.

Many thanks and great appreciation go to Dr. Nicole Duplaix, Dr. Christine Osmann, Dr. Klaus Wünnemann, Achim Winkler, German Corredor, and Volker Gatz for their reviews of either this entire manual or parts of it and for their invaluable comments.

The Philadelphia Zoo and Dortmund Zoo staff were instrumental in providing support, help, and advice for the first edition giant otter husbandry and management manual and research. Many special thanks and great appreciation go to Karl Kranz, Kim (Whitman) Lengel, Dr. Andy Baker, Barbara Toddes, and Ann Hess of the Philadelphia Zoo and to those named above at Dortmund Zoo. The opportunity, knowledge, and inspiration gained from my first hand experiences working with the giant otters and research experience at Philadelphia and Dortmund Zoos were also invaluable. I would also like to thank Peter Engel and Peter Zwanzger for their helpful assistance. I am also very grateful for Bernie Sykes's technical help and support for the 1st edition manual. Tatiana Lucena Pimentel was also very helpful with her assistance to review the health section that formed the basis for the second edition. Many thanks and great appreciation go to Dr. Christof Schenck, Achim Winkler, Dr. Nicole Duplaix, and Volker Gatz for their intensive reviews of and invaluable comments to the 1st edition manual. I would like to thank Dr. Klaus Schüling very much for the opportunity to publish the 1st edition "Husbandry and Management of the Giant Otter (*Pteronura brasiliensis*).

This manual is dedicated to the giant otters I have been honored to know. My most special gratitude and high regard go to them.

Giant Otter Characteristics

(The following has been excerpted from: *Staib, E. and Schenck, C. 1994. Giant Otter…A giant under even bigger pressure. Wildbiologische Gesellschaft, Munich and Frankfurt Zoological Society, Frankfurt.*)

Name:	scientific: Pteronura brasiliensis spanish: Lobo del Rio portugese : Ariranha engl.: Giant Otter
Identification:	length: 1.5 – 2 m [4.92 ft - 6.56 ft] total length 45 – 65 cm [17.7" - 25.6"] tail length weight: 25 – 32 kg [55.11 lbs - 70.54 lbs] tail: flat and broad colour: dark brown, light spots on throat area
Distribution:	tropical rainforests of South America
Habitat:	rivers, lakes, streams, swamps
Diet:	mostly fish
Families:	live in groups of up to 10 individuals. A group usually consists of an adult couple with their young from two or three consecutive years. Families may live in the same area for many years
Pregnancy:	65 to 72 days
Offspring:	1-4 young once a year
Singles:	Giant Otters reach sexual maturity at the age of two or three years. Both males and females leave the group when mature. On their own, they search for a partner and a free territory in order to start a new family.
Activity:	day – active. All otters belonging to a group sleep together in their den at night.
Enemies:	no important natural enemies. Young otters may be endangered by other predators such as black caimans. Otters are susceptible to various diseases, including those common to domestic dogs (Parvovirosis). Otters regularly host parasites such as larvae of flies in the skin as botflies, and hookworms, tapeworms and whipworms in the intestines.
Age:	oldest documented life span was eight years for free-ranging giant otters, and over 17 years in captivity. [The oldest giant otter known in captivity survived to 19 years of age, although this age is an estimation.]
Status:	highly endangered throughout its distribution range. Only remnant populations left. Numbers are uncertain.
Threats:	formerly over–hunting, today habitat loss, over–fishing, river pollution, poaching, tourism
Protection:	listed in Appendix 1 of CITES (Convention of International Trade of Endangered Species). Any trade with giant otters or their fur is prohibited. Additional protection through national legislation throughout the distribution range

Table 1: *Pteronura brasiliensis* Status in the Wild:

"The giant otter's original distribution was across much of South America, including Colombia, Venezuela, French Guiana, Guyana, Suriname, eastern Ecuador, Peru, Brazil, Bolivia, Paraguay, Uruguay, and northeastern Argentina. Today, the species has declined dramatically in distribution and has probably been eliminated in Uruguay and Argentina. With an estimated total population of only 1,000 to 5,000 individuals, the giant river otter is considered highly vulnerable to extinction. In a recent analysis conducted by World Wildlife Fund, the species was assessed as the large Neotropical vertebrate species most vulnerable to extinction. It is also classified as endangered by the World Conservation Union (IUCN), as endangered by the US Fish and Wildlife Service, and is listed in Appendix 1 of the Convention on International Trade in Endangered Species (CITES)."

Giant Brazilian Otter (*Pteronura brasiliensis*)
Endangered

"The giant otter is the largest of the 13 otter species and is found only in the rainforests and wetlands of South America, living in large rivers, lakes, and swamps. This species has declined dramatically in distribution and has probably been eliminated in Uruguay and Argentina. Historically hunted for pelts, the species is now threatened by increased human colonisation of tropical lowland rainforests. The resulting destruction of forests leads to soil erosion and a decrease in food sources for the otters. Other threats include over-fishing, illegal hunting, mining, and water and land pollution."

CITES-listed species database :

"Taxon : Pteronura brasiliensis (Gmelin, 1788)
Common name: English - Giant Brazilian Otter; Giant Otter
Distribution: Argentina (ex?) , Bolivia , Brazil , Colombia , Ecuador , French Guiana , Guyana , Paraguay , Peru, Suriname , Uruguay (ex?) , Venezuela
(ex - extinct)
CITES Identification Manual Reference : A-112.004.025.001
Legislation Details : CITES I 01/07/75"

Chapter 1

Husbandry and Management Problems and Possible Solutions: An International Historical Overview

Synopsis

In the past, there has been little information on captive *Pteronura* husbandry, management, biology (esp. reproduction and physiology), and physical and mental/behavioral health that has been maintained, studied, published or shared among zoos. Little communication and cooperation exists between many institutions holding this species. Few zoos have exchanged giant otters across, or even within, international boundaries. Many zoos currently hold giant otters singly or in single sex groups or are in need of unrelated animals to prevent further inbreeding. Very few zoos in the world have had successful reproduction. A great number of litter losses occurred because parents, stressed by human disturbances and presence, failed to properly care for their cubs. This species requires very special and complex care and housing facilities to rear offspring with success. Often enclosures have been designed without these considerations in mind. It is not uncommon that giant otters are kept in inappropriate enclosure conditions, i.e. without enough land area because of inappropriate land to water area ratios or enough soft loose natural substrates or with insufficient size deep digging areas. Unfamiliar otters are sometimes introduced incorrectly. Appropriate/safe vaccinations for some diseases are not available or are not used in many countries. Severe inbreeding was likely to have prevented the survival of all of the cubs born at one institution. (The total number of cubs born at the aforementioned institution represents a significant number of litter losses compared to the historical number of cubs born worldwide). Cub, juvenile, and sub-adult deaths resulting from medical illness not related to litter loss caused by human disturbances, remain a problem and this aspect is largely unstudied on an international level.

As a result, many problems have existed worldwide and historically (Sykes 1997-99; Sykes-Gatz 1998/2002 & 2001 and unpublished reports). These problems include high cub mortality, a small population, severe inbreeding, mental, behavioral, and physical health problems, injuries, deaths, and a significant number of potential breeding otters being held singly or in single sex groups. As well, many questions still exist about this species in captivity. *If these problems are not resolved, creating a healthy self-sustaining captive population will be impossible*. The captive population may also soon disappear and this may pose a greater threat to the already endangered wild giant otters.

Giant otters in zoos can play an important role to raise public awareness about this endangered species (IUCN 1999) and its habitat. (See Table 1 for status.) Studies on *P. brasiliensis* in captivity have contributed to overall knowledge and conservation/management strategies for this species in the wild (Schenck, pers. comm., 1999). For example, because very few *P. brasiliensis* field studies exist, research on life history data (i.e. morphology, reproductive characteristics, dietary habits, behaviors/vocalizations, genetics, etc.) of captive animals is used as a reference source for wild populations. Also, the discussion of a captive *P. brasiliensis* cub death due to parvovirus (Wünnemann 1992) inspired Schenck, Staib, and Storch (1997) and Schenck and Staib (1998) to conduct a study on the influence of domestic animal diseases on *P. brasiliensis* wild populations/survival. Additionally, Wünnemann (1992) reported captive born litters that failed to survive because the mother was under stress (i.e. as stress induced milk-deficiencies have been caused by human disturbances). This study was taken into consideration when strategies were developed for eco-tourism management in protected *P. brasiliensis* habitat

in Peru (Schenck and Staib 1998). Studies on captive individuals have helped to develop/improve management/conservation strategies for wild populations. See Chapter 1 Sections 4-5 for information that is needed by field researchers to use as a reference source for wild populations. It is important to note that some of the information needed can not be acquired through parent-reared cubs in captivity or in the wild (i.e. the disturbance would negatively affect cub-rearing success), but instead it only can be gathered from handreared cubs. Other information although, such as estrus cycling and earliest age of sexual maturity etc., can be collected from otters in captivity.

The participation of all zoos/institutions holding this species within the international giant otter studbook is urgently needed. Institutions that participate in the studbook should fulfill the recommendations within this manual. The goal of this studbook is to encourage better record keeping, communication, and information sharing and increase awareness of the existent problems and encourage actions needed to resolve them. This studbook also aims to further conservation support and promote research into the management and biology of this species in captivity that may not only benefit captive *P. brasiliensis*, but might as well, help conservation efforts for giant otters in the wild. (A future edition of this manual will also include information on what zoos/institutions can do to further support conservation.) This is necessary to help improve husbandry and management practices and increase the number of potential breeding pairs, the number of successfully reared cubs, and the size of the small captive-born population so that a healthy self-sustaining captive population can be created. It is also essential to help conservation efforts in the wild.

All institutions holding giant otters need to participate within the studbook, keep thorough documentation, openly communicate and share information, and be supportive of and actively responsive to the efforts to create a healthy self-sustaining captive population. It is essential that they provide the very special and complex care and housing facilities needed to keep giant otters and rear offspring with success. All zoos/institutions holding this species are obligated to support conservation efforts by at least helping to increase public awareness about the critical situation of wild giant otters and their habitat and by keeping the husbandry records, recommended within this manual, that can be used to aid field research. Additionally, they should do as much as they can to support other conservation efforts. Zoos/institutions who wish to acquire giant otters should be “in need”, have experience keeping giant otters, and also fulfill the aforementioned requirements. These facilities should be given first priority to receive available giant otters. An institution “in need” is one that is in need of mates for individuals held singly or in single sex groups or is in need of unrelated animals to prevent further inbreeding. It is crucial that all holding institutions be open and willing to exchange otters with / transfer otters to those zoos that fulfill the requirements listed above.

Over the past years and in regards to captive giant otter issues, much work has been done, by those responsible for the international giant otter studbook, to stimulate and maintain international communications, conduct comprehensive world-wide census, husbandry, and management surveys and research, publish papers, organize and attend giant otter in captivity meetings, and develop and distribute husbandry and management recommendations. Participation and support for the studbook has also been encouraged. Much communication has been oriented to individual conversations with zoo/institution personnel, researchers, field biologists, and conservationists. These individuals have made contact through the giant otter studbook, the IUCN/SSC Otter Specialist Group, or other avenues. This has served as an effective way to exchange husbandry and management information and advice with zoos/persons and exchange information with those who work with conservation issues. An

informal international network has been established to help achieve all of the aforementioned goals. Already, progress has been made to help reduce some of the problems of giant otters in captivity. For example, on an international level there has been increased communication, information sharing, interest in working together, and research, and improved cub-rearing success and transfer/exchange of otters as well as improvement in enclosure conditions. Because of the contributions, research, and shared experiences of the institutions world-wide and historically that have held giant otters and those who have studied this species in the wild, the formation of the studbook and husbandry and management guidelines for giant otters in captivity have been possible. Summaries and details of this collected information are presented throughout this manual and the guidelines are based on this information. This although is only a beginning as much more progress is needed to achieve all of the necessary goals. (It would be beneficial if the studbook and husbandry and management recommendations could be available in multiple languages. Efforts will be made to accomplish this within future editions.)

Section 1
Census Data and Number of Potential Breeding Pairs

Historically, international census data show small populations of *P. brasiliensis* in captivity. Many zoos currently hold giant otters singly or in single sex groups or are in need of unrelated animals to prevent further inbreeding. There is little interest, communication, and cooperation among many institutions holding this species to pair individuals to increase the number of potential breeding pairs and reduce inbreeding (Sykes-Gatz 2001). Because few zoos have exchanged giant otters across, or even within, international boundaries, a significant number of mature individuals are held in non-breeding situations in this small population. The majority of these individuals are held singly without any partner. Giant otters are social animals that mate for life and live in family groups, therefore keeping them singly for an extended period of time may cause mental / behavioral health problems. These health problems may also negatively affect future pairing and breeding success. Limited complete data regarding world-wide age distribution, genetic relationships, and census/birth/death records exists, therefore appropriate sound groupings and regroupings will be more difficult to make with the current records. Much of the information needed to complete this data is not published, recorded, or shared by/among many institutions.

Current international census data revealed that between 2002 and September 30, 2003 approximately 27 institutions in 10 countries (7 countries in South America) reported holding 58 otters (30.28) (Sykes-Gatz and Gatz unpublished report). (Census only includes individuals one year old or older and the institution's census during the most recent year reported. The total population therefore refers to all animals one year old or older. See census Tables 4-5.) Between 2002 and 2003, 37% of the total number of institutions (10 institutions) held at least one potential breeding pair. Of the captive population of animals that are 2 years old or older, 51 % (or 12.13* individuals) are paired in a potential breeding situation. Note: Cuiaba Zoo holds one male paired with two females. Currently, of the number of animals who are in potential breeding pairs, only four of these pairs (or 31 % of the potential breeding pairs) are producing offspring. Of these four pairs, 3 are rearing their litters successfully (i.e. at least one cub in the litter lives to one year or older). Inherited thyroid malfunctions due to severe inbreeding were likely to have prevented the survival of all of the cubs born at fourth

aforementioned institution (Dortmund Zoo) (Osmann & Wisser 2001). It is expected that this breeding pair at Dortmund will never reproduce successfully.

Of the giant otters that are 2 years old or older, 24 (14.10) are held singly or in single sex groups. This means that of the population of otters that are 2 years old or older (26.23 or 49 individuals), 49 % are held singly or in single sex groups. The number of institutions that are holding otters in this category are 19 (or 70.4 %), although it is important to note that some of these institutions also hold at least one or more potential breeding pairs.

At this time only 4 individuals (4 males) or 8.2 % of the population that are two years old or older and are not currently paired, could hypothetically not be paired, as there is no mate available for them. This means that 40.8 % (10.10) of the population of otters who are 2 years old or older could hypothetically be paired, instead they are held singly or in single sex groups. (Seventeen (11.6) animals that are two years or older are held singly. This equals 34.7% of the population over two years old. Six animals (2.4) are held in single sex groups, which equals 12.2 % of the population two years or older.) One additional animal (1.0) is held without a mature partner, but he is held with two juveniles.

Fifteen (7.8) animals are known to be over ten years old (born 1993 or before), including the breeding female at Cali. That equals 25.9 % of the total population. Four of these animals are known to be over 15 years old, including the breeding male at Brasilia. The age of 16 (7.9) individuals is unknown. (Note : The animals in this category are estimated to be at least over two years old.)

Currently, 31 (15.16) individuals are wild born, which equals 53.4 % of the total population, while 27 (15.12) individuals are captive born which equals 46.6 %. Seven individuals (2.5 or 12.1 % of the total population), held at Brasilia Zoo, are the first known captive born cubs that have ever been successfully reared to one year of age or older by parents which both have been captive born. Eleven (7.4) animals that were captive born are already over ten years old. That equals 19 % of the total captive population. Nine captive born animals (4.5) are around one year old, which equals 15.5% of the total captive population.

As of September 30, 2003 (i.e. currently), approximately 47 giant otters are known to be held in 22 South American institutions. More captive giant otters are held in **Brazil** than in any other country. Successful breeding pairs live at the Brasilia Zoo and at Criatorio Crocodilo Safari, a private facility close to the city of Belem. Two institutions keep single females and have so far not been able to acquire mates and one zoo keeps a single male. Many captive giant otters in Brazil are related as they are descendants of Brasilia, Cuiaba, or both bloodlines (Brasilia Zoo staff, pers. comm. 2002). Pairs that have not bred so far are held at INPA/Manaus, Curitiba Zoo, and Brasilia (Brasilia Zoo keeps two pairs in different exhibits). In **Bolivia**, only one male is known to be held at the Santa Cruz Zoo (Sigsgard & Swannie, pers. comm. 2002). In **Peru**, the zoos of Pucallpa and Quistococha currently keep giant otters. All 1.2 animals at the Quistococha Zoo are held singly and one female is already eleven years old (Taggart, pers. comm.; Groenendijk, pers. comm.). The Pucallpa Zoo held two females in 2000 (Galvez, pers. comm.). In **Colombia**, only Barranquilla Zoo and Cali Zoo currently keep giant otters. Cali also has the only successful breeding pair outside Brazil, although it has to be noted that the female is already eleven years old. The exchange or transfer of offspring has not been possible so far (Corredor, pers. comm. 2003). In **Guyana**, the Guyana Zoo in Georgetown keeps one young female singly (Duplaix, pers. comm. 2001). Diane McTurk at the Karanambo Ranch frequently receives and handrears orphaned wild giant otters, although after rehabilitation they

are only released into the wild, therefore they are not included within this studbook. In **Trinidad**, a single male is kept at the Emperor Valley Zoo in Port of Spain. Attempts to acquire a female have not been successful so far (Ali, pers. comm.; Jacques, pers. comm. 2001). In **Venezuela**, five zoos are known to keep single males while one zoo keeps two females together. One non-breeding pair is kept at the Valencia Aquarium (Richardson & Raines, pers. comm. 2003; Jacques, pers. comm. 2001; Bartmann, pers. comm. 1998).

Currently, only eleven (6.5) giant otters are held in zoos outside of South America. Unfortunately, 5.4 of these individuals are all very closely related (i.e. all are descended from the Brasilia Zoo bloodline). Until recently (when Dallas World Aquarium acquired 1.1 otters from Venezuela in 7/02, and Dortmund and Philadelphia Zoo each acquired 0.1 from Brasilia Zoo in late 2002), and despite many efforts, the process of acquisition has failed for all zoos outside of South America since 1988 (Gatz & Sykes-Gatz, pers. comm.).

Nine of the otters currently held outside of South America are all closely related, as the following explains. Hagenbecks Tierpark (Germany) is the only zoo outside of South America that has successfully reared giant otter cubs (7.2 total). It was discovered afterwards that the parents of these cubs descended from two generations of inbreeding. The mother died in 1994. The surviving cubs, now mid-aged to old adults, and their father and uncle (both the oldest living giant otters known i.e. 16 years old), live at Philadelphia Zoo in USA (1.0), Chestnut Centre in England (0.1) (their 1.0 died recently), Duisburg Zoo (1.0), and Dortmund Zoo (3.1) in Germany. The two females were paired with their brothers, as no other otters were available. In late 2002, Philadelphia Zoo exchanged a male, born at Hagenbecks Tierpark, for a female born at Brasilia Zoo and Dortmund Zoo acquired a female from Brasilia Zoo. Unfortunately, both of these newly acquired females are partly related to the otters born at Hagenbecks Tierpark and no other choice was available but to mate them with the otters born at Hagenbeck. Individuals still must be acquired from and exchanged with other zoos to help prevent further inbreeding by attaining new genetic bloodlines.

One important goal of this studbook is to promote responsible genetic management of the captive population. It is crucial that all institutions holding giant otters thoroughly record and openly share information as recommended and be open and willing to exchange otters with / transfer otters to those zoos that fulfill the requirements listed in the "Synopsis" above. This is necessary to help create genetically sound and successful pairings/re-pairings, minimize inbreeding, and increase the number of potential breeding pairs in attempts to increase the number of captive born animals. The reduction of the number of giant otters that are held singly can also help to avoid the occurrence of mental / behavioral problems caused by holding solitary animals. The ultimate goal of creating a healthy self-sustaining captive giant otter population will only be possible when the aforementioned actions are carried out.

Census records that should be kept for every individual born/acquired include individual identification and sex, identification of the dam & sire or location born in the wild, birth, acquisition, death, and transfer dates and corresponding locations, and reasons for death. Also needed are complete records on every cub/litter that a parent sired or gave birth to and any suspected pregnancies/births and reasons for the death of each cub/litter. Medical, physical, and behavioral information on each individual held should also be recorded. Expanded detailed census, age, family heritage/origin, and reproductive information can then be collected and analyzed. Individual behavioral assessments / reports (i.e. identifying dominant / submissive animals, animals with poor parenting skills, etc.) can also help to aid successful introductions and cub-rearing success.

Section 2
Breeding, Cub-Rearing Success & Privacy from Human Disturbances

A self-sustaining captive giant otter population has never been created. Very few zoos in the world have had successful reproduction. In captivity *P. brasiliensis* does not appear to be particularly difficult to keep, but successful rearing of offspring has been rare, as high cub mortality exists world-wide and historically (Sykes 1997-99 & 1998/2002; Sykes-Gatz 2001 & unpublished data, 2003). See Tables 2-3. From 1968 to 1997, seven institutions reported captive giant otter births. Litter size (n=31; i.e. litter sample size) ranged from 1 to 6 cubs, with a mean of 2.9 and common litter size of 2 cubs. Of 177 cubs born live at seven institutions (born 1968 -1997), only 16.4 % (29) were successfully reared (i.e. survived to one year of age or older). This is an 83% cub mortality rate. [In 2003 more detailed census records became available, so the cub survival rate reported in Sykes-Gatz 2001 was updated and slightly increased for current census records.] More detailed data available for 90 of those 177 cubs, indicated that 53% died during the first week of life, while 50% of the cubs surviving to one week, died before reaching four months of age. (See Graph 1.) Most of these deaths occurred because parents, stressed by human disturbances, failed to properly care for their cubs. This was the primary cause of death. These two main mortality phases show that different factors were responsible; i.e. gross parental neglect in the first week (when most cubs were eaten or/and not cared for properly) and medical illness either independent of or resulting from parental neglect thereafter. Medical illnesses that were commonly reported when cub deaths occurred were pneumonia, enteritis, malnutrition, and intestinal invagination (Trebbau 1972; Autuori and Deutsch 1977; Flügger 1997; Brasilia Zoo; pers. comm.; Dortmund Zoo, pers. comm.). Many of these illnesses were thought to be secondary causes of death that developed as a result of parental neglect/cub abuse.

From 1968 to 1997, all of the zoos with successful parent reared litters, provided parents with privacy and isolation/seclusion from human disturbances (visual and acoustic) and presence (zoo staff and visitors) during cub-rearing. Either their management methods (which were only discovered and carried out after the loss of many litters) and/or "exhibit design" permitted privacy. ("Exhibit design" means that the enclosures were natural or semi-natural and expansive, i.e. at least 600m² (6,458.4 ft²) or more in size, and the otters could dig their own dens underground to keep their cubs in. For management methods provided see Chapter 2 Section 10 and for "exhibit designs" provided see Chapter 2 Sections 10 & 12.) This is the most important management factor needed to help parents rear litters successfully. (Great emphasis has been placed on this management method throughout this manual and its 1st edition. See Chapter 2 Section 10 and below under "Historical Overview" for information on this method.)

From 1998 to 2002, four zoos reported litter births (40 cubs were born live) (Sykes-Gatz, unpublished report). Three zoos (Belem* and Brasilia in Brazil and Cali in Colombia) reported successfully rearing cubs (i.e. 16 of their 23 cubs total, were reared to one year of age or older). [*Both Museu Paraense Emilio Goeldi (Belem, Brazil) and Criatorio Crocodilo Safari (Belem, Brazil), the private facility associated with Museu Goeldi, are referred to under "Belem". The breeding pair at Museu Goeldi was loaned to Criatorio Crocodilo Safari in 2001 where the pair had one litter (in 2002) while they were held at this institution. The parents successfully reared the one litter born at the Safari and they had successfully reared 2 litters born at Museu Goeldi. Because the same pair gave birth to at least one or more successful litters at both of the two aforementioned institutions, these institutions are associated, and no other breeding pairs were known to be held at these institutions, these two institutions, except where noted, are counted as one institution for all data within this manual and are referred to as "Belem".] Inherited thyroid

malfunctions, due to severe inbreeding, were likely to have prevented the survival of all of the cubs born at the fourth institution, Dortmund Zoo (Osmann & Wisser 2001). (This institution only had one breeding pair and this pair had 28 cubs/13 litters born from 1995-2002. No cub born from this pair, whether parent-reared or hand-reared (8 were handreared), survived beyond 3 months of age. It is expected that this breeding pair will never reproduce successfully and that this problem likely resulted from three generations of inbreeding. These conclusions were based on necropsies (i.e. where thyroid glands were closely examined and found to be non-functioning or malfunctioning) and similar cub symptoms. Cub deaths, mostly very young cubs, also resulted when the parents ate or severely abused them (esp. soon after their birth) when seclusion was not offered during previous litters. See Chapter 5 Section 5 for more information on this problem.)

From 1998 to 2002, all four of the aforementioned institutions provided their parents with privacy from human disturbances and presence during cub-rearing through their management methods and/or "exhibit design" alone. [Note: Museu Goeldi (Belem) provided privacy through their management methods and Criatorio Crocodilo Safari (also referred to as Belem) provided privacy through their "exhibit design".] Cali Zoo although did not use this method for three of their litters (7 cubs total) during this time and their zoo staff believed that the seven very young cubs in these litters were eaten by their parents because of human disturbances (Corredor, pers. comm.). These cubs accounted for 17.5% of the total number of cubs born between 1998-2002. Of the total number of cubs that were born live at all four of these institutions between 1998-2002, 40 % were successfully reared. (This is a 60% cub mortality rate.) This shows a significant increase in the success of cub-rearing compared to the success rate found from 1968 to 1997. This seems to be because more cubs were born with the provision of privacy than during the last study. It is also important to note that the cubs born live at Dortmund (17 cubs) accounted for 42.5% of all the cubs born between 1998-2002 and this is a significant proportion of the total births. If these cubs were not included within the statistics, it would show that all of the cubs born between 1998-2002 and that were offered privacy lived to one year or older (i.e. 100% were successfully reared).

In a 34 year period, between 1968 and 2002, nine institutions worldwide reported giant otter births. A total of 82 litters were born and a total 217 cubs were born live and registered. Of these 217 cubs, only 45 (or 20.7%) are known to have survived to one year old or older. (This is a 79.3% mortality rate.) It is important to note that a greater number of cubs could have been born. This suspicion is based on the theory that not all litters have been detected. **No zoo has ever reared their giant otter cubs successfully unless privacy was offered during cub-rearing. Even parents that had already reared one or more litters successfully with seclusion, did not rear their following litters successfully unless they were offered this method.** (I.e. without this method they ate or neglected their cubs and litter loss resulted because of disturbances to the parents.) Parque del Este Zoo at Caracas was the first zoo in the world to report a giant otter birth and this occurred in 1968. Until 2000, there were no known captive-born cubs that have been successfully reared by parents which both had been captive born. Since 2000, at Brasilia Zoo, eight cubs were born from such a pair.

When indoor and/or outdoor enclosure land to water ratios offered smaller land proportions than recommended or/and land/floor surfaces were not nearly entirely covered with soft loose natural substrates (including appropriate types, qualities, and depths) or provided with sufficient size deep digging areas as recommended, the following has occurred. Physical and mental/behavioral health problems and/or abnormalities have occurred not only during typical daily circumstances, but also during cub-rearing. (See Chapter 2 Sections 3B & 10 and Section

3 below.) E.g. the otters' ability to successfully rear cubs has been adversely affected or seriously compromised in the aforementioned enclosure conditions. (This not only includes the ability of parents, but also any older siblings that might be present during cub-rearing. I.e. older siblings help to care for their younger siblings.) This is because these inappropriate enclosure conditions caused abnormally elevated or excessive levels of stress during cub-rearing. As well, cub illness and death have occurred when enclosure surfaces remained very damp/wet because of inappropriate substrates and/or land to water ratios. (Note: other inappropriate land and water area locations and designs and unsuitable locations for nestboxes and dens have also caused or worsened health problems already resulting from the unsuitable conditions described in the beginning of this paragraph.) It is essential that all zoos/institutions modify or design and furnish their giant otter enclosures so that the basic necessities (that are needed to maintain physical, mental, and behavioral health and promote successful cub-rearing and help otters successfully adjust to new/unusual situations) are provided. These basic necessities are usually simple and inexpensive to provide whether the enclosure is already in use or not.

Cub, juvenile, and sub-adult deaths that resulted from medical illnesses not related to those caused by human disturbances have been numerous and they remain a problem. In addition to the cub mortality phases aforementioned, deaths also occurred from medical illnesses when giant otters were between 4 months to around 12 months old. [Because of these deaths, which were not numerous, but still problematic (esp. considering their late development), giant otters are considered successfully reared when they reach one year of age or older.] This aspect is largely unstudied on an international level, so it is crucial that this be researched. The affects of severe inbreeding (i.e. inherited thyroid malfunctions that resulted in litter losses) should also be given immediate international attention. (The total number of cubs born live at the institution with severe inbreeding represents a significant number of cub losses (12%) compared to the historical number of cubs born worldwide). It is hoped that the developed husbandry and management recommendations will help to address, increase awareness of and information sharing on, and promote research into these problems. (See Section 4 for vaccination and disease prevention methods/problems.)

It may be possible that when siblings from the same litter are reared and reach sexual maturity together, they will not breed if they are housed together as a potential breeding pair. It may also be possible, that if unrelated giant otters are reared together or introduced well before they reach sexual maturity, and they reach sexual maturity together, they will not breed. It is therefore not advisable to keep otters in the aforementioned situations (see specific examples for these occurrences in Chapter 2 Section 10).

Many factors, see below and Chapter 2 Section 10, can affect how successfully juvenile and sub-adult siblings (and adult siblings) are able to co-exist with and help care for their younger siblings, this therefore affects cub-rearing success. The success of the few institutions (Corredor, pers. comm. 2003, Brasilia Zoo, pers. comm. 2002, Flügger 1997) which have experienced this situation has shown that more cubs have died in such situations than survived. (See Chapter 2 Section 10 for details.) It is therefore advisable to remove cubs from the parents when the cubs reach 6 months old. Although, because of limited available data and limited experiences a guideline cannot yet be made. In an ideal situation, it would be advantageous for cubs to remain with their family group until they are two years old. Helping to replicate the natural social structure found in the wild would provide the maturing cubs and parents with a more natural, enriched, and stimulating environment. If new litters were born, this would allow otters from previous litters to gain experience helping to rear cubs, which would be highly beneficial towards their own parenting skills later on in life. When cubs reached sexually

maturity (i.e. at 2 years old), they then could be mated with non-related individuals to form a breeding pair. Although, because the situation of giant otters in captivity is so critical, cub-rearing success has been so poor, there are very limited experiences with these matters, and many zoos do not have ideal situations, little chance should be taken for experimentation.

Research should continue on how cub-rearing and breeding success are effected by the following factors. All of the factors below must be considered for appropriate conclusions to be drawn. E.g. when cubs are reared to independence in inappropriate enclosure conditions, this does not validate that the enclosure conditions were appropriate or responsible, either in part or entirely, for the success. All factors must be accounted for to correctly explain this outcome. Cub rearing success can be effected by the quality, furnishings, design, and size of indoor and outdoor enclosures, the extent of isolation/privacy from human disturbances and presence available, husbandry and management practices, and the duration, intensity, frequency, and familiarity of the disturbance (see below). It also can be effected by stress (esp. caused by human disturbances and/or inappropriate enclosure conditions), parental and sibling cub neglect and abuse (i.e. resulting from the stress), individual otter personality and history (e.g. physical and behavioral health problems), the degree of experience that each parent and if present, older offspring has with rearing cubs, and family social structure (i.e. the age of any older offspring present at the time of the new litter birth, whether the sire is present etc.). Inbreeding, physical, behavioral, and pair compatibility problems should be considered for repeated breeding or rearing failure, providing appropriate husbandry and management is used during cub-rearing and at all other times. If siblings from the same litter were reared and reached sexual maturity together or if unrelated giant otters were reared together or introduced well before they reached sexual maturity, and they reached sexual maturity together, these factors should be evaluated for how they affect breeding success. Note: enclosure conditions that can affect cub-rearing success include: the appropriateness of land to water ratios, land and floor substrates, deep digging area sizes, other land and water area designs and locations, enclosure size, and the designs and locations of dens, nestboxes, areas/hillsides for natural underground dens, animal shift doors, and keeper doors. They also include whether natural otter dug underground dens and/or expansive enclosures are available and the amount of enrichment and privacy designs available within an enclosure. The husbandry practices that can affect cub-rearing success include: how well enclosures and nestbox, den, and natural underground den areas are isolated from human disturbances and presence, how well caretakers limit and minimize their activities and carry them out so that they do not disturb otters, if the otters are familiar and comfortable with their caretakers, and if parental care and cub development, behavior, and health is monitored in a way that does not cause disturbance to the otters. (See Chapter 2 for more information on these issues.) Also litter births that are not detected, but they are suspected, false pregnancies, and estrus cycles should also be closely monitored and evaluated. (Section 4 below lists other reproductive characteristics that should be recorded and studied.)

Detailed records on the aforementioned issues should be recorded, studied, and openly shared by every institution holding a potential breeding or breeding pair, unfortunately they are often not. These records should be compiled and scientifically studied so that husbandry and management recommendations can be further updated and expanded upon. The international studbook is needed to help encourage all holding institutions to achieve these goals.

Observations of wild giant otters in Peru:
"Only half of the cubs survived the first year: Out of 31 cubs that were identified by their throat pattern, 16 (51.6 %) disappeared during their first year of life. Because of their dependence to the mother [i.e. for nursing] and the fact that only

animals that are two years or older have been observed to leave the group, it can be concluded that these animals did not survive. In no case was an identified cub sighted again after it disappeared from the group. It is very likely that the cub death rate is even higher then estimated here, because we were usually only able to identify the cubs when they were two months old or older." (Translation from Staib 2002).

"In the wild, Schenck and Staib (1994) monitored three Pteronura groups living in three lakes heavily visited by tourists in Manu National Park. The groups successfully reared only three of nine litters over three years, with six litters dying of early malnutrition. While the sample size of this data may not be enough to draw an generally applicable rate of cub mortality, the findings suggest potentially severe impacts of tourist disturbance in the wild. This is 1/3 the expected success rate; undisturbed otters normally successfully rear each litter. The fact that the peak tourist season (June-October) is also Pteronura's cubbing season and the dry season, when aquatic habitats shrink, increasing interactions with humans….
Aside from altering lactation, it has been suggested—though not systematically confirmed— that tourism can cause entire Pteronura groups to catch less fish, alter normal denning activities, reproduce out of the naturally optimal season, and abandon a habitat altogether (Charles Munn, personal communication) (Schenck, 1999)(Patty Herrera, personal communication)." (Dauphin, internet)

Historical Overview

The recommendations for what is needed to promote the successful rearing of giant otters in captivity are based on the husbandry, management, and facilities, etc. used at each zoo in the world that has reared giant otter cubs with success (i.e. to one year or older). The history and general profile of the individual otters were also considered. The information about each zoo and that which supports their findings/documentation's was drawn from published and unpublished reports/studies, surveys, personal communications, conferences, and lectures. (Duplaix-Hall 1975; Autuori and Deutsch 1977; Hagenbeck and Wünnemann 1992; Wünnemann 1995; Wünnemann 1995[b]; Baker et al 1996; Flügger 1997; "Genealogical Meeting…in Brazil" 1998; Gomes de Castro, pers. comm. 1998; Brasilia Zoo staff, pers. comm.; Louzada da Silva, pers. comm. 1998; Marcato de Oliveira, unpublished report 1995; Dortmund Zoo staff, pers. comm.; Gatz, pers. comm.; Corredor, pers. comm.; Sykes 1997-99 & 1998/2002, Sykes-Gatz 2001 & unpublished reports; Costa, pers. comm. 2003). This study (Sykes-Gatz, unpublished study) covered the years from 1968 to September 30, 2003.

Between 2002 and September 30, 2003 there were approximately 58 giant otters held in 27 institutions. Census records indicate that the population of giant otters held and number of zoos holding them have not been much larger than this since the 1970's. From what is known, and since 1968, world-wide only 9 institutions holding giant otters have reported litter births (including aborted fetuses). Of these nine institutions, six institutions have successfully reared cubs to one year or older. (Two institutions which had successfully reared litters were counted and represented as one institution within this manual because of the special circumstances involved. See above.) Each institution had many differences (i.e. otter personalities, keepers, enclosure design etc.). All six institutions although had one thing in common, they provided the parents rearing cubs with privacy from human disturbances and presence. Either their management methods and/or "exhibit design" (see above) alone permitted privacy. The

remaining 3 institutions bred otters, but they did not rear them successfully. These zoos were Chestnut Centre, who only had aborted pre-mature fetuses, Parque del Este in Caracas, who did not mention that they provided privacy for any of their 9 failed litters, and Dortmund Zoo where no litter is expected to survive (see above). These three zoos do not fit into the "successful" category, so information from these zoos was not used to base conclusions on. Although the number of total known zoos that have bred otters is small, this has to be compared to the small population and small number of holding zoos that have existed historically. This also has to be compared to the small number of animals that are/were held as mated pairs. For example world-wide, between 2002 and 2003 there were only 25 otters (or 51%) that were in a mated situation, out of the total of 49 otters who were 2 years old or older.

In 1971, Sao Paulo Zoo found and published later (Autuori and Deutsch 1977), that when they provided isolation from human disturbances and presence, a litter was reared with success. Sao Paulo did not achieve this until they used this method during cub-rearing. (No further reports about management methods used for two litters born after their success were available.)

Twenty-one years later another zoo (Hagenbecks Tierpark) first published their research (Hagenbeck and Wünnemann 1992) stating that when parents were rearing litters, privacy from human disturbance and presence was the most important management factor needed to promote successful cub-rearing at their institution. (They too did not have success until and unless they used this method.) "Despite optimal feeding, comprehensive vaccinations and control of parasites breeding results have been unsatisfactory….In total there were 42 otter pups born [i.e. from one of their multiple breeding pairs], of which 6 (14.2%) were either still born or did not survive the first two days of life. Sadly, only nine animals reached adulthood. There were multifaceted causes of death. Foremost among necropsy results are malnutrition, bronchopneumonia and enteritis. We suspect, based on our unfortunate experiences, that the actual cause of death in almost all cases involved stress to the mother animal and consequent milk deficiency. Secondary causes were pups weakened due to various microorganism infestations." (translation of Flügger 1997). "Normally, giant otters are curious of visitors and don't feel disturbed by their presence. This changes completely when they have cubs. At this time they are more vulnerable against disturbance than all felid mothers (!)…" (Wünnemann 1995). Hagenbeck was the first zoo to use video cameras (with microphones) to monitor giant otter cub development and health and parental care without disturbance to the parents. In 1992, they recommended that this management technique be used at other institutions as well and they discussed these points in their future publications, based on continuing research at Hagenbecks Tierpark (Wünnemann 1995; Flügger 1997).

The other zoos, with successfully reared litters demonstrated or found that isolation from human disturbance and presence promoted successful cub-rearing, but from what is known at this time (September 2003), they did not publish anything about these matters. It is important to note that none of these zoos, unless the "exhibit design" alone naturally permitted isolation, had successful litters until and unless this management method was purposely offered when parents were rearing litters.

Since the first successfully reared litter in Sao Paulo in 1971, 27 more years passed before it was found that privacy from human disturbances and presence during cub-rearing is the most important management factor responsible for successful parent-rearing of giant otter litters in zoos world-wide and historically (Sykes 1997-99; Sykes-Gatz 1998/2002 and 2001 & unpublished reports, 2003).

Section 3
Health and Other Problems Caused by Inappropriate Enclosure Conditions

(*Note: the terms* ***"enclosure" and "exhibit"*** *are used interchangeably. They refer to any/all areas, both indoors and outdoors, in which a captive otter is held or has access to, regardless of whether or not public/visitors can view these areas or the areas are intended for temporary or permanent use. They include such areas as dens, off-exhibit holding and quarantine areas, and areas on-exhibit (i.e. for public viewing), etc..* [2]***"Land"*** *refers to any base*

below 240 m² (2,583.4 ft²) in size, requires a different land to water area ratio based on its specific size. Enclosures between 240 m² to 600 m² (6,458 ft²) require other land to water ratios, as do enclosures above 600 m².) Continual direct exposure to more than a small area/proportion of enclosure land/floor substrates that are hard, tightly packed/compacted (i.e. they are not loose enough for otters to easily dig into), artificial, continually wet or very damp (see below), slow drying, or poor draining or any direct exposure to coarse, rough, or abrasive substrates will cause health problems or/and abnormalities. Inappropriate substrates that create the aforementioned conditions that otters must not be directly exposed to include: concrete, cement, tile, artificial or natural rockwork, bricks, gunnite, wood, fence; soil (with/without vegetation) that is poor draining, slow drying, or tightly packed or compacted; small rocks, gravel, or pebbles (smooth, rounded, or otherwise), river rocks, construction sand, abrasive sand, and mulch, soil, or sand mixed with any kind of pebbles, gravel, small rocks, construction sand, or abrasive sand throughout. Various problems occur when the depth of soil, sand, or mulch fall below (i.e. become more shallow than) the minimum depth recommended or substrate quality (esp. when new mulch is not added on top of existing mulch that has broken into small pieces and packed down) is not maintained. Problems can develop when deep digging areas are insufficient in size (see the recommended minimum size needed in Chapter 2).

A significant amount of water will always be tracked, carried, or splashed onto the land by the otters. *Continually very damp or wet surfaces are caused by* not enough land area because of inappropriate land to water ratios, substrate depths that are below the recommended minimum depth, or inappropriate substrate types or qualities (esp. hard or artificial surfaces, poor draining/slow drying soil, mulch bark pieces that have broken into small pieces and packed down). (Note: new mulch must be added on top of existing mulch that has broken into small pieces and packed down and new sand, mulch, or soil must be added on top of the already existing layer when it falls below minimum depth.) Even after continual use (i.e. regular digging and grooming throughout the entire enclosure and digging away large areas of vegetation/turf [these natural behaviors must not be prevented] and exposure to water), soil (and all substrates) with/without vegetation, needs to retain all of the recommended qualities. When it can not, it will erode too easily, not remain dry enough, or become tightly packed/compacted. Surfaces will also remain very damp or wet when there is not enough land area bordering and extending away from the water's edge, more land area is exposed to the water's edge than recommended, inappropriate water area contour lines are used, or nestboxes, dens, or areas for natural underground dens are located too close to the water. Nestboxes (including bedding substrates), dens, and natural underground dens, as well as a significant proportion of the other land/floor areas, can remain very damp or wet when any of the inappropriate enclosure conditions aforementioned exist. Note: wet or damp conditions can occur easily and rapidly or become worsened from rain or high humidity, esp. extended periods. Daily enclosure cleaning with water is not necessary when the recommended substrates are offered, but when unsuitable substrates are offered (e.g. hard surfaces) this form of cleaning can cause land areas to remain damp/wet. Small or limited grooming areas will also remain very damp/wet when they are the only areas offered for grooming. The smaller the amount of land area available, the more difficult it is to keep the land dry. This is one crucial factor that determines land to water ratios for enclosures. It is also just one reason why land area percentages (in the land to water ratio) must be increased proportionately and water area percentages must be decreased proportionately, as the enclosure size is decreased below 240 m^2 (2,583 ft²).

It is necessary that nearly the entire base surface area that otters are directly exposed to in every indoor and outdoor enclosure is soft, well-draining, easily drying, and loose enough in texture so that otters can effectively groom on (which includes digging and scratching on/into the

substrate), and very importantly, easily dig into it. In addition, soil substrates should not erode easily. It is crucial that within each indoor and outdoor giant otter enclosure[1] the recommended soft loose natural substrate types, qualities, and depths cover nearly the entire land and floor area and the land to water ratios (i.e. enough land area) and deep digging area (sizes, depths etc.) be provided as recommended. The other recommended land and water area locations and designs and locations for nestboxes, dens and areas for natural underground dens should be provided. These include the provision of plentiful land/floor area bordering and extending away from the water's edge, water area contour lines as recommended, no more land area exposed to water edges than recommended, and nestboxes, dens, and areas for underground dens located a sufficient distance away from the water's edge. The other recommended natural furnishings, such as bamboo stands ("man-made" or/and live growing), large logs, leaf piles etc. should be provided as well. See Chapter 2 Sections 1-2 and 4-5 for the necessary land area designs, locations, and furnishings.

Following is a synopsis of the health problems and abnormalities that have occurred when the aforementioned necessities have not been provided.

Health problems involving the lower back, hind legs, and walking abilities:

Note: There are two different types of walking difficulties that involve the lower back and hind legs that have been found in giant otters and both types are serious health problems. One type involves acute severe walking difficulties that occur suddenly and only for a brief period of time (i.e. problems occur over a period of hours, days or up to a week or so) and the other involves walking difficulties that occur on an on-going basis (i.e. problems occur continually over the years and they are progressive). Moderate and severe degrees of on-going walking difficulties have occurred. The type that occurs only for a brief period of time is discussed in Chapter 1 Section 4A. The type that occurs on an ongoing basis is a very important issue and this is discussed below and in detail in Chapter 2 Section 3A.

It seems that continual long-term (e.g. 3 or more years) exposure to hard surfaces can cause or/and predispose, at least some giant otters, to develop ongoing walking difficulties/abnormalities involving their hind legs and lower back. A lack of sufficient land area (because of inappropriate land to water area ratios) or/and digging area may also have worsened or helped to cause/predispose animals to this problem. (Without sufficient and comfortable land and digging areas otters will/can not use their bodies to their full normal physical extent/capability and they can/will not carry out the full range or extent of innate terrestrial activities that are possible in captivity (i.e. exercising, playing, digging, and grooming throughout the entire expanse of their land area). Hard surfaces are uncomfortable and insufficient land area literally limits the physical space that otters have available to freely use the land.) Giant otters have become affected to a moderate and severe degree. Problems included shuffling their hind legs/feet rather than lifting them, walking very stiffly and/or abnormally, limping, showing moderate difficulty when walking, or/and having great difficulty when walking. The physical disorders which have been expressed by the walking difficulties have also affected the ability to mate successfully. Covering nearly the entire enclosure land area with soft loose natural substrates (as recommended) seems to be the most important husbandry provision needed to maintain healthy walking abilities. This also seems to be the most important husbandry method needed to avoid or at least significantly reduce the chance that these health problems will occur or to improve otter health if these problems have developed. This type of husbandry practice alone can help otters that have developed these

difficulties/abnormalities to a moderate and even severe degree, to return to a very significantly healthier or completely healthy state. Appropriate land to water area ratios (this is esp. critical in enclosures around or below 240m² [2,583 ft²]) and sufficient digging areas are necessary as well. "Intervertebral disc disease is … [a] common entity reported in …otters, and other mustelids. Exhibit space, housing, handling procedures and activity can predispose animals to vertebral problems..." (Petrini 2001).

Health problems with pads, webbing, and skin on feet/toes: Are pink foot/toe pads healthy?

This species has sensitive delicate feet. Healthy pads, skin, and webbing on giant otters' feet and toes are entirely brown, not pink, in color and supple, smooth, and soft in condition. The otter has unhealthy damaged feet when any part of the foot appears differently and inappropriate enclosure conditions (aside from any obvious accidental injury) are responsible for this health problem. Captive giant otters are often observed or reported to have pink color foot/toe pads. When foot/toe pads are pink in color they are irritated and damaged. This occurs most often because otters are kept on hard surfaces and soft natural substrates are not covering nearly the entire enclosure land/floor areas. (If hard surfaces are not responsible for this problem then other inappropriate surface conditions, such as continually very damp/wet substrates (whether soft or loose or not) or other inappropriate substrates, are responsible.) Even when the greater portion of enclosures are covered with soft natural substrates, continual exposure to just those lesser areas with hard surfaces causes pink foot/toe pads. The longer the otter has been exposed to hard surfaces or/and the greater the percentage of enclosure area covered with such, the greater the resulting health problems.

It is not uncommon that pink foot/toe pads develop into a more unhealthy state. Cracks, cuts, small red sores, rawness, or dried out appearance on pads and webbing, moderate to dark pink or worse red color pads, pink/red on the edges of webbing or in worse cases on the larger area of skin between the toes, etc. are not that uncommon of an occurrence**.** The darker the pink color (whether on the pads or webbing) the more unhealthy the feet are. This is because pink foot/toe pads can quickly and easily develop into a more unhealthy state when land/floor substrates/surfaces remain very damp or wet or other inappropriate provisions exist. Continual exposure to rough, coarse, abrasive, all hard, wet or very damp, slow drying or poor draining enclosure substrates/surfaces results in very unhealthy feet. E.g. pebbles, gravel, and small rocks (whether smooth, rounded, or not) are coarse and hard and when they are provided alone or they are mixed throughout soil or sand they will damage the otters feet and they are not comfortable for otters to use. See above for the inappropriate substrate types, depths, and qualities, land and water area locations and designs, and locations for nestboxes, dens and areas for natural underground dens which cause land areas (including sleeping areas) to remain very damp/wet. An infection could result if foot and/or enclosure conditions continue to decline.

All indoor and outdoor enclosure land and floor surfaces must be nearly entirely covered with soft sand, mulch, or/and soil, as recommended (with appropriate substrate depths, types, and qualities), to prevent foot and toe pads from becoming pink. Additionally, unhealthy feet can not fully recover until this provision is offered. It has recently been discovered that this is the most important husbandry method needed to maintain healthy natural foot condition, prevent foot problems, and improve unhealthy feet. This type of husbandry practice alone can help unhealthy feet, affected by continual exposure to inappropriate surfaces, recover to a very significantly healthier state or a completely healthy natural state. Appropriate land to water area

ratios, as well as the recommended substrates, are needed to keep surfaces dry enough, so they also must be provided to prevent foot problems and the other recommended land and water area locations and designs should be provided for similar reasons.

Fur coat condition, grooming, infections and related health problems:

Poor fur coat condition and associated poor health and death by infections have occurred among captive giant otters because of exposure to continually very damp/wet surfaces. It is also important to note that giant otters will/can not groom on substrates when they become or remain very damp or wet. "Otters possess a dense, water-resistant two-layered pelt which provides warmth, insulation and buoyancy, but [the coat] remains a particularly vulnerable point. ...rubbing and other grooming patterns keep the guard hairs and under-fur clean, unmatted and dry..." (Duplaix-Hall 1972). Otters' fur coats must remain clean, shiny, and waterproof (i.e. water does not penetrate or even dampen the white underfur), otherwise animals will become unhealthy, they may refuse to swim, or/and pneumonia, enteritis, or death may result (Duplaix-Hall 1972 & 1975). To maintain health, otters must be able to adequately dry and groom themselves and stay clean and dry when they are on land. Health problems, occurring when animals do not have these possibilities, are especially evident when the otter's fur coat is in poor condition. In these cases, health can easily and quickly decline, esp. if normally fast changing enclosure conditions worsen.

A lack of sufficient land area, resulting from inappropriate land to water area ratios, may not offer otters enough area for the aforementioned necessities. Continual exposure to wet, very damp, muddy, unclean, slow drying, or poor draining surfaces/substrates can cause poor fur coat condition. Additionally, abrasive (e.g. abrasive sands such as builder's sharp construction sand), rough, or sharp surfaces can wear away guard furs and result in poor coat condition as well. It is also difficult, unenriching, or/and uncomfortable for otters to dry and groom themselves when hard (e.g. river rocks, concrete), coarse (e.g. pebbles or small rocks alone or mixed throughout soil or sand etc.), or tightly packed/compacted substrates (e.g. soil that is not loose enough for otters to easily dig into) or insufficient land area, must be used for these activities. (E.g. hard surfaces are not absorbent and water cannot drain through them. When such surfaces are wet or very damp it is impossible for otters to effectively dry and groom themselves on them.) It is just as difficult when the only soft loose substrates available are those provided in nestboxes, small or limited grooming areas, or/and small digging pits. Even freshly offered bedding material, such as straw etc., or small areas for grooming become wet and lose their absorbent drying qualities quickly. As well, when not enough land area, limited grooming areas, or inappropriate substrate types, depths, or qualities are provided otters will not be able to carry out the full extent of their innate grooming behaviors as is necessary to maintain the otter's health. See a description of grooming and drying behaviors below in "Mental and behavioral health problems" and the mental/behavioral health problems/abnormalities that can develop when grooming and/or digging behaviors can not be carried out to their full extent.

Inappropriate substrate types, depths, or qualities, land and water area locations or designs (esp. inappropriate land to water ratios that do not offer enough land), or/and locations for nestboxes, dens or areas for natural underground dens cause the following. (See above for more information). The dens, nestboxes (including bedding substrates) or natural underground dens, the land around these locations, the land around the water, and/or the remaining/other enclosure land areas can remain very damp or wet. (Note: how wet nestboxes, dens and natural underground dens themselves become/remain is not only dependent upon how close these areas

are to the water, but it is also dependent on all of the enclosure conditions.) E.g. when the otters leave the water to enter their sleeping areas, water will be easily tracked and carried into the nestboxes and underground dens, as well as onto the land that lies between these resting places and the water. (Because giant otters take naps throughout the day, numerous trips of this nature can be made during the day, although they also rest on other land areas as well.) Otters will also quickly dampen/wet these areas when they use them to dry off and groom on because sufficient land area and/or adequate substrates are not conveniently available for them to use for these activities before they enter their sleeping areas. Without sufficient land area and/or adequate substrates, the aforementioned areas will likely remain very damp or wet. Note: young cubs will primarily stay/be kept by their parents in and near their nestboxes, dens, and natural underground dens and on the land near the water's edge. In the above inappropriate conditions, otters will be exposed to damp/wet conditions for long/extended periods and poor health, serious health problems, or even death can result. E.g. cub death by infection has occurred during cub-rearing because of these conditions. Parents, with no other choice, will be subject to keeping their cubs as well as themselves in such conditions. Also when insufficient land area exists, parents may be encouraged to put their cubs into the water more frequently than they should.

Appropriate land to water ratios (i.e. sufficient land area) and enclosure land and floors nearly entirely covered with soft sand, mulch, or/and soft loose soil (i.e. with the substrate types, depths, and quality as recommended) are the most important husbandry provisions needed to offer optimal grooming area and keep the land, floors, nestboxes and otters on land dry and clean. In such conditions the otter's fur coat, body, and feet will remain in a healthy condition and otters can carry out the full extent of their innate grooming behaviors. The other recommended land and water area locations and designs and locations for nestboxes, dens, and areas for natural underground dens should be provided for similar reasons. It is also especially important that the areas where young cubs primarily stay/are kept, remain as dry as possible. Additional furnishings (large diameter logs with bark, hollow logs large enough for entrance, nestboxes with bedding substrates etc.) that provide dry areas in enclosures should also be offered. This is esp. important when indoor enclosures are not available. Natural underground dens that otters dig into hillsides / banks (constructed as recommended) also provide additional dry areas.

Mental and behavioral health problems:
Conditions that negatively affect the ability to successfully rear cubs, adjust to new/unusual situations, and maintain mental and behavioral health.

Giant otters with *healthy behavior* and *the recommended enclosure conditions*, dig deep into and groom, dry, rub, roll, dig, and scratch on/into soft loose natural substrates *throughout the entire expanse of their land area*. As instinctively avid diggers and groomers, these are among their most favored and frequently performed land activities; i.e. they perform these with a high degree of frequency and intensity, and long (relatively speaking) duration throughout the day. They do not just limit the location of these activities to a specific enclosure area, e.g. to just limited digging and grooming areas that may be provided, they instead use the entire enclosure land area to perform these behaviors. (*Obviously, if the entire land area does not have the appropriate conditions, these behaviors cannot be carried out as described.* See below.) *Giant otters groom and/or dry themselves by rubbing, rolling, scratching, and digging on the surface of/into soft loose natural substrates. During these activities substrate particles are moved/dug freely about and otters' often cover their body/fur with the freed particles. They groom themselves when they are dry as well as wet* and also rub on substrates to help mark their territory. *Pteronura* also dig

and scratch on/into the surface of soft loose substrates to help mark their territory and simply dig. [In the wild they use these behaviors to help form/clear "campsites" to help mark their territory.] *Captive giant otters also dig deeply into substrates whether they can create underground dens or not* (they can easily dig 100 cm (3.28 ft) deep). *They in addition, when given the recommended enclosure conditions, use the entire land area to frequently play and exercise on.* Digging and grooming *carried out to their full extent* (as described above) are among the most important *activities* that giant otters need to perform to maintain their mental and behavioral health and normality and promote successful cub-rearing and adjustment to new/unusual situations. Because playing and exercising on land also constitute a significant portion of their goal oriented activities, *Pteronura* must be able to carry these out to the fullest extent for the same reasons aforementioned. These *are among the most important activities that giant otters need to perform to prevent, counteract, or significantly reduce the negative responses*, *i.e. stress, boredom, nervousness, fear, frustration etc., that can occur during new/unusual situations, cub-rearing, and typical daily circumstances*. (New/unusual situations include when otters are moved to new locations, housed in quarantine or temporary holding areas, introduced to unfamiliar animals, anesthetized, etc..) Giant otters will spend more of their daytime hours (including daytime resting hours) on land than in the water. These aforementioned land activities constitute a significant proportion of a behaviorally healthy giant otter's daily goal oriented activities.

When giant otters have been exposed to new/unusual situations, the full extent of digging and grooming (i.e. as described) activities were performed with an extraordinarily increased amount of frequency, duration, and intensity compared to otters during normal circumstances. (Some otters that had access to live growing and/or "man-made bamboo stands" also manipulated and played with the bamboo to the same extraordinary degree.) They used the entire expanse of their indoor and/or outdoor land areas to carry out these behaviors. Of their daily typical behaviors and in appropriate enclosure conditions, these were the only activities that were carried out in such an exaggerated way during new/unusual situations. (I.e. many other appropriate options, such as swimming etc., were available to be focused on in this way.) Because the otters could carry out these behaviors to the full extent, that allowed them to focus/divert their attentions and actions away from the stressful, frustrating, frightening, or uninteresting situations that normally can be caused because of new/unusual circumstances. This therefore significantly reduced/counteracted the negative responses that could have developed or that could have abnormally elevated, if the otters had focused on the stressful etc. situations. (Note: of course, during such times, some negative responses can normally be expected to occur to a certain

deep digging areas as recommended, otters will/can not carry out the aforementioned essential innate terrestrial behaviors to their full extent or at all. As a result, they can not carry out their behaviors in a normal and healthy way as compared to captive otters held in the recommended conditions. They also, as a result, can develop mental/behavioral health problems (in addition to the abnormalities) and their ability to successfully rear cubs and adjust to new/unusual situations can also be adversely affected or significantly impaired. The more inappropriate the provisions, the greater the resulting problems and abnormalities. Note: in addition to unsuitable land to water ratios, other inappropriate land and water area designs and locations can cause the land area to become inappropriate and worsen the aforementioned conditions and when this occurs, the land also can not be effectively used. As well, zoo visitors will not benefit, in an educational or enjoyable way, when otters are not carrying out their behaviors in a normal healthy manner.

Not enough land area because of improper land to water ratios, small or limited deep digging and grooming areas, inappropriate substrate types, qualities, and depths, and enclosure land areas only partially covered with soft loose substrates are not uncommonly the only areas offered for terrestrial activities to take place. All of these areas are insufficient for any of the necessary behaviors to be carried out to their full extent. In such conditions, surfaces can/will not be dug into or groomed, played, or exercised on effectively, comfortably, or at all. Digging and full grooming behaviors can only be carried out in small or limited areas, rather than the entire land area, therefore this behavior is significantly restricted. Too often, giant otters are kept on hard or artificial surfaces (e.g. concrete, tile, rock etc.), pebbles, small/river rocks, or sand or soil mixed with pebbles, gravel, or small rocks throughout. Because the land area that is offered is usually not soft and/or large enough it does not allow or encourage otters to use it as they should. Otters can not play and exercise in an unrestricted and comfortable manner in such areas. Digging can not be carried out on hard surfaces and if otters dig in soil or sand mixed with pebbles or small rocks throughout or pebbles alone, their feet will be harmed, they can not carry out the behavior to its full extent, and a comfortable surface is not provided for these activities. Grooming can not be carried out to its full extent on the aforementioned surfaces and these surfaces do not provide comfortable areas to do such. As well, substrates that are not deep enough (i.e. below the recommended minimum depths) or loose enough (e.g. tightly packed/compacted soil) to allow sufficient and easy digging (both deep and shallow) or full grooming behaviors, are sometimes offered. Land with soft loose soil, but no, not enough, or only small areas of hills for deep digging, are also sometimes offered. When enclosure terrain is fairly flat and soft loose soil (with/without grass, turf, or vegetation) is provided, otters will not be able to dig deeply, so hills/banks, with the recommended designs and substrates, must be provided for this activity when only soil substrate is offered. Otters will/can not groom on very damp or wet surfaces, whether they are soft and loose or not. See above for the inappropriate substrate types, depths, and qualities, land and water area locations and designs, and locations for nestboxes, dens and areas for natural underground dens which cause land areas (including sleeping areas) to remain very damp/wet. Small or limited grooming areas will also remain very damp/wet when they are the only areas offered for grooming.

Digging and grooming behaviors will significantly and abnormally decrease in frequency and duration. The location where these behaviors will be carried out within the enclosure will become very limited (e.g. to limited/small digging or grooming areas rather than the entire land area). The amount of time otters play and exercise on land will also significantly decrease and otters will likely only use limited land areas, rather than the entire land expanse. [E.g. hard, artificial, or coarse (e.g. pebbles, river rocks or sand/soil mixed with pebbles, gravel, or small rocks throughout etc.) surfaces are uncomfortable for otters to play and exercise on. Insufficient land area (size), because of inappropriate land to water ratios, literally limits the physical space

that otters have available to freely play and exercise.] All of these behaviors will be carried out with decreased intensity. Giant otters will also spend a significantly greater percentage of their entire day in the water than on land because there are far fewer opportunities for them to carry out goal-oriented behaviors on land. I.e. inadequate environments do not offer sufficient area on which otters can focus on or divert their attentions and actions to in a healthy and normal manner. Giant otters will swim aimlessly or swim pace in the water rather than walk aimlessly or pace on land. Swimming aimlessly means that the otter is swimming without real purpose to accomplish something. E.g. it is not swimming to exercise, play/interact with other otters, catch fish, etc.. The more unsuitable the land area, the more time otters will spend in the water vs. on the land.

When giant otters behave in the aforementioned ways in captivity, they are not carrying out their behaviors in a normal and healthy way compared to captive otters that can carry out their behaviors to the full extent, therefore these animals, in comparison to the aforementioned otters, are not exhibiting normal and healthy behavior. Unfortunately giant otters are not uncommonly reported to behave as such, therefore a significant number of institutions mistakenly assume that this is an exhibition of normal and healthy behavior in captivity. Observations of giant otters held in partially, or even totally, inadequate enclosure conditions as described or of otters that have not recovered to full health because they have been exposed to appropriate enclosure conditions for only part of their life (see below), have often caused these misconceptions. Otter enclosures are often designed and furnished with these misconceptions, as well as the misconception that river otters are aquatic mammals, in mind. (Giant otters are land mammals that swim.) Giant otters are reacting in these ways because their enclosures do not offer land area where they can/will carry out the aforementioned essential behaviors to the full extent. The entire land area can not be used in the way that is necessary to maintain normal healthy behavior.

When the behaviors, that are among the most important needed to help prevent, counteract, or significantly reduce the chance that negative reactions develop (i.e. stress, boredom, nervousness, fear, frustration etc.), become severely impaired, the chance that negative responses will occur are significantly increased. I.e. because the otters can not carry out digging, grooming, playing, and exercising on land to the full extent, their opportunities to focus/divert their attentions and actions away from the stressful, frustrating, frightening, or uninteresting situations that can occur during typical daily, new/unusual, or cub-rearing situations, are significantly limited. The negative responses that can develop or abnormally elevate in such circumstances cannot therefore be significantly reduced/counteracted, when the otters focus on the stressful etc. situations. Abnormally elevated and excessive levels of negative responses can occur when the recommended enclosure conditions are not offered. The more inappropriate the enclosure conditions, the more limited their opportunities are to carry out normal healthy behavior, the less the ability they have to counteract/reduce the negative responses, and the greater the resulting health problems.

As a result, mental/behavioral health problems (in addition to the abnormalities) have occurred among a significant number of giant otters in typical daily circumstances in varying intensities from mild to severe. Stereotypical behaviors (esp. swim pacing), less/non directed or non-goal oriented behaviors (esp. swimming aimlessly/without purpose sometimes to an excessive extent), frustration, stress, tension, very dulled/lack of alertness, attentiveness, and curiosity, depression, dulled responsiveness, nervousness, fear of change, and other abnormal behaviors have occurred. Additionally, as a result, the negative responses that usually/normally or easily occur during cub-rearing or new/unusual situations can be increased. Abnormally elevated and excessive levels of negative responses have occurred and these reactions in turn have caused

greater problems. I.e. the ability of giant otters to successfully rear cubs and adjust to new/unusual situations has been adversely affected or seriously compromised. (Increased negative responses, resulting from the new/unusual or cub-rearing situation, can occur alone or in addition to any already existing mental and behavioral health problems that have been caused by inappropriate enclosure conditions.)

For example, stress to giant otter parents rearing cubs has been responsible for many litter losses. Stress, most especially results from human disturbances and presence during cub-rearing, although inadequate enclosure conditions (as described) can increase stress caused from these sources and/or in itself create additional new stresses during cub-rearing. E.g. bored or stressed parents or older siblings can excessively focus on, handle, play with, abuse, or kill cubs or be responsible indirectly or directly for the cubs' death, as a result of having nothing else better to focus their attentions on. Additionally, sometimes during cub-rearing giant otters may have to be held in indoor enclosures (e.g. during cold weather or to offer privacy) and locked out of their adjoining outdoor enclosures. It is very important that these generally smaller indoor enclosures are properly furnished and designed to counteract the frustration, boredom, etc. that otters, who normally have year-around outdoor access can likely experience. This is also crucial in all small enclosures [i.e. enclosures below 240 m² (2,583.4 ft²)] such as temporary holding areas, quarantine, or any enclosure, whether permanent or temporary. When animals are moved to new enclosures or held in quarantine or temporary holding areas fear, stress, boredom, and nervousness can be significantly reduced with just the appropriate provisions aforementioned. Without such provisions, negative responses can increase, so that the ability to successfully adjust to these new situations can be adversely affected or seriously compromised and future healthy normal behavior (if the enclosure is a permanent/long-term home) will not be possible in such conditions.

During introductions of unfamiliar animals and temporarily separated familiar otters, animals need to take frequent breaks from the intensity and tension (and possibly fear) of the new situation by having stimulating enclosures to focus their activities and attentions on. They also need to refocus their attention on something else other than solely each other. (It is important to remember that in addition to the otters having to adjust to each other, they also have to adjust to a new enclosure, husbandry practices, keepers, etc. when they are moved from other locations and this can cause additional stress. Also when otters are held in very small temporary holding enclosures, such as in quarantine or separable enclosure areas (during visual introductions), this may likely cause additional stress.) It is especially important that they have adequately furnished and sufficient land area to focus on to relieve their stress etc. and focus on something else other than the other otter. They also need sufficient land area to get away from each other and rest alone. Focusing solely on each other and/or abnormally elevated or excessive negative responses can cause introduction difficulties. It can result in serious fights and injuries. (See below.) The other natural furnishings as recommended (see Chapter 2 Section 4), in addition to the aforementioned essential enclosure conditions, helps further to reduce stress, boredom etc. in all situations. Natural furnishings, such as plentiful large logs, bamboo stands (both live growing and/or "man-made"), etc. and the aforementioned essential enclosure conditions will also provide the following: enough land area and safe furnishings to allow an otter to get away from the other animal, stay out of the other's view, and rest alone in semi-private places when it needs to take a break from the other otter or the intensity of the situation. (Note: nestboxes must be closed during physical full-contact introductions.)

Substrates, deep digging areas, and land to water ratios (i.e. enough land area) as recommended are the most important husbandry provisions needed to prevent mental and behavioral health

problems and abnormalities and to improve and maintain otter health and normality if such problems have developed. This type of husbandry practice alone can help otters that have developed problems, because of continual exposure to inappropriate enclosure conditions, to return to a very significantly improved or completely healthy state. Giant otters have recovered from even the most severe unhealthy behaviors (see those listed on the page before under stereotypical behaviors, very dulled/lack of alertness, attentiveness, and curiosity etc.) in this way. As well, those recovered animals, who encountered new/unusual situations after their rehabilitation, had the ability to successfully adjust to these situations without abnormally elevated or excessive levels of negative responses as they had shown before recovery. They exhibited the behaviors that a behaviorally healthy otter would display during such a situation when housed in appropriate conditions. Such furnishings and designs as aforementioned are necessary to promote successful cub-rearing and adjustment to new/unusual situations and maintain behavioral/mental health and normality in typical daily circumstances. Visitors, viewing otters carrying out their behaviors in a healthy normal manner, will also be provided with an enjoyable and educational experience. The other recommended land and water area locations and designs and locations for nestboxes, dens and areas for natural underground dens should be provided as they also affect the quality and appropriateness of the enclosure land (including sleeping areas) and how effectively the land can be used. The other recommended natural furnishings, such as bamboo stands ("man-made" or/and live growing), large logs, leaf piles etc. should be provided as well. See Chapter 2 Sections 1-2 and 4-5 for necessary land area designs, locations, and furnishings.

Giant otters that have not had exposure to appropriate enclosure conditions during their entire lives or developmental stages, or for a long period, may take some time to “adjust to activating/using” their innate terrestrial behaviors after appropriate environments are offered. They then can carry these activities out to a full or at least moderate degree of normality and healthiness, as compared to an otter that has had proper exposure throughout its lifetime. I.e. after recovery grooming, digging, playing, and exercising on land are carried out with a moderate degree of frequency, duration, and intensity. Totally healthy otters although, carry these activities out with a high degree of each. The recovered otters although have significantly improved, as without the recommended conditions these activities are not carried out at all or are carried out only to a minimal degree. The amount of time a recovered otter spends on land as opposed to in the water will also increase accordingly, most esp. because goal-oriented behaviors are carried out on land more frequently and for a longer duration. These otters will spend significantly more time on land than an otter without the recommended circumstances that may spend most of its day in the water. These “rehabilitated” otters will although use the entire expanse of their land area to carry these terrestrial behaviors out. This represents a full recovery as compared to a healthy otter. Because otters may not recover to 100% health and normality, these behaviors should not be considered normal, but rather an animal that is displaying a very significant improvement in mental and behavioral health. Because a very significant, rather than full, recovery may occur this *should not be considered as a reason to not provide the necessary furnishings and designs*.

Conclusions

In most cases, whether the enclosure is already in use or it is being designed, simple solutions to the aforementioned problems exist. It is only necessary to correct the conditions that are responsible for causing their abnormalities and unhealthiness and no other techniques or husbandry methods are needed. The provisions needed for resolution, i.e. the changes and

additions that can be made to enclosures, are easy and inexpensive to provide and maintain. E.g. the recommended mulch and soft sand types, qualities, and depths are ideal for both indoor and outdoor use to cover over inappropriate surfaces such as hard, artificial, tightly packed/compacted (e.g. soil with/without vegetation), poor draining, and slow drying surfaces. The required substrates are inexpensive, very effective, easy to care for, remain sanitary, and at each institution at least one or more of these substrates are easy to acquire. They also can be easily provided whether the giant otter enclosure is already in use or not and regardless of any existing surfaces within the enclosure. As well, when land to water ratios provide smaller land proportions than recommended, pools (obviously if there is more than one pool) can be emptied or portions of pools can be divided (with waterproof barriers) and filled in with appropriate substrates to provide enough land area. This will avoid or significantly reduce the chance that otters will become unhealthy or significantly or fully improve otter health and normality after problems have developed. The ability to successfully rear cubs or adjust to new/unusual situations can also be significantly improved. See Chapter 2 Sections 2-3 for more information on these very important issues.

Improper Introductions of Unfamiliar and Temporarily Separated Otters; Enclosure Designs That Do Not Offer Parents Rearing Cubs Privacy from Human Disturbances

Isolating parents from human disturbances (both visual and acoustic) and presence during cub-rearing is also in need of immediate international attention. Fortunately, it has become more widely accepted that giant otter parents need privacy to successfully rear offspring and methods to monitor parental care and cub health and development that do not disturb the otters. It is not uncommon although that enclosures have been designed without these considerations in mind. It is possible in many cases to modify enclosures after they have been built or at least modify husbandry methods so that the necessary conditions can be offered. Although in some cases it may be difficult or impossible to provide privacy (unless enclosures are expansive in size) because of where the otter enclosure is located within the zoo/institution and/or because of particular enclosure designs. E.g. other animal enclosures might be adjacent to/adjoining the otters' enclosure and servicing these other enclosures might disturb the otters. Otter enclosures may be located in central areas within the zoo/main zoo pathways and therefore visitor/staff traffic around the otter enclosure might not be able to be prevented. Dens containing nestboxes might be located next to the only keeper entrance that allows staff access to feed the animals or service the enclosure. It might be very difficult/impossible to feed the animals or service the enclosure without disturbing parents rearing their cubs. Giant otter enclosures must be designed with these considerations in mind to avoid these problems. (Information about this topic is discussed in Section 2 above and in Chapter 2 Section 10.)

Introducing otters that are unfamiliar with each other and re-introducing those that have been temporarily separated (i.e. animals that were previously housed together) in a gradual, cautious and closely monitored manner, with visual-acoustic-olfactory introductions before physical full-contact introductions, is also in need of immediate international attention. (Note: when the term "visual introduction" is used within this manual it actually implies a "visual-acoustic-olfactory introduction".) Unfortunately, reports of significant injury and death during improperly conducted giant otter introductions have not been uncommon. I.e. it is not uncommon that visual introductions have not been conducted before animals were given full physical contact. Sometimes animals have not been observed and monitored closely enough during visual

introductions to detect tensions and stress that indicate that serious fights may develop if the otters are introduced physically or to detect that serious fights may develop with animals that have just been introduced with full-contact.

Methods and provisions necessary to avoid or reduce the chance that these problems develop are simple and inexpensive to provide, although too often enclosures have been designed without these considerations in mind. In many cases enclosures can be modified after they have been built and husbandry methods can be adapted so that the necessary conditions can be offered during introductions. In some cases although it may be difficult or impossible to introduce otters in a comfortable manner or there might be no way the enclosure can be modified to allow visual introductions. E.g. there may be no other option but to offer the unfamiliar otters with a very small area (such as connecting dens) to stay in during the short (e.g. one to a few weeks) non-physical contact phase of the introduction period. Though the otters should be rotated and exposed to each separable area within the enclosure during the visual introduction, so that both are familiar with all enclosure areas, both otters will at some time be confined in a small area (e.g. dens), which could become stressful and frustrating. In addition, the area where otters can actually make visual-acoustic-olfactory contact and spend time with each other in this way, will likely not be large enough to have an optimally successful introduction. (Small visual introduction areas, such as through small introduction (howdy) shift doors, can be frustrating for both otters and will negatively affect the situation.) It is essential that giant otter enclosures are designed with these considerations in mind to avoid these problems. See Chapter 2 Section 18 for information on introductions and enclosure locations and designs needed for introductions.

The otters' ability to successfully rear cubs and adjust to new/unusual situations has been adversely affected or seriously compromised when inappropriate enclosure conditions have been offered. See Chapter 2 Sections 3B, 10, & 18 and just above for this discussion.

Great emphasis has been placed on all of the aforementioned matters within this manual. It is essential to increase awareness of these existent issues and to encourage actions needed to resolve them.

Section 4
Part A. <u>Health Problems, Viral Diseases & Vaccinations</u>

Cub, juvenile, and sub-adult deaths resulting from medical illnesses not related to those caused by parental neglect/abuse because of human disturbances/stress to the parents, remain a problem. Leptospirosis, parvovirus, pneumonia, gastroenteritis, internal bleeding, and exposure to continually very damp/wet conditions have been reported as reasons for death. This aspect is largely unstudied on an international level. It is crucial that such research be carried out. The affects of severe inbreeding (i.e. inherited thyroid malfunctions that resulted in litter losses) should also be given immediate international attention. Many cubs have died from pneumonia, enteritis, malnutrition, and intestinal invagination because of parental neglect/abuse. See Section 2 above for more information on these issues. See “Additional Health Problems / Topics of Giant Otters” below and health problems caused by inappropriate enclosure conditions under Section 3 above and Chapter 2 Section 3. See a discussion on false pregnancies and female reproductive capabilities (estrus, bearing litters etc.) during late age

(esp. around approx. 10 to 11 years old) and possible associated health problems in Part B below and Chapter 4.

Distemper has not been reported to cause any giant otter deaths/illnesses in captivity. A parvovirus infection combined with severe cryptosporidiosis caused the death of a 7 1/2 month old otter in a European zoo (Hagenbeck & Wünnemann 1992; Flügger 1997). A Venezuelan rancher reported two handreared orphaned wild cubs died from parvovirus, although no necropsy or veterinary consultation was reported therefore the diagnosis must be considered unconfirmed. The cubs weighed approx. 2 kg (4.41 lbs.) at their death and they were handreared for 24 days until their death (Lopez de Ceballos pers. comm. 2000). At least two captive-born otters contracted leptospirosis at a Brazilian Zoo and both of these animals died (one female died at 1 year and 2 months old and the other died before he reached 2 years old (Louzada da Silva & Pimentel, pers. comms.). It seems that one of the two aforementioned animals may have contracted leptospirosis two times and the first time it was successfully treated (Pimentel et. al), although this remains uncertain from available records. These cases were supposed to have occurred because the otters were fed much more fish than they could eat at each feeding and staff felt that the significant amounts of fish left over in the enclosure during the day/overnight attracted rats that carried leptospirosis. (Left-over food should be minimized by feeding only what otters eat readily to avoid these problems.)

Disease prevention methods should be promoted and/or developed. Some appropriate/safe medical vaccinations are not used or they are not available or produced in many countries/zoos. The availability and production of specific appropriate/safe medical vaccinations need to be increased. Some vaccinations that had been formerly used for giant otters are no longer produced and there is a demand for them. An adequate/safe vaccination for distemper is currently lacking or very difficult to find in South America, Europe, and the U.S. For example, in Germany killed parvovirus and killed distemper vaccinations have been used for giant otters, although currently neither are produced (Osmann, pers. comm.). The company, Hoechst AG, that used to produce killed canine parvovirus, is no longer in business. (See below under Hagenbeck and Dortmund vaccination schedules.)

Vaccinations

Otters are susceptible to contracting feline and canine diseases such as distemper, parvovirus, leptospirosis, and rabies (Duplaix-Hall 1975; Foster-Turley 1990). Pet, domestic, feral/stray, wild (e.g. rodents, raccoons, foxes), and zoo animals can transmit diseases to captive otters. There is a possibility (although no cases were found) that wild giant otters may be susceptible to contracting canine distemper or canine parvovirus through contact with infected domesticated dogs or their excretions (Schenck et al 1997).

"Giant otters are susceptible to most viral diseases of dogs and cats…. They should be vaccinated, if possible, only with killed vaccine [referring to all vaccines]! There is too little experience to take a risk with these endangered animals." (Wünnemann 1995). Killed parvovirus (canine or feline origin vaccine), killed rabies, killed leptospirosis, killed canine distemper (see cautions for modified-live distemper below) vaccinations should be considered for otters held where these diseases are present and there is a risk of contraction (Lewis 1995; Moore 1997). [With regards to parvovirus, univalent / monovalent vaccines are preferable over polyvalent (combination) vaccines in mustelids (Hinshaw et al 1996; Petrini et al 2001). Only killed virus rabies vaccines should be given (Merck 1986; Hinshaw et al 1996; Moore 1997).

Killed rabies vaccinations are given at 4 months of age and must be repeated annually (Petrini et al 2001). Killed parvovirus and distemper vaccinations are given at 8, 12, and 16 weeks of age and boosters are given annually thereafter (Petrini et al 2001).] The compiler/author of this manual has found no scientific research on the safety, efficacy, and duration of immunity of any vaccines used on giant otters specifically, although this is true with many vaccinated exotic species. As well, only a few zoos have reported vaccinating their giant otters, so experience is not widespread [see below].

Controversy continues over whether to vaccinate otters with killed or modified live distemper vaccines. To avoid the possibility of vaccine-induced disease, killed virus distemper vaccines are preferable over modified live virus distemper vaccines (Merck 1986; Wünnemann 1995; Lewis 1995; Read & Meier 1996; Moore 1997). Modified live distemper vaccines have caused vaccine-induced distemper in a "variety of mustelids" (Petrini et al 2001; Hinshaw et al 1996; Lewis 1995). Killed distemper vaccines will not cause vaccine-induced distemper, although they may not "stimulate a strong protective immune response", "have not provided long-lived protection", and are not available in many countries. "There is marked variation between species and individuals in their reaction to MLV [modified live virus] vaccines." (Merck 1986). There are some commercial varieties and strains of MLV distemper vaccines that should be entirely avoided and a few that are considered/found *more safe for some otter species* (Lewis 1995; Petrini et al 2001; see Hagenbecks Tierpark below for giant otters specifically). For example, "Live vaccines of canine or mink cell culture origin should be avoided as these are capable of producing clinical disease in vaccinated mustelids. Non-Onderstepoort strain MLVs of chicken embryo tissue culture origin should also be avoided for the same reason." (Lewis 1995). "Ferret-virulent-MLV vaccines are poorly attenuated and therefore contraindicated for use in any nondomestic carnivores." (Merck 1986). In addition to the usual great cautions needed when vaccinating exotic, previously unvaccinated, and young animals, "…caution is advised in vaccinating wild-caught animals because of the possibility that they may have been exposed to the virus and be incubating the disease." (Merck 1986). This can be especially critical for handreared orphaned wild giant otter cubs. *A veterinarian must carefully evaluate the risk of vaccine-induced distemper versus the actual chances of contracting distemper. The compiler/author has found no reports of captive or orphaned handreared wild giant otters with distemper.*

Of 10 zoos / institutions surveyed (Sykes 1997-99) who hold / held giant otters in South America, only one reported giving vaccinations of any kind (distemper vaccination - not specified whether live or killed - given to one 18 month old otter held in Trinidad). In early 2000 although, reports indicated that at least one or more giant otters might have been vaccinated for leptospirosis at Brasilia Zoo (Pimentel pers. comm.). Only two [Hagenbeck Tierpark and Dortmund Zoo] of the five zoos outside of South America who hold / held giant otters reported giving any vaccinations (see below). No killed distemper vaccine was available within South America and at least two institutions there reported they did not vaccinate with modified live distemper for fear of vaccine-induced distemper. Philadelphia Zoo (U.S.) reported they did not vaccinate their adult giant otters (that were acquired from and previously vaccinated at Hagenbecks Tierpark) because a killed distemper vaccine was unavailable in the U.S.. The surveyor found one zoo that vaccinated with modified live distemper vaccine, although this was on limited occasions *and only after otters were vaccinated with initial killed distemper vaccines (i.e. only after at least the initial 3 killed distemper vaccinations were completed).* (See Hagenbecks Tierpark Vaccination Schedule.) Vaccinations have been administered by small blowpipe darts when the otter is confined in a den or by hand syringe while the otter (a cub) is physically restrained (Dortmund Zoo, Osmann, pers. comm.).

Hagenbecks Tierpark Giant Otter Vaccination Schedule
(Flügger 1997; Hagenbeck 1994, pers. comm.)

8 weeks old:
Killed canine distemper vaccine (Behring-Werke)
Killed canine parvovirus vaccine (Candur P; Hoechst AG)
Killed leptospirosis vaccine (Candur L; Hoechst AG)
Baypamun HK (Company name; stimulates the immune system)

12 weeks old:
Killed canine distemper vaccine
Killed canine parvovirus vaccine (Candur P)
Killed leptospirosis vaccine (Candur L)
Baypamun HK

***24 weeks old:**
Killed canine distemper vaccine

1 year old and annually thereafter:
Killed canine parvovirus vaccine (Candur P)
Killed leptospirosis vaccine (Candur L)
**Killed canine distemper
*****or** on limited occasions modified-live canine distemper vaccine (no company name or other information given).

*****OR** on at least one otter Candur P and Candur SHL (Hoechst AG)

*Varies with other killed parvovirus and distemper vaccination schedules for mustelids (see above).
**To avoid the risk of vaccine-induced distemper the otters were given only killed distemper virus vaccines.
***On limited occasions, the otters were vaccinated with a modified-live distemper vaccine to strengthen their immunity, **but only after 3 killed distemper vaccines were first given** (Flügger 1997).
****The combination of Candur P and Candur SHL (Hoechst AG) [see below] vaccines were used on at least one otter (annually on 2 successive years), **but only after 3 killed distemper vaccines were first given** (Hagenbeck 1994, pers. comm.).

Product information (12/1995) reported Candur SHL (Hoechst AG, Frankfurt a. M.) as: S = Modified-live canine distemper of dog kidney cell cultures multiplied distemper virus (Stamm Rockborn); H = Killed canine hepatitis of dog kidney cell cultures; L = Killed leptospirosis (*L. canicola* and *L. icterohaemorrhagiae*); and aluminum hydroxide. Indicated for use in dogs. (Institut fuer Veterinaerpharmakologie und –toxikologie; 2001).

Dortmund Zoo Giant Otter Vaccination Schedule
(Osmann, pers. comm. 2001)

8 weeks old:
Killed canine distemper vaccine (Behring-Werke)
Killed canine parvovirus vaccine (Candur P; Hoechst Roussel Vet AG)

12 weeks old:
Killed canine distemper vaccine (Behring-Werke)
Killed canine parvovirus vaccine (Candur P; Hoechst Roussel Vet AG)

16 weeks old*:
*No cub at Dortmund was vaccinated at this age as none lived longer than 100 days, although if they survived they would have been vaccinated as follows.
Killed canine distemper vaccine (Behring-Werke)
Killed canine parvovirus vaccine (Candur P; Hoechst Roussel Vet AG)

1 year old and annually thereafter:
Killed canine distemper vaccine (Behring-Werke)
Killed canine parvovirus vaccine (Candur P; Hoechst Roussel Vet AG)

Additional Health Problems / Topics of Giant Otters

A brief overview of **additional** health problems / topics of giant otters held in captivity are reported below.

Accidental Deaths/Injuries: A giant otter died after it climbed a 2m high fence and fell from this height to a concrete floor (Trebbau 1972). A solitary adult giant otter was attacked and wounded by a nesting female spectacled caiman sharing its zoo exhibit. The animal received a wound on its rear flank that was treated with an antibiotic powder before being stitched closed. The otter fully recovered after medical treatment and thereafter caimans were no longer housed with any giant otters (Taggart pers. comm.). An approx. 3 month old cub suffocated in a plastic cup (Flügger 1997). A visitor fed a giant otter a toxic substance, causing its death (Trebbau 1972).

Anesthesia: Anesthetizing can be very dangerous to the otter and it is only recommended to be carried out when it is absolutely necessary (e.g. for serious/life threatening health problems, when necessary medical treatment can be administered in no other way). For example, at least two giant otters were known to have died because of problems caused by anesthesia and at least two more were reported to have serious problems caused by anesthesia. E.g. one giant otter died during recovery from anesthesia after it was anesthetized to crate it for transport to another institution. Also, another giant otter, anesthetized for a medical procedure, had an excessively long recovery period (i.e. the period when the animal was coming out of anesthesia). When giant otters are anesthetized "Caution must be exercised because otters go into respiratory arrest easily." (Pimentel, Reis & Passerino, unpublished manuscript). See Part C below for how some husbandry procedures could be conducted via husbandry training rather than by anesthetizing. Information on anesthesia (e.g. anesthetic drug types that have been successfully used on giant otters etc.) is available upon request, please contact the author/compiler of this manual.

A **blocked urethra** caused the death of one male orphaned wild otter cub (Lazzrini 1998, pers. comm.).

Dental Problems: Gingivitis and calculus with loss of teeth was reported in a 6 year old otter in a Brazilian zoo (Vera da Silva, pers. comm.). A broken and chipping tooth was removed in a zoo otter (Dominguez, pers. comm.).

Dietary Related Problems: Diarrhea and loss of appetite were caused by feeding fish in the reproductive state (i.e. when they carried eggs) (Lazzrini 1998, pers. comm.; Dortmund Zoo, pers. comm. 2001). (Fish eggs should be removed before feeding.) Giant otters have contracted helminthes from live-fed fish (Flügger 1997).

When feeding giant otters "The fish has to be first quality, freshwater fish. Saltwater fish is taken, but contains too much fat." Wünnemann (1995[b]). Also Hagenbeck & Wünnemann (1992) explain, "Marine fish, such as herring (*Clupea harengus)* and mackerel (*Scomber scombrus*) are preferred by the otters but are not given as we consider them too oily to offer a good balanced diet." "Marine products contain high levels of poly- and mono-unsaturated fatty acids." (Reed-Smith 2001). Nutrient values vary between fish species and even within the same species depending on age, sex and season of capture (Crissey 1998). Merck (1986) states "Many fresh-water and salt-water fishes contain thiaminase, an enzyme that results in thiamine [vitamin B_1] deficiency in animals fed exclusively on a diet of such fish." Lewis (1995) states, with regards to mustelids, "Diets high in polyunsaturated fat or fish may predispose vitamin E deficiency." The process of fish storage (freezing), thawing, and preparation causes fish nutrient loss, particularly vitamins B_1 and E, and especially in fish with a high fat and/or high thiaminase content (Crissey 1998, Merck 1986). Fish types containing high thiaminase and/or high polyunsaturated fat levels should be avoided, as they can cause malnutrition, sickness and even death (Merck 1986). Vitamin supplements, most especially vitamin B_1 (thiamine), vitamin E, and a multivitamin, must be added when *thawed frozen fish* is the main diet. See Chapter 2 Section 19 for information on diets.

The following problems could be caused by feeding inappropriate diets, although these problems have not been reported (see the paragraph below) to occur among giant otters: (Following are excerpts from Reed-Smith, 1994-1995). "Thiamine (B1) - Thiamine deficiency is also known as Chastek's paralysis. Clinical signs include, anorexia, salivation, ataxia, incoordination, pupillary dilatation, and sluggish reflexes. Chastek's paralysis: *"..a vitamin B1 deficiency induced by feeding certain types of raw fish that contain the enzyme thiaminase.* " (Merck, 1991) Early in the disease an abnormal gait, as if the hind legs were stiff, will be observed. This leads (within 12 - 36 hours) to *"extensive spastic paralysis"* and the animal will be unable to rise. It is treated by removing fish from the diet (then substituting fish that do not contain thiaminase) and *"daily injections of 100$_u$ of thiamine..".* (Merck, 1991). "Vitamin E Deficiency (yellow fat disease, steatitis) is produced by feeding high percentages of long-chain polyunsaturated fatty acids provided in fish oils or horse fat." (Wallach & Boever 1983). Clinical signs may include lethargy, lumpy subcutaneous fat, rear leg weakness and death." (End of excerpts.)

See under "Vomiting" and "Walking Difficulties Involving the Lower Back and Hind Legs" (i.e. under "acute severe walking difficulties that occur suddenly and that last only for a brief period of time") below for more information about diets.

Excessive humming vocalizations: Otters have nine different vocalization types and many sub-categories exist for each type (Duplaix 1980). Normally humming is a positive contact vocalization. Although when otters hum excessively (i.e. hum for an abnormally long time or/and unusually frequently) this is not necessarily a positive sign and these sounds can mean that the otters are stressed, nervous or anxious (Sykes-Gatz & Gatz pers. obs.).

Foaming at the Mouth: This species in captivity has been observed to have significant amounts of foamy saliva coming from the mouth when they are exceedingly anxious, excited, nervous, or stressed (Sykes-Gatz and Gatz, pers obs.).

Foot/Toe Pad, Webbing, and Skin Health Problems: Pink color toe/foot pads indicate that the otters' feet are irritated and damaged. This is a common problem among captive giant otters. Other foot conditions, such as rawness, cracks, cuts, sores, dried out appearance, etc. in the pads or webbing, also indicate that the feet are in poor health condition. This species has sensitive delicate feet. Healthy pads, skin, and webbing on giant otters' feet and toes are entirely brown, not pink, in color and supple, smooth, and soft in condition. If any part of the foot appears differently, then the otter has unhealthy damaged feet. Inappropriate enclosure substrates/surfaces (i.e. hard surfaces, pebbles, gravel, small rocks either alone or mixed throughout soil or sand, or river rocks etc.) are most likely causing the problem (aside from obvious accidental injury). If this is not the cause, then not enough land area, because of inappropriate land to water ratios, or other inappropriate land and water area designs and locations which cause substrates to remain very damp/wet, can cause the problem. This can also worsen foot condition when combined with the other inappropriate condition. Substrates that are below the recommended minimum depth or quality (e.g. broken and packed down mulch bark pieces) can also remain very damp/wet. Health problems, such as infections, could develop if enclosure or foot conditions decline too far. See Chapter 2 Section 3 for information on foot problems and Chapter 2 Sections 1-2 and 5 for substrates and land and water area designs locations that are necessary to prevent foot problems. *Note: these lesions are different than and not related to those described under "Lesions" below.*

Handreared Orphaned Wild Giant Otters: Unfortunately, wild giant otter cubs taken in as pets or for handrearing often reach wildlife rehabilitation centers or zoos/institutions in poor physical condition and in bad health (Lazzrini, pers. comm.; Taggart, pers. comm.; Gomez et al 1999). Often many of these cubs can not be saved. Other cubs never reach professional rehabilitators and therefore some die in the care of inexperienced unqualified handrearers (Laidler 1984; Duplaix 1980). A wildlife rehabilitation center in Brazil reported that some cubs received at the center arrived with *pneumonia*, *diarrhea*, and *severe dehydration* because of being handreared by inexperienced persons. These cubs died. (Lazzrini 1998, pers. comm.). An approx. two month old handreared orphaned wild cub "…was in contact with domestic animals, from which she had contracted several illnesses." [Diseases were unspecified.] The cub also had two deep non-healing injuries in the neck area that were not infected (Gomez et al 1999).

Infections: can occur because of many reasons. See the infections listed throughout this section (Part A) and under "Foot/Toe Pad, Webbing, and Skin Health Problems; Handreared Orphaned Wild Giant Otters; "Poor Coat Condition; Pneumonia; and Pyometra-OP". Also see Chapter 1 Sections 2 -3 and Chapter 2 Section 3.

Lesions: Lesions are reported to occur on the tops, sides, and bottoms of feet/toes/webbing and ankles and on the underside of the tails on cubs (as early as 7 days of age and esp. after one month old). The same has occurred on adult giant otters. The affected otters were held at two zoos (Dortmund Zoo, pers. comm. and Hagenbecks Tierpark, Flügger pers. comm.) and these otters were/are all related. Dortmund staff described that the lesions appeared as small (averaging approximately 5 mm [0.2"] in diameter, with some smaller in size) dry circular areas that had a muted pink raw/irritated appearance when they were in their active stage. They then turned to a yellowish/brown color and faded away/ healed (on the adults) within roughly one to three weeks. The lesions were/are observed to re-occur on the adults (approx. three or four

times over 10 years) then disappear without medical treatment. (At least one time they were treated, although it is unclear whether they faded away naturally or the treatment was successful.) They did/do not seem to bother the otters and their cause/identification is unknown (scrapings of the lesions have been analyzed but they revealed nothing conclusive) (Osmann, pers. comm.). (See Chapter 1 Section 2 under inbreeding and thyroid malfunctions causing the death of the cubs at Dortmund Zoo. These were the cubs that were observed to have lesions at Dortmund. The parents of these cubs also had lesions and the parents themselves resulted from two generations of inbreeding.) Flügger (pers. comm. 2003) commented that these lesions might occur when the otters' immune system is compromised. It is also interesting to note that a picture of a very young orphaned wild giant otter cub that had been taken to a wildlife rehabilitation center had similar looking lesions as aforementioned (the photo was taken by Lazzarini). This cub died the day it was brought in from a blocked urethra. *Note: these lesions are different than and not related to those described under poor foot condition because of exposure to inappropriate enclosure conditions.* See below under "Miscellaneous".

Low Heat Tolerance: Captive giant otters have been observed to have a low heat tolerance (Carter & Rosas 1997; Sykes-Gatz & Gatz pers. comm.).

Mental/Behavioral Health Problems and Abnormalities: It is not uncommon that giant otters carry out some essential behaviors in an unhealthy and abnormal way and that these otters are also mistakenly thought to be exhibiting healthy and normal behavior. These problems are caused by inappropriate enclosure conditions and such conditions result because of general misconceptions about otter behavior. Inappropriate enclosure conditions can negatively affect the otters' ability to successfully rear cubs, adjust to new/unusual situations, and maintain mental/behavioral (as well as physical) health. See a discussion of these problems in Chapter 2 Section 3.

Miscellaneous: The necropsy of a 4 1/2 month old captive born male cub did not reveal the cause of death. Although, before its death it was noted to have a "**grayish circular spot – about 1.5 cm [0.59"] in diameter" on its tail.** This cub was also smaller and less developed than its only sibling, its sister, who survived to independence. "Some days after birth, this specimen showed very little signs of progress, compared with its sister and depended always on its mother's help for feeding until its death." (Autuori & Deutsch 1977)

In captivity, giant otters have been reported to **take up large mouth fulls of sand and it appears that they also purposely** (i.e. not by accident) **swallowed sand** as well. (A few institutions have reported these occurrences.) Giant otters also have been reported to **bite off pieces of bark from large logs and it appears that these pieces were chewed up and swallowed** as well. On the rare occasion they also have been observed to chew on mulch (i.e. tree bark) pieces and might have swallowed the rare piece as well. On other occasions they have been seen to chew on and bite off pieces of wood on the corners of their wooden nestboxes or the edges of other structures made of wood. No harm or health problems were reported to have been caused by any of these actions. The otters do not seem to be able to bite on wood structures that have no edges or no corners and there are no known reports that otters have done such. It has not been proven necessary to line the inside of wooden transport crates with fence/lattice when transporting giant otters and this is not advisable E.g. Giant otters have been transported successfuly and without problems from distances as far as South America to Europe when wooden transport boxes were not lined with fence/lattice. Exposure to fence/lattice on the inside of crates could likely cause damage to the otters' delicate sensitive foot pads, webbing and/or skin.

Mycotic Diseases (Fungal Diseases): Mycotic dermatitis was found in a dead 27 day old captive born cub (Flügger 1997). Dermatitis through yeast was found in a dead 23 day old captive born cub (Flügger 1997).

Nephritis [kidney inflammation]: A necropsy revealed severe bilateral nephritis with multiple stone build-up in a 10 year old captive-held female (Flügger 1997 citing Murmann & Hagenbeck 1984).

Parasites: Parasites are found in captive and wild giant otters (Flügger 1997; Hagenbeck and Wünnemann 1992; Schenck 1997). Cestode (tapeworm / unidentified species), cestode / *Diphyllobothrium,* Nematode / *Strongyloides* (in one case severe diarrhea was reported in connection with a strongyloides infection (Wünnemann 1995), ascaridoid nematodes were all found in a zoo in Germany (Flügger 1997). Nematode */ Ancylostoma sp.* were frequently found in wild orphaned cubs brought to a Brazilian wildlife rehabilitation center. (Lazzrini 1998, pers. comm.). *Parvovirus and a severe cryptosporidiosis* infection / infestation caused the death of one 7 1/2 month old otter in a German zoo (Hagenbeck and Wünnemann 1992; Flügger 1997). The history of the last otter aforementioned is as follows "At four months one pup, "Blacky", suffered severe diarrhoea. No bacterial or parasitic infection was found but the problem occurred several times over the following months until the animal's death at the age of seven-and-a-half months. The post-mortem examination revealed severe cryptosporidiosis and a parvovirus infection." (Wünnemann 1992). Also described was the earlier successful treatment of a strongyloides infection within that pup (Flügger 1997, Wünnemann 1992).

Pneumonia: One 2.5 year old giant otter died suddenly and quickly after she developed pneumonia (she showed no symptoms of pneumonia or being sick before her death) and a 5 year old otter died of pneumonia (Brasilia Zoo pers. comm.). As well at the same institution, a 4 month old cub died of gastroenteritis and another 3 month old cub died of pneumonia. Pneumonia caused the death of an adult giant otter in a Venezuelan zoo. More than 3/4 of its lungs were severely affected, "but the otter showed no sign of illness, playing actively and feeding well until the day of its death." (Trebbau 1972). At an institution in Belem, Brazil an adult giant otter died of bronchopneumonia. Also, see the beginning of this Section and under "Handreared Orphaned Wild Giant Otters" above and "Poor Fur Coat Condition" below.

Poor Fur Coat Condition: can be caused by inappropriate enclosure conditions. When the coat is in poor condition serious health problems such as infections or even death can result. In the past, river otters were thought to be aquatic animals and unfortunately exhibits were designed with this misconception in mind (Duplaix 1972 citing Hediger 1970). Inappropriate enclosure conditions, esp. improper land to water ratios resulting in not enough land area or/and improper substrates, were often the reason that poor fur coat condition and associated poor health and death by infections, occurred among various river otter species. In the present, exposure to continually very damp/wet surfaces, caused by the aforementioned inappropriate enclosure conditions, has caused poor coat condition, infections and death in giant otters. See Chapter 2 Section 3 for a discussion on this topic. (See above under "Foot/Toe Pad, Webbing, and Skin Health Problems" for a brief description of how very damp/wet conditions are caused.) Sometimes circumstances, other than those related to inappropriate enclosure conditions, can cause poor coat condition, although this has not been reported to occur among captive giant otters.

Pyometra-OP: a female otter died during recovery from surgery for pyometra (Flügger 1997) (See Chapter 4 and Part B below for more information.)

Thyroid Malfunctions: see Chapter 1 Section 2 for more information.

Vomiting: Giant otters, both in captivity and in the wild, have been reported to vomit on occasion. The occurrence of occasional vomiting does not seem to be a problem for giant otters in captivity. Three zoos (Philadelphia & Dortmund Zoos and Hagenbeck Tierpark) have provided comments about vomiting among their giant otters.

At Philadelphia Zoo, in an eight month period (from 1/1997 through 9/1997; 2/97 results were not available) where the occurrence of vomiting was reported in detail, vomit was found in the enclosure holding two giant otters about 2-3 times per month on average during three of the eight months monitored (Sykes, pers. obs. & reports 1996-99). (These three months were not consecutive and a one and five month period occurred between these occasions. Vomit was found esp. in the dens when the keepers first arrived to check the animals in the morning, sometimes it was found outside on exhibit, or the otters were observed vomiting.) In the remaining months vomiting did not occur or it only occurred once per month. Because two male giant otters, one approx. four and the other five years old, were held together at that time and both had been reported to be seen vomiting on occasion, it was assumed that one or the other otter vomited. The vomit consisted of partially digested or nearly digested fish and sometimes included a lot of white/gray mucous or it consisted of a yellow colored liquid substance (bile?) and/or mucous alone. The amount of vomit varied from a lot to a little. After the conclusion of the aforementioned detailed report, both otters were noted to vomit occasionally (this was noted until June 1999 at which time this report was concluded). I.e. sometimes vomit was found one to three times in a month and in most of the other months no vomit was found or sometimes one such occasion occurred in a month. As well, sometimes the animals heaved as if they would vomit, but no substance was expressed. Sometimes they also acted as if they had a fish spine caught in their throat and dry heaving or vomiting (either fully or just saliva) resulted. The fish spine that was stuck in their mouth/throat was presumably the cause for this event. Other than the reason just aforementioned, no factor was identified to be specifically responsible for causing the vomiting and no other health problems resulted from vomiting.

Some theories about what might have caused this vomiting were posed (Toddes, pers. comm. 1997 & unpublished report, 2004; Osmann, pers. comm. 4/1997; Wünnemann, pers. comm. 3/1997; Sykes, unpublished report, 1997). These theories mainly concerned diet. For example, it was posed that feeding salt-water fish that was high in fat content, such as esp. mackerel (*Scomber sp.*), may cause vomiting (Osmann, pers. comm. 4/1997; Sykes unpublished report, 1997). At Philadelphia Zoo, fresh-water fish formed the main part of the giant otters' diet, although salt-water fish were fed for variety. Toddes modified the diet offered in consideration of this theory. Although in 2/1997 the salt-water fish mackerel and herring (*Clupea harengus*), among some other fresh-water fish (i.e. catfish (*Ictalurus punctatus*) etc.], were eliminated from their diet and their principal diet was changed to fresh water rainbow trout (*Salmo gairdneri*), vomiting still occurred occasionally thereafter. (See the full diet that was offered and the health problems that occurred in 1997 with the giant otters at Philadelphia Zoo under "Walking Difficulties Involving the Lower Back and Hind Legs" just below.) Giant otters have been noted to purposely swallow sand (reported at a few institutions) and even tree bark, although again this has not been specifically linked to causing vomiting or any other health problems (see under "Miscellaneous" above). Also, when otters eat fish in an area that contains sand, sand may stick to the fish and the otters will naturally ingest both (Wünnemann, pers. comm. 3/1997). [It is not known whether feeding fish in the reproductive state (i.e. when they carry

eggs) would cause vomiting as no studies have been done to correlate these occurrences. See above under "Dietary Related Problems**"** for the problems caused by feeding fish with eggs.]

Dortmund Zoo staff have reported that their giant otters vomit occasionally; i.e. their reports are similar to the experiences (i.e. number of occurrences for the same number of animals etc.) reported at Philadelphia Zoo (Gatz, pers. comm. 2004). (Dortmund housed several giant otters. See the diet they offer under "Walking Difficulties Involving the Lower Back and Hind Legs" and Chapter 2 Section 19.) Hagenbeck Tierpark reported that their giant otters vomited sometimes when fish bones got caught in their throats/mouths (Wünnemann, pers. comm. 3/1997). (See Hagenbeck Tierparks giant otter diet in Chapter 2 Section 19.) Wünnemann also commented (pers. comm., 3/1997), that the occasional vomiting (two times in a month's period) reported at Philadelphia Zoo does not seem to be a problem. Giant otters in the wild have been observed vomiting and these observations are not uncommon (Groenendijk, pers. comm. 2003). Some captive North American river otters (*Lontra canadensis*) have also been noted to vomit on occasion and no other health problems were evident and the cause of such occurrences was not identified (Sykes, unpublished report 1997).

Walking Difficulties Involving the Lower Back and Hind Legs: There are two different types of walking difficulties that involve the lower back and hind legs that have been found in giant otters and both types are serious health problems. One type involves acute severe walking difficulties that occur suddenly and only for a brief period of time (i.e. problems occur over a period of hours, days or up to a week or so); see the paragraphs below for more information. The other involves walking difficulties that occur on an on-going basis (i.e. problems occur continually over the years and they are progressive). The type that occurs on an ongoing basis is a very important issue and inappropriate enclosure conditions (i.e. continual exposure to hard surfaces) can predispose giant otters to/cause such problems. Moderate and severe degrees of on-going walking difficulties have resulted. The physical disorders which have been expressed by the walking difficulties have also affected the ability to mate successfully. This subject is discussed in Chapter 2 Section 3A.

There is little known about the type of acute severe walking difficulties that occur suddenly and only for a brief period of time. This has been reported to occur in three different adult giant otters (i.e. two males and a female) which were held in three different institutions. It is not known yet what was actually responsible for causing these problems. Following are descriptions of those occasions and what factors might be responsible for causing this particular health problem. Note: At one additional institution, Cali Zoo in Colombia (Corredor, pers. comm.), a giant otter was reported to display limping and difficulties while it walked. Further information about this occurrence is being gathered and at this time it is not known if this occurrence is similar to the others reported below. Update: In late 2004 a 12 year old female giant otter was reported to develop the same acute severe walking difficulties that occurred suddenly and it resolved almost completely in several weeks. This female still displayed some minor residual difficulties that had not fully had time to resolve yet at the time this report was completed. A more detailed report on this occurrence is not reported below. For more information please contact the compiler/author of this manual.

At Philadelphia Zoo (in the U.S.), two male giant otters, one approx. four and the other five years old, were held together in the same enclosure. (They had lived in this enclosure for approx. one year before the following health problems occurred and they were siblings.) On Feb. 1, 1997, the male named Banjo (the five year old) was found in the morning, when the keeper first arrived, dragging the hind end of his body, hind legs, and tail on the floor (Sykes,

unpublished report 1997). His hind legs also appeared very stiff. He almost appeared as if he was paralyzed in the hind end/lower back and legs, although otherwise he did not appear or act sick. He progressively and dramatically improved within two hours and by the end of the day he was able to walk fairly normally. During the day he progressively became less stiff in his hind legs when he was walking. Throughout the day (after his dramatic recovery in the 2 hours noted) he was active, playing, and appeared otherwise normal and ate well. On the next morning he was a little stiff in the hind legs, but he was eating well and active and then he appeared totally normal. No medical treatment or medications were administered for this problem. This acute severe problem was reported to never occur again (this report was concluded in June 2004).

Note: On three separate occasions, one occurring in March 1997, April 1997, and August 1997, Banjo was observed with hind leg stiffness and was found shuffling his hind legs/feet on the floor rather than lifting them normally off of the floor when he was walking. In March 1997 and April 1997, his brother named Rio, was found occasionally during these months also exhibiting the same behaviors as just described in the last sentence. Since the last occurrences noted, both of these otters exhibited the same problems as just aforementioned on rare occasions in the summers and the winters that followed until at least June 1999 (when this report was concluded). (Note: these animals did not display the aforementioned problems continually throughout the day on which they were noted to occur. They only occurred over a short period of time, usually this was after the animal first had risen from sleeping. This problem resolved shortly, i.e. within a few to several minutes or more after the animal first moved about. This problem had to be closely monitored or it could have been easily missed. E.g. it may or may not have occurred before March 1997.) No medical care was given for these problems. The physical problems that were reported to occur with both animals since the beginning of March 1997 were mild in their appearance compared to those that Banjo displayed on Feb. 1, 1997 which were severe in appearance. It seems reasonable to assume that these two types of problems (i.e. those reported in the paragraph above vs. those in this paragraph) were not related as they (comparatively) appeared very different in severity and one type was reoccurring and the other occurred only once. It seems that the problem that occurred occasionally may be related aforemse plo5.6

to them and happening in an area where they must stand upright on their hind legs to see it, they may have to stand upright for long periods to satisfy their curiosity because there is no other possibility for the otters to look at something interesting without standing. He advised to monitor such situations. [Wünnemann also reported (pers. comm. 2003) stairs or any structure/surface that otters must climb every day in a significant manner to access or utilize it should not be used in enclosures. Note: climbing stairs or the other surfaces/structures as aforementioned is not the same as other forms of climbing. Captive giant otters often climb onto and lay on the top of their nestboxes and large diameter logs, tree stumps etc. This behavior is natural (they climb and lay on large fallen trees in the wild), they enjoy it, and it is not harmful to their health.] Dr. Osmann (pers. comm., April 6, 1997), of the Dortmund Zoo in Germany, also communicated: A relationship between vitamin E deficiency and hind leg paralysis is something else that should be considered for this acute problem. [Note: a vitamin B1 (thiamine) deficiency may also cause similar problems and should be considered.] See under "Dietary Related Problems" above for more information on vitamin deficiencies.

At Philadelphia, the majority of the entire land area (including that within the indoor and outdoor enclosures) that the otters were exposed to daily was hard. No changes were made to the indoor or outdoor enclosure surfaces from April 29, 1996 (when they arrived at Philadelphia) until at least June 1999 when this report was concluded. Also, the outdoor land area was very limited/very small in size as the land to water ratio offered a significantly smaller land proportion than what is recommended. (Update: In late 2002 or early 2003 and based upon the recommendations made in the giant otter studbook husbandry guidelines, within the indoor enclosure, mulch was added to completely cover over the concrete floors, a deep digging area made of mulch was also provided, and an additional den area was added to help increase the amount of land area.) The giant otters were also exposed to various areas within their indoor enclosure, which they had access to every day, that they had to regularly climb to access and use. One enclosure modification was made (in approx. 4/1997) to reduce the amount of climbing, although this change did not significantly limit climbing and it had to be removed (see below) and other changes to do such could not be made. The otters therefore still climbed a significant amount on a daily basis from 4/1996 until at least 6/1999. For example, the otters had to climb vertically a height of 92 cm (3 ft.) to enter their small indoor above ground swim-tank which they used frequently. They sometimes used the single step provided to access the tank. Though a wooden ramp was installed to reduce climbing, the otters rarely used it and instead they chose to access the tank as before. The ramp was removed later. As well, to access all of their dens in the indoor enclosure the otters regularly (i.e. frequently) had to climb up and down concrete rockwork, which was a nearly vertical incline of approx. 130 cm (4.3 ft) in height, that separated the dens. The rockwork formed an uneven surface creating various artificial rocks that could be climbed on. This area could not be modified, so the otters continued climbing there. A very large tub (with a single access step), that extended 61 cm (2 ft.) above the den floor, was also climbed into frequently and it was not removed.

At Philadelphia, fresh-water fish formed the main part of the giant otters' diet, although salt-water fish were fed for variety. In 2/1997, Toddes modified the diet offered in consideration of the possibility of vitamin deficiencies. Although the otters were not overweight, the amount of fish offered was reduced in Feb.-March/1997 (as a significant amount of fish that was offered was normally left in the enclosure uneaten). (See their body weights listed in Table 7.) The amount of vitamin B1 and E previously offered in their diet were increased as follows. Previously given were one 50 mg vitamin B_1 tablet per otter daily and one 400 IU vitamin E geltab and one tablet of K-dec (multiple vitamin & mineral for adult humans) per otter 3 times/week. In February 1997 this was changed and the following was given: one 100 mg

vitamin B_1 tablet and one 400 IU vitamin E geltab per otter daily, and in addition 1 tablet of K-dec 3 times/week per adult otter.] This was offered until at least June 1999. Their diet before Feb. 1997 consisted of mainly fresh water rainbow trout (*Salmo gairdneri*), fresh water channel catfish (*Ictalurus punctatus*), mackerel (*Scomber scombrus*), and red salmon (*Oncorhynchus nerka).* (Salmon was not offered when it was out of season.) (Note herring (*Clupea harengus*), common carp (*Cyprinus carpio)*, bass (*Micropterus sp.*), and tilapia were also offered at times.) In 2/1997 the salt-water fish mackerel and herring were eliminated from their diet and catfish and salmon were no longer offered. Also, at this time their principal diet was changed to fresh water rainbow trout. This diet remained basically unchanged until at least June 1999. (The otters were fed three to five times per day and all fish had been frozen and thawed.)

The same acute severe problem that was observed to be displayed by Banjo on Feb. 1, 1997 at the Philadelphia Zoo was also observed to occur, on one occasion, in an almost 3 year old male giant otter, that was held in Dortmund Zoo in Germany (Osmann, pers. comm. April 6, 1997, 2001 & unpublished report 2004). I.e. the animal was seen dragging its hind end, hind legs and tail on the ground and having acute hind leg stiffness etc.. This occurred on January 29, 1993. Corticosteroids, phenylbutazon and antibiotics were administered over a period of two weeks. The otter recovered and this acute severe problem as just described above was reported to never occur again (this report was concluded in June 2004). An x-ray of the vertebral column (done in March 1993) showed a slight lesion on one lumbar vertebra. It was assumed, as no other reasons for this occurrence were evident, that perhaps the animal might have been hit by a wooden trunk while it was playing. Note: on occasion, between March 1993 and May 1993 this otter exhibited hind leg stiffness and was found shuffling his hind legs/feet on the floor rather than lifting them normally off of the floor when he was walking. Mild to severe cases of this type of problem were reported, although none of these cases were as severe as that which occurred in January and the animal did not act if he was paralyzed in the hind end/lower back and hind legs as he acted before. Between March and April some medications were administered for this problem, but they did not resolve the problem. Then finally in May 1993 a nonsteroid antiphlogisticum called "Metacam"/Fa. Boehringer Ingelheim (drog: meloxicam) was administered together with phenylbutazon and he recovered completely during the next weeks.

This affected otter was held in an enclosure with mostly all hard surfaces, although the enclosure had an appropriate land to water ratio. The otter did have access to a deep sand area for deep digging in his outdoor enclosure, although access was limited during colder temperatures. The affected otter and his brother, both from the same litter, were held in the aforementioned enclosure together. Both of the animals were held in this enclosure for approx. 2 years before the acute severe health problem described in the paragraph above first occurred. (The otter that did not have problems was sent to another zoo approx. one year and 3 months after his brother was first affected.) These otters were not exposed to stairs within any of their enclosures and the otters did not encounter other structures/surfaces where they had to regularly climb on to access or utilize it. (Note: Years later, the affected otter was observed to have developed on-going walking difficulties because of continued exposure to hard surfaces. He fully recovered, without any medical treatment, after the land and floor surfaces of his enclosures were covered with soft loose natural substrates.)

The giant otters at Dortmund were fed mainly with fresh water fish to avoid the high fat content found in sea fish (Osmann, pers. comm. April 6, 1997). (The specific type of fish were not listed in this pers. comm., although see below for the fish types that were fed in 1997/1998 that were similar to the diet fed in the early 1990's.) Osmann also reported that the amount of fish

that was fed was nearly the same as that which was fed at Philadelphia before 2/1997: approx. 6-7 pounds per animal per day. Also given at Dortmund were the following: once per week vitamin B1, 200mg per animal, vit. E 350mg per animal, vit. D3 1000 I.E. per animal, and 3 times a week multivitamins (A/D2/C). (It was reported that the animals were not overweight.) Normally the giant otter diet at Dortmund Zoo consists of *90%* local freshwater fish that include mostly *Rutilus rutilus* (Redeye) and *Abramis brama* (Brachsen) (Gatz, pers. comm. 2/1998). *Perca fluviatilis* (River perch) and *Tica tinca* (Tench) are only occasionally offered. Small fish are usually fed and they are of high quality. Occasionally, when there is an absence of local freshwater fish, this diet is replaced by 90 % rainbow trout, although we try to limit the time that large amounts of rainbow trout are given, because it can become difficult to encourage the otters to return to their normal diet after they have had trout for longer periods (e.g. for a 4 week period). Ten percent of the diet consists of herring and mackerel as it is used during husbandry training and to hide medication and vitamins within. All fish are stored below minus 20 °C and thawed at the day of feeding. Live fish, which is given up to three times a week, consists mostly of rainbow trout *(Sa/mo irideus),* but it also includes *Rutilus rutilus* and *Abramis brama.* Each animal eats approximately between (2-3 kg) (4.4 lbs. to 6.6 lbs.) of fish each day, given at three to five different times. As well vitamins were offered as follows: Optovit 500 (vitamin E) two times/week; vitamin B1 two times/week; Vigantolette 1000 two times/week; and Multivitamins (Lichtenstein) 5 times/week. A more current diet is also listed in Chapter 2 Section 19.

An approx. six year old female giant otter, living in Chestnut Centre in England (Heap, pers. comm. 1997), was reported to suddenly display significant problems and walking difficulties involving her hind legs and lower back. [I.e. the animal was seen dragging its hind end, hind legs and tail on the ground and having acute hind leg stiffness etc. (Heap, pers. comm. 1997 & 1999.] A course of cortico-sterioid tablets, administered for treatment, resolved her problems. (I.e. her problem resolved soon after it first occurred.) The cause of her problem remains unknown. (An approx. 7 year old male giant otter lived together in the same enclosure with the female and they lived there approx. 4 years before the female had this particular health problem. This pair were brother and sister.) The otters had access (all year) to an expansive natural outdoor enclosure with an appropriate land to water ratio and an indoor enclosure. (See a detailed description of the outdoor enclosure in Chapter 2 Section 1C and the indoor enclosure in the same chapter Section 9). All of the surfaces in the outdoor enclosure were soft (i.e. soil) and they were offered a sand deep digging area and could also dig in the soil. The land area indoors is covered with soft loose substrates. Chestnut Centre fed live fresh water rainbow trout (*Salmo gairdneri*) (3 to 5 lbs. per day per animal) as the principal diet and also offered sprats (½ lb. per day per animal). (The trout was fed live.) Also 2-3 day old chicks were given daily per animal and a ½ lb. of minced beef was offered per animal twice weekly. The otters were fed twice per day. They gave vitamin supplements daily (Aquavits. one tablet each) and one dessert spoon of cod liver oil daily. This diet was fed at least until late 1999. The otters were not exposed to stairs within any of their enclosures and the otters did not encounter other structures/surfaces where they had to regularly climb on to access or utilize it. The otters were not reported to be overweight and they also did not appear overweight in 1999. At least until late 1999 no further occurrences of this health problem were reported to be seen.

It seems that all of the above reported occasions of severe acute walking difficulties observed among these giant otters can be linked and regarded as a single specific type of health problem (i.e. verses being considered unrelated ailments). (It seems reasonable to assume that this health problem is a different type than the ongoing progressive walking difficulties known to occur among giant otters.) With this assumption and based on the theories posed about what may cause this acute problem, analysis should be made about the amount of hard surfaces that these

otters were exposed to in their enclosures, the degree to which the otters had to regularly climb, and if the diets offered could have caused possible deficiencies of the vitamins B1 or E. (Also, whether the animal was overweight or if it stood on its hind legs for long periods should be noted.) This analysis should be used to determine which of those particular factors just listed might be responsible for causing the problem. It also should be seen if similarities regarding these factors can be found among these three cases. Finding a link between these cases may help to find a cause for this problem or it may help to strengthen what seems likely to be a cause in a particular case. There are many aspects of the topics that concern what may have caused this problem that should be considered, although there is only space for some of them to be pointed out here. It is also possible that other reasons to explain this problem could exist, but they have not yet been identified.

It is important to note that only one of the two otters held together in each facility were affected though they were exposed to the same enclosure conditions, diet etc.. The otters with this problem were also of varying ages and both sexes. Also this acute health problem occurred only once in each otter. None of the affected otters were reported to be overweight or to stand on their hind legs for long periods.

It is also very important to point out that all of the affected otters were kept in the same enclosure conditions before and after their health problem occurred. (Note: although a modification was made to create less climbing surfaces at Philadelphia, this modification was not used by the otters and the affected otter climbed nearly the same amount both before and after its health problem occurred.) The otter at Chestnut was given the same diet and the otter at Dortmund was given a similar diet before and after their health problems occurred. Only the Philadelphia otter's diet was modified after the otter was affected, although it is not known if this change (see above and below) prevented the problem from reoccurring and it is not known if the former diet was responsible for the problem. Caution should be taken although as all of the assumptions about the diets are only made on a gross analysis of the diets offered. Detailed nutritional analysis has not been conducted on all three of the affected otters' diets. (Note: the author/compiler of this manual who has written this report has no expertise in the area of nutrition, therefore analysis should be done on all three of the giant otters' diets to draw further conclusions on the similarity of diets and how the diets might be involved in causing such a problem.) In general, the points aforementioned could easily indicate that there is a strong possibility that none of these factors could have been responsible for causing this problem. Other factors should therefore be identified as possible suspects. Although and putting this possibility aside, as other unidentified reasons may be responsible for preventing the reoccurrence of this problem, the following should also be considered.

It seems that the enclosure conditions at Chestnut would not be a factor that could be held responsible for causing this acute problem. It is not known if the diet could have been responsible in this case. It seems that the acute problem that occurred at Philadelphia could likely have been caused by the significant exposure that the affected animal had to hard surfaces or the significant amount that the otter had to climb, or to both problems. It also could have been due to the diet, as the diet was modified after the animal's problem occurred, although it is not known if that diet change (i.e. changed to feeding principally fresh water rainbow trout) could have been responsible for the problem not reoccurring. This assumption is based on the fact that Chestnut also fed the same principal diet (i.e. fresh water rainbow trout) both before and after their otter was affected. Although it must be taken into consideration that Chestnut fed live fish as compared to Philadelphia which only fed thawed frozen fish (and vitamins). If the Philadelphia otter's diet did cause the problem, it is not known if this diet could have been

responsible for the occurrence of this problem in addition to or independent of the enclosure conditions. A complete nutritional analysis to determine if the diet fed before Feb. 1997 could have caused a problem, has not yet been made. The significant exposure that the affected animal had to hard surfaces at Dortmund could have been responsible for causing his acute severe walking difficulties. It is not known if the diet could have been responsible in this case.

Two (at Dortmund & Chestnut) of the three affected otters were not exposed to stairs within any of their enclosures and these otters did not encounter other structures/surfaces where they had to regularly climb on to access or utilize it. I.e. the otters had no surfaces that would have caused problems if they were to climb on it. Although, at Philadelphia Zoo the giant otters were exposed to various areas within their indoor building that they had to regularly climb to access and use. A link can not be made between the amount of climbing that was carried out among the three affected otters. Two (at Dortmund & Philadelphia) of the three affected otters were kept in enclosures where the majority of the land area was made of hard surfaces, therefore they had significant exposure to hard surfaces. The third otter (at Chestnut) was housed on soft surfaces. A link can not be made between the amount of exposure that these three animals had to hard surfaces. Each of the three otters were fed a different diet. Nutritional analysis has not been conducted on all three of the affected otters' diets for comparison, the diets although seem to be diverse enough (i.e. in simply the types of fish that were fed) that an obvious and quick link can not be made between the diets at a gross level.

Watery Eyes: It has been observed that in captivity giant otters' eyes can appear significantly more watery when they are under stress as opposed to when they are in typical/usual situations (theory posed by C. Schenck via pers. comm. and observations made by Sykes-Gatz & Gatz). Note: sometimes, their eyes become a little watery when they are under normal circumstances. The otters tear clear liquid when their eyes are watery as described. (When giant otters are exceedingly stressed they have been observed to foam at the mouth; see above under "Foaming at the Mouth".) Any unusual discharge, whether clear or mucous-like in appearance, from the eyes should be evaluated to determine if a medical problem exists. E.g. a reaction to environmental factors, such as irritation from chlorine or other chemicals in pool water, or a health problem, such as an infection, heart problem etc., could exist.

Part B. <u>Reproductive, Physical & Behavioral Characteristics</u>

The physical and behavioral development of cubs, cub health, parental behavior, and reproductive characteristics that can be monitored without human disturbance and presence to giant otters rearing cubs in captivity should be thoroughly documented and shared by each institution holding giant otters. Other biological (i.e. physiological etc.), physical, and behavioral characteristics of this species should also be recorded and shared. As well, the same should be carried out for each wild orphaned and captive-born individual handreared (see Section 5 below for more information). Otters should not be anesthetized and no other potentially stressful, harmful, or dangerous methods (to both otters and staff) should be used for the specific and sole purpose of gathering such information. Information should only be gathered through unintrusive monitoring methods, husbandry training, when animals are handreared, or when the otter has been anesthetized for some other reason (e.g. for a medical emergency). [Anesthetizing could be very dangerous to the otter. It is recommended that it only be carried out when it is absolutely crucial and necessary to ensure the survival of the

animal, e.g. for serious/life threatening health problems. Because of the critical situation of this species in captivity, no risk should be taken.]

It is crucial that every holding institution keeps and openly shares these records. It is also necessary that this shared information be compiled so that comparisons and study can be carried out. Such information is needed as a reference source for giant otters in the wild, as well as for comparison studies in captivity. Often such records have not been kept, thoroughly documented, or shared among institutions therefore comparisons have been difficult or impossible to make and many questions exist. Advancing management methods and knowledge, increasing the number of captive-born individuals, and the support for conservation efforts in the wild will be hindered until these uncertainties can be studied and explained. (See Chapters 2-5 and Section 5 and Part C below for more information on these issues. Section 2 and Part A above and Section 5 below describe other aspects, not included within Part B, that need further study.)

Aspects that need further study include: estrus cycling, delayed implantation (Flügger 1997), gestation periods, earliest age of sexual maturity for both sexes (i.e. mating), earliest and latest age of siring/bearing litters, undetected litter births, parental behavior during cub-rearing, and cub development and health. False pregnancies (which are not uncommon) and female reproduction capabilities (estrus, bearing litters etc.) during late age (esp. around approx. 10 to 11 years old) and possible associated health problems should be more thoroughly studied. (At least some female giant otters, may slow/end in reproductive capabilities or experience difficulties/health problems during reproduction because of advancing age or/and a high number of litter births during their lifetimes.) See below how portable ultrasounds can be used to study/monitor pregnancy and uterine condition and health. Recently it has been reported that a few giant otters, that are sexually mature and that have been paired together for nearly a year or more, have mated, but the females did not become pregnant. At least two of these animals have also been reported to display estrus cycles/mating at unusual intervals. It should be determined if there is a trend in these occurrences and what the causes may be. A significant number of zoos report false pregnancies. It should be determined why they are occurring at this frequency and what is causing them to occur. How cub-rearing success is effected by parents rearing more than one litter at a time and how the same is effected by the presence of juveniles/sub-adults during cub-rearing should be more thoroughly studied (see Chapter 2 Section 10). Detailed records should be kept and shared on all of these issues/aspects.

Hormonal studies (via sampling of feces/spraint) should be conducted so that estrus cycling can be more thoroughly evaluated. Milk (lactation) samples should be drawn, only after litter loss and through husbandry training, so that the nutritional content of mothers' milk can be analyzed to help determine which milk replacers are ideal for handrearing cubs. (See Section 5 below and Chapter 5 on why giant otter milk sampling is important.) Physiological values, such as heart and respiration rate and body temperature when the animal is not under stress or anesthesia are needed. This can be done via husbandry training only, as true/normal values will be altered under stress/anesthesia. When the animal is under anesthesia these values and blood samples (i.e. chemistry) should also be recorded/analyzed for comparison. Cub body temperatures and similar physiological values should be taken during handrearing.

Field researchers are currently requesting information on the earliest age of sexual maturity for both males and females and the earliest age of siring/bearing litters. They are also in need of a body weight and length growth curve with corresponding age for cubs throughout their entire development. I.e. measurements should be taken from the earliest age to the latest age that is

possible. (See Chapter 5 for how to measure, Chapter 4 for when otters grow to full size/ general growth rates, Tables 6-7 & Graph 2 for body weights & lengths, and Chapter 3 for husbandry training.) This data must only be attained from cubs that are handreared. Parents rearing cubs and cubs themselves should never be disturbed/approached/handled to attain this or other information or to perform procedures (e.g. sex determination, transponder implants, etc.) that are not necessary to sustain the cubs' livelihood. Massive disturbance, parental cub abuse or neglect, or/and litter loss could result. If although, a parent-reared cub must be temporarily pulled for medical treatment/vaccination or for some other crucial reason, these measurements might be able to be quickly taken at that time. It is important that this data is shared as it can be used to help expand the incomplete curve that is included within this manual. Handlers should wear plastic/surgical gloves to help prevent that parents smell that the cub has been touched by humans. See other techniques that should be used if intervention is necessary in Chapter 2.) Behavioral and physical (i.e. abilities) development (e.g. first eating fish, swimming, or leaving the nestbox on its own, etc.) should also be recorded and shared. This will help biologists to determine the age of wild born cubs and comparisons can be made with other hand and parent reared cubs. Also requested is information on adult body length and corresponding weights and sexes for comparison to giant otters in the wild. E.g. biologists are interested to find out if a difference in female and male body size exists (Hajek, pers. comm.). In this case however, a rather large sample size of otters is needed to properly conduct this project. Measurements should only be taken through husbandry training or when the otter has been anesthetized for another reason. An otter should be measured from the tip of its tail to its nose and again from its tail base to its tail tip. The otter's entire body (including its tail, which is a significant amount of weight) should be weighed.

Concerns/reports that some births go undetected (i.e. cubs are eaten in infancy or at a very young age and no remains are found) suggest that more litters may have been born than were recorded (Louzada da Silva, pers. comm.). It is important that these suspicions are thoroughly documented. If a significantly higher number of litters are born than are reported, this could have a substantial impact on cub-rearing success figures.

Detailed records of estrus and mating (i.e. dates & behaviors), the female's physical appearance during pregnancy/false pregnancy, and behaviors indicative of birth should be kept as they can help detect possible pregnancies and births. Pair compatibility should also be reported. Monitoring methods that do not disturb otters rearing cubs (i.e. infra-red video cameras with microphones in nestboxes, dens and enclosures) function as an unintrusive way to detect births, as well as to monitor cub health and development and parental care. (When video cameras are not available otters might be able to be quietly watched from an area outside of the otter enclosure that hides and isolates the observer, as long as the otters are unaware of and undisturbed by the observer's presence. A baby sound monitor can be used to monitor vocalizations. The vocalizations of cubs and parents will tell as much about what is occurring, as visual pictures will. Otter vocalizations are just as important to determine the health and contentment of the cubs and parents, as are visual pictures. See Chapter 2 for more information on monitoring methods and privacy during cub-rearing.)

Reports of delayed implantation have been implied (Flügger 1997), so this should also be recorded if suspected. Hormonal studies (via sampling of feces/spraint) could be conducted to help determine estrus cycles. Using portable ultrasound, via husbandry training only, is highly recommended to confirm false pregnancies or actual pregnancies, view fetuses, and to determine health and uterine condition during pregnancy or after litter loss. It is also recommended so that institutions can make comparisons between their females and other health

conditions/problems can be identified and monitored. Ultrasound for these purposes should only be conducted via the aforementioned method and not through anesthesia which is a dangerous procedure. Because only one institution has conducted ultrasounds for these purposes, no comparisons could be made with other females to determine how a healthy uterus should appear (esp. in size) soon after litter birth and loss (see Section 5 below). Giant otters can also be scale trained to monitor weights. Weight gain may also indicate pregnancy. (Weight loss may indicate the existence of health problems. See Chapter 3 and Part C below for husbandry training information.) The aforementioned practices will help caretakers to prepare in advance methods to provide parents rearing cubs isolation from human disturbances and presence. Unfortunately sometimes, litters are born without zoo staff being aware of a pregnancy and cubs are soon eaten after parturition because of disturbances.

If you have applicable information that you would like to contribute, please submit it and your full contact information to the compiler/author of this manual. The information you contribute will be submitted for further study and publication and it will be credited to your name/institution within all studies/publications. It is very important to also include the sex, date of birth, exact age at the time the information was taken or at least the approximate age, place of origin/sire and dam identification, and reproductive and/or social structure history of each otter along with the applicable information. As well if you have interest to research these matters or are engaging in such studies already, please alert the compiler/author.

Part C. Ultrasounds (to detect pregnancy/health), Lactation Samples, Biological Values & Better Management via Husbandry Training

Husbandry training, through operant conditioning, should be carried out to help better manage giant otters in captivity (e.g. for health, transport, rearing of offspring etc.) and increase knowledge. Unfortunately, only a couple zoos that hold giant otters practice this technique. The many benefits of husbandry training are therefore not gained at most institutions and many questions remain unanswered.

Sea otters, North American river otters, and even Asian small-clawed otters have been trained quite frequently in recent years to perform husbandry behaviors. Although, giant otter husbandry training has only been reported to be carried out at Dortmund and Philadelphia Zoos and target and station training was carried out at Brasilia Zoo.* Dortmund Zoo is the only known zoo to have trained giant river otters to receive ultrasounds and to allow milk sampling, physical body examinations (via palpation), and physiological data to be taken (i.e. heart and respiration rate, body temperature). Both Philadelphia and Dortmund Zoos have target, crate, and weight scale (with beam/human scale) trained their giant otters. Two giant otters at Brasilia Zoo were trained to follow and station at a target. [All of the training and husbandry procedures have been done in semi or totally protected contact. I.e. the otters and trainers were/are always separated by containment barriers during training and the husbandry procedures. Only the trainer's hand, most of his/her forearm, and/or equipment (i.e. target, ultrasound head, thermometer, stethoscope etc.) are passed through the barrier fence.] See Chapter 3 for information on training techniques and a detailed report on the training program and corresponding husbandry procedures used at Dortmund Zoo.

*[Training started at Dortmund Zoo in 1996 and it is continuing. It has been/is being carried out by Gatz and/or Sykes-Gatz. These persons also performed the training aforementioned at Brasilia Zoo in 1998. Sykes [now Sykes-Gatz] carried out the training described at Philadelphia Zoo from 1996-1999.]

Husbandry training (via operant conditioning) is a stimulating and positively challenging form of behavior enrichment and it is highly recommended for many reasons other than just providing enrichment.

Husbandry training allows for better management of the otter during necessary husbandry procedures. In this way, these procedures can be done more safely and easily, and very importantly as well, with little or no stress, to both the otters and zoo staff. Crate training is a very good example, as it is the best method to help animals become accustomed to the transport box and be easily readied for transport in a non/less stressful situation. The very stressful and potentially dangerous procedure (for both otters and zoo staff) of netting, herding an animal into a crate, or anesthetizing it for transport can be avoided by crate training. (E.g. one giant otter died during recovery from anesthesia after it was anesthetized to crate it for transport to another institution.) The stress to the otter of being held inside the crate can also be significantly reduced. When crate training was carried out, giant otters have used/entered the transport crate either the same day or within the immediate days after the actual move/transport occurred (Sykes-Gatz and Gatz pers. obs.). Health and body condition have also been monitored and some forms of minor medical treatment have been accomplished with husbandry training. E.g. a medicinal spray was applied to a female's irritated teats (cause unknown) when the otter was stationed to stand upright on her hind legs in a wooden frame (attached to a containment barrier fence) so her teats were exposed to the trainer. (The term "station" means that the animal is trained to remain stationary at one place within its enclosure.) A suspicious lump on a giant otter's lower back/hind end could be closely monitored and palpated. Foot condition could be closely monitored and examined by the trainer spreading out/extending (i.e. with her/his hands) the otter's paws to their entire width for a full view.

In addition, procedures that normally would not be able to be carried out on a regular basis or even at all (without significant stress or danger), are achievable during husbandry training. For example, otters would have to be anesthetized to carry out some procedures, such as ultrasounds. Anesthetizing can be very dangerous to the otter and it is only recommended to be carried out when it is absolutely necessary (e.g. for serious/life threatening health problems, when necessary medical treatment can be administered in no other way). (See Section 4 Part A above for problems that have occurred while giant otters were under anesthesia.) Conducting ultrasounds, via husbandry training, has been used to confirm pregnancy, view fetuses, evaluate health and uterine condition during pregnancy and after litter loss, and to confirm false pregnancies (which are not uncommon) with no/little stress or danger to the otters and zoo staff. See why it is so important to detect pregnancies in Part B above. Giant otters have been scale trained to monitor weights. Weight gain may also indicate pregnancy and weight gain or loss may indicate the existence of health problems.

Training is of course also a very helpful tool to improve the keeper - animal relationship, which is important during giant otter cub-rearing, as well as many husbandry procedures (Gatz 1997). During cub rearing, giant otters are very sensitive to any kind of human disturbance and presence. Privacy from human disturbances and presence during cub-rearing has been found to be the most important husbandry practice responsible for successful parent-rearing of giant otter litters in zoos world-wide and historically (Sykes 1998/2002 & Sykes-Gatz 2001). In a zoo environment, some minimal disturbances are unavoidable during cub-rearing, and it is essential

that the otters are very familiar and comfortable with the caretaker during this period to lessen disturbance/stress (Hagenbeck & Wünnemann 1992; Flügger 1997). (See Chapter 2-3 for more information).

Husbandry training should also be carried out to increase knowledge. Many details about giant otter behavior, physical characteristics, and biology (esp. reproduction & physiology) are still unknown and much research needs to be conducted. (See Part B above and below for aspects that should be studied.) Such information is needed as a reference source for giant otters in the wild, as well as for comparison studies in captivity. Otters should not be anesthetized and no other potentially stressful, harmful, or dangerous methods (to both otters and staff) should be used for the specific and sole purpose of gathering such information. When otters are trained to allow procedures to be conducted for research, information can be easily and safely gathered without stress or harm to the otters or staff and studies can be conducted to help conservation efforts in the wild and help better manage giant otters in captivity. The otters will also have an enriching experience.

For example, field biologists have recently requested information on adult body length and corresponding weights and sexes for comparison to giant otters in the wild. Measurements should only be done through husbandry training or when the otter has been anesthetized for another reason (i.e. medical emergency etc.). Milk samples that normally could not be drawn (without stressful or dangerous methods) may be drawn from lactating females only after litter loss and via operant conditioning. (See Section 5 below and Chapter 5 on why giant otter milk sampling is important and Part B above for taking adult measurements.) Additionally, during anesthesia some physiological values, such as normal resting heart and respiration rate and body temperature, will change so true values can only be reported via training (see below).

Examples of husbandry training and procedures, specific physiological values drawn, and specific biological information that is needed for study/comparisons are discussed below. Much of this information has never been gathered before and it is highly recommended that other zoos carry out such training so that scientific knowledge can be increased and comparisons can be made with other otters. When cubs are handreared this information should also be gathered.

A female giant otter at Dortmund Zoo has been husbandry trained to allow ultrasounds to be conducted on her, via portable ultrasound. From what is known, Dortmund was the first and only zoo to conduct ultrasounds on giant otters in this manner (i.e. when otters are not under anesthesia and via training). Ultrasounds are used at this institution to detect giant otter pregnancies well before birth and to determine health status and health problems (i.e. uterine condition) related to reproduction. Several ultrasounds were conducted during gestation up until one week before this mother gave birth. Fetuses and uterine condition were observed during the ultrasounds. The female aborted decomposing fetus parts 4 to 5 hours before the birth of live born cubs and missed several following estrus cycles, which indicated that she may be slowing down/ending in her reproductive capabilities and/or may experience health problems during future pregnancies. (See more information under Chapter 4.) It is suspected that either her late age or great number of litters, or both, are responsible for these problems. The size and condition of the female's uterus was also monitored by ultrasound one time per week for several weeks after litter loss (which was soon after birth) and once every two weeks thereafter. Staff wanted to be sure that the cub which was aborted in a decomposed state, did not infect the mother's uterus and that no cub parts were left within her uterus. (Antibiotics were also administered as a precaution.) Because normal uterine size is not yet known, no comparisons with other females could be made to determine if this female's uterus decreased in size at a

healthy/normal rate. Conducting regular ultrasounds is a very effective tool to monitor her health condition and status of pregnancy. Ultrasounds were also conducted at varying times to determine if this female was pregnant and at other times when she appeared pregnant. False pregnancies (i.e. at least three) were confirmed via ultrasound.

The aforementioned female has also been trained to allow milk samples to be drawn after litter loss (see Chapter 3 and Section 5 below). (This must only be done after litter loss and via training.) Unfortunately, the only sample drawn was lost due to technical reasons, but training and study will continue at this institution to gather more samples. No other institutions are known to have drawn milk samples from giant otters and information gathered could be very helpful to determine ideal handrearing replacement milk formulas for this species.

A 15 year old male (at *Dortmund Zoo*) was trained to allow physiological information, such as resting heart rate, respiration, and body temperature (i.e. a thermometer is placed under the skin folds of the otter's arm pit) to be monitored. As well, this individual allows the examination of his body condition through hand palpation via husbandry training. This otter also has been trained to receive portable ultrasound and initial ultrasound sessions have already begun (although pictures from him have not been attained yet; see Chapter 3).

For example, little information is available on precise giant otter body temperatures. No rectal body temperature of healthy giant otters (neither cubs nor adults) that are not under anesthesia or immobilization have been found or been reported. At Dortmund Zoo, a body temperature, taken with an oral thermometer placed snugly between the loose skin of the armpit of a 15 year old adult male giant otter, was taken under normal daily circumstances via training (i.e. otter was not immobilized or stressed). The otter's temperature was 37.28^{o}C when he was at rest (i.e. he was lying down but not sleeping). Unfortunately, it is not clear if this temperature can be compared with rectal temperatures. Although the temperature of an adult domesticated ferret was taken in the same manner (under the skin folds of his armpit, during rest) and it was 37.8^{o}C. A couple minutes after the ferret got up from this resting state (i.e. he moved around a little), his rectal temperature was 38.0^{o}C.

Heart and respiration rates were also gathered from the aforementioned otter under the same circumstances (via training). Heart rate was monitored either with the hand of the trainer or with a stethoscope and respiration was visually monitored. Respiration occurred at 7 respirations per 15 seconds (or 28 respirations/minute) and heart beat varied from 33-34 and 28 heart beats/15 seconds when the otter was at rest during the same training session (i.e. he was not sleeping, but just lying down). When the otter was in full or deep sleep 8, 9, 10, 11, and 12 respirations/minute were observed on varying occasions. When the otter was in a light sleep 13, 14, 15 respirations/minute were observed. At rest 24, 20, 19, and 18 respirations per minute have also been observed on varying occasions.

If you have applicable information you would like to contribute, please see part B above for instructions. As well if you have interest to research or train or are engaging in such studies or husbandry training/procedures already, please alert the compiler/author.

Section 5
Handrearing Captive-Born and Wild-Born Orphaned Cubs

Little information on giant otter handrearing has been maintained, studied, published or shared among institutions. Therefore many questions exist and many issues are in need of immediate international attention and scientific study. Field researchers, handrearers, and those who work with giant otters in captivity have requested information to help them make comparisons with other cubs (in the wild and in captivity) or/and improve management practices. Because much information has been unavailable or is not known, such benefits could not be gained. It must be stressed that some vital information, important to increasing knowledge of giant otters, can be gathered **only** from cubs that are handreared (i.e. cub physical development, body temperatures etc.). Giant otters that are reared by parents in the wild **and** in captivity must not be disturbed by humans to gather this particular information, as it could lead to the loss of the litter because of massive disturbance/stress to the parents/family group. Handrearers are urged to share their experiences and expertise so that all may benefit. It is essential that this information is recorded and openly shared with the international professional community to help increase overall knowledge and awareness of the existent problems and to encourage scientific study and problem resolution. This will help to improve management practices for animals in captivity and as well, will help conservation efforts in the wild.

Detailed records and scientific study on handrearing practices, physical and behavioral cub development, health issues, and progress / success of cubs released in the wild or held in captivity should be maintained / carried out for all captive-born and orphaned wild-born handreared cubs. The "hacking out" process of wild orphaned cubs should also be handled in this manner. The nutritional content of mother's milk (i.e. *samples must be gathered after litter loss only*), the most successful/appropriate milk replacers for cubs (esp. those under one month old), and the optimal age to start a slow gradual weaning process should also be investigated. Information about these issues can be found in Chapter 5 and below.

For example, commercially prepared milk replacer formulas for carnivores, esp. Esbilac™, are highly recommended to rear all river otter cubs. Although, commercially prepared milk replacers for human babies or cow's milk (for human consumption) which are not recommended for use, have been most commonly used to rear giant otter cubs. Interestingly, these formulas have been used with success. The nutritional content (esp. percentages / types of fat, protein, lactose etc.) of giant otter mother's milk should be analyzed for comparison to the variety of milk replacers available/used for this species. This information could then be used to formulate and/or recommend types or brands of milk replacers that are most optimal to rear giant otters specifically. (See husbandry training to attain milk samples after litter loss only, under Section 4 Part C above and Chapter 4). Additionally, concerning an effective milk replacer for giant otter cubs less than approx. one month old, either no information is reported or formula fairly tried and found successful. It is most important to develop/find formulas that could be used successfully in these cases. If a successful formula is already known, but not reported, handrearers are encouraged to share this vital information with the professional community. The research on milk replacer formulas currently used for giant otters should be expanded and be studied in more detail. For example, studies should be conducted to determine if the formulas currently used have been successful on every handreared cub and to what degree are the cub's total nutritional needs met with these formulas. The existence of lactose intolerance should be studied, as well as, if or when vitamin, mineral, oil, or rice cereal supplements are necessary. (See Chapter 5 Section 5 for details.)

The gradual change-over from feeding milk replacer formulas to feeding a total fish diet is called "weaning". More research needs to be conducted to determine the most optimal age to start a slow gradual weaning process. The information available indicates that a giant otter cub should be around at least 2 ½ to 4 months old when fish is first introduced into its diet and the weaning process is begun. The age at which each cub will first accept fish will vary from individual to individual, although it seems that milk formula should be given to fulfill 100% of the giant otter cub's nutritional needs until it reaches around at least 2 ½ months of age. Not fulfilling 100% of the cub's nutritional needs with a milk formula before this age or waiting too long to begin the weaning process may cause health problems. When the weaning process was started with cubs that were around approx. 2 ½ and 3 or 4 months old, those cubs were successfully reared. Many wild-born orphaned cubs reared at the institutions that used this method have been successfully reared (Lazzarini 1998 pers. comm.; McTurk/Duplaix pers. comm. 2004). Note: the ages of the wild-born animals were estimated. At Hagenbecks Tierpark (Germany) giant otter cubs, at approximately 8 weeks old, mouthed and played with fish that the mother brought to them; although they only first started swallowing solid fish at 70 days of age (10 weeks old) (Hagenbeck and Wünnemann 1992). Later reports explain that two captive-born handreared cubs at Hagenbecks ingested solid food at 3 months old, although it was found that they could not digest the fish properly when they were this age. "The feces contained a lot of undigested fat and protein and the enzyme level of chymotrypsin was much lower than in adult animals" (Wünnemann 1995[b]). Giant otter cubs are dependent on the mother's milk for at least the first 4 months of life (Wünnemann 1995). The cubs continued nursing mother's milk when they were around 6 1/2 months old, although only insignificant amounts were obtained and it provided little nutritional value. The weaning process can occur over a varying time period until the cubs choose to reject the milk formula (Duplaix/McTurk & Wünnemann pers. comms. 2004). Cubs may choose to reject milk formula from one, a couple, a few, or even several months after accepting fish within their diet for the first time (pers. comms. of the handrearers listed within this manual). Sometimes they may also reject milk formula from 2 to 3 weeks after they start to eat fish within their diet. Caution must be taken although, as the offering of milk formula should not be eliminated or reduced in amount too soon or problems may result. See Chapter 5 Section 12 for details.

Reports indicate that giant otters do not require milk to meet their basic nutritional needs when they are at the age of around 6 ½ months and older (note: this does not mean that their needs can not be met at an earlier age; see the paragraph above). At one institution, some handreared otters although have been reported to drink some supplemental milk formula (i.e. in addition to their fish diet), even up to 10 months of age and they were reported to be successfully reared (Duplaix/McTurk, pers. comm. 2004). Handrearers should although take care that otters wean themselves fully of all milk formula within a reasonable time period. It seems that by at least 6 ½ months of age, and up to an age that does not exceed approx. 10 months [based on the outcome of the handreared otters just mentioned above], the cub should be eating a total fish diet and should no longer be drinking any milk formula (Duplaix/McTurk & Wünnemann pers. comms. 2004). Scientific research on the meeting of nutritional needs of handreared giant otters at various ages should be conducted to establish scientific guidelines for the weaning process.

The physical and behavioral development of each wild orphaned and captive-born individual handreared should be thoroughly documented and studied. Field researchers are currently requesting information on cub body weight, body length, and age correlation and behavioral and physical ability development in order to use as a reference source for wild populations. A complete age - weight - length growth curve needs to be developed for handreared giant otters. I.e. measurements should be taken from the earliest age to the latest age that is possible. (See

Chapter 5 for how to measure, Chapter 4 for when otters grow to full size/ general growth rates, and Chapter 3 for husbandry training. An incomplete age - weight growth curve is available (see Graph 2), but no body length growth curve is known to exist. See Table 6 for cub weights.) This will help field biologists to determine cub age in the wild (Groenendijk & Hajek, pers. comm.). This data is also necessary for comparison during handrearing of all cubs and for monitoring/assessing the development of parent reared cubs in captivity and in the wild. It would also be interesting to assess if there are significant differences between these factors for handreared captive-born and orphaned wild-born individuals. Information, such as this, can not be acquired through parent reared cubs in captivity or in the wild, so it is vital that records such as these are kept and shared. There are no known reports of rectal body temperature of healthy handreared cubs. This and other physiological information should be gathered from handreared cubs for comparison to adults, other cubs, and to increase in general knowledge. See Section 4 above.

Diseases, illnesses, parasites, injuries etc. that each individual orphaned wild cub contracted in the wild (or/and during handrearing) and each captive-born individual contracted in captivity should be recorded and studied. This is important to assess the health problems that wild giant otters and captive giant otters are exposed to. The general health, as well as degree of physical and behavioral development, of each wild-born orphaned and captive-born individual, upon its arrival to the handrearer, should be documented. This is important to use for comparison to other cubs and to help determine cub age. Appropriate vaccinations for giant otter cubs, the availability of vaccinations within specific countries, and disease prevention methods need immediate attention and study. See Section 4 above.

Unfamiliar or even temporarily separated otters of all ages should be properly introduced to avoid otter death or injury. It is important that handrearers/institutions involved are aware of these potential problems. See below and Chapter 2 for more information. More study should be carried out to determine at what ages handreared otters (i.e. cubs, juveniles, or sub-adults) are old enough to be successfully and slowly introduced to unfamiliar captive adult, sub-adult, juvenile otters, or cubs. The age that it is most optimal to first expose cubs to small tubs of water/large swimming pools, to begin swimming lessons, to safely leave cubs alone around water tubs or large swimming pools should be studied. How it is best to teach cubs to swim should also be determined.

An international study on the census, future, and success of both handreared captive-born and orphaned wild otters needs to be expanded. For example, how successfully these individuals pair with a mate, breed, and rear offspring (whether they are housed permanently in captivity or released in the wild) should be scientifically studied over a long-term period. Many questions exist regarding matters such as how human contact, contact or lack of contact with other otters during handrearing, housing conditions, “hacking out” methods etc. affect success.

For example, giant otters are highly social and live in family groups in the wild. Mated pairs bond for life and all family members (including sub-adult offspring) care for the young. Each litter usually consists of more than one cub and cubs are dependent upon the other family members for care, socialization, learning life skills etc.. It is therefore ideal if more than one giant otter cub (i.e. siblings or healthy cubs near their same age) can be handreared/housed together. This will help provide for their stimulation, enrichment, and mental, social, behavioral, and physical development and health needs [i.e. socialization, companionship/contact, play interactions etc.] (Read and Meier 1996).

Unfortunately, it is not always possible to handrear giant otters together and negative consequences may result because of this or simply the fact that otters are handreared by humans. Some handreared carnivores may "…have difficulty fitting into a social group, exhibiting either excessive aggression or shyness. Animals raised without any carnivore contact may not fit in at all, preferring human contact to that of their own species." (Read & Meier 1996). It also should be determined if there are "critical periods" for the social development of handreared giant otter cubs. I.e. critical periods exist for the socialization of domestic dogs and therefore exotic species [such as giant otters], may also have a critical period (Read & Meier 1996). "Experiences, or lack of them, during these times may permanently affect the animal, resulting in abnormal adult behavior." Additionally, cubs that are reared alone and/or are not socialized early enough in life with conspecifics may not only be unable to interact normally with conspecifics, but they may even reject or kill them when introduction does occur. They may also be unsuccessful at breeding and rearing offspring.

On the other hand great caution must be taken as young giant otters, juveniles, sub-adults, or adults may fight with, injure or possibly, even kill unfamiliar young animals introduced to them. Unfortunately, reports of this do exist. Young otters have fought against other unfamiliar young otters and adults have fought against unfamiliar young animals and even familiar juveniles (Lazzarini pers. comm., Kranz pers. comm.). Even familiar temporarily separated otters have caused injury upon re-introduction. See Chapter 2 for more information on how to conduct safe introductions of unfamiliar otters and familiar otters that have been temporarily separated.

Note: during handrearing a dog might be helpful, in addition to human companionship, to provide additional stimulus and companionship. Although little is known about how successful or appropriate this practice would be, as this was known to have been used only with one giant otter and no further details are available. I.e. a dog had been used a companion for a giant otter with one of the first giant otters kept in Germany...[and] it might be interesting for evaluation if this is also feasible for giant otters [during handrearing] (Wünnemann, pers. comm., 2004). This practice although has been used with other species and it has been successful. E.g. domestic cats or dogs have been successfully used for companion animals during the handrearing of golden cats and tigers (Wünnemann, pers. comm., 2004).

Institutions that handrear orphaned wild giant otters should possess and/or provide the following: appropriate care and facilities, handrearing experience, thorough documentation, open communication, and information sharing. It would also be helpful if they could carry out scientific research on handrearing practices and cub development. Because reports indicate that the mortality rate of handreared orphaned wild otters released back into the wild has been very high, handrearers should be open to the option to transfer otters to zoos/institutions to facilitate breeding success in captivity. Which institutions are available to receive wild orphaned cubs for handrearing needs to be determined. The development, organization, and communication of a broad base of international facilities that are qualified to handrear orphaned otters need to be encouraged. Handrearers should be encouraged to join a communication network so that connections and information sharing can be easily accomplished. Persons who can volunteer their services as translators should be organized to help assist communications. International meetings / conferences involving professional and experienced handrearers should be organized.

Any institution/person who receives orphaned wild cubs/otters should thoroughly investigate and document why and how the otter became orphaned and where its original family exists. Known events that occurred from the time it was separated from its wild parents until it was received and all persons involved should be recorded. This information should be given to the

proper authorities (i.e. park officials, wildlife authorities, police, government, conservation groups) so that any necessary action can be taken. It is very important that the number of otters that are orphaned and each particular situation is reported and evaluated to determine the impact on wildlife, what particular problems exist, and how these problems can be better addressed and/or resolved. This is crucial to help protect this endangered species.

What should be done with wild born orphans after handrearing (i.e. release in wild, place in zoo/institution etc.)? This is a very serious issue that deserves much attention, scientific study, and open discussion among all involved. The consequences of the final decisions combined will have a serious impact on giant otters in captivity and may have some impact on this species in the wild, as both of these populations are currently in serious danger of extinction.

It is essential that the institutions that are interested in acquiring/keeping otters after handrearing meet the requirements stated in the "Synopsis" under Chapter 1. Pairing the individual with an otter that it has not grown up and/or been handreared with, may be an important factor to help increase the chances of successful reproduction, therefore this is highly recommended. (The otter obviously should be paired with an unrelated individual.)

Great planning and a scientific approach are necessary if handreared wild orphaned otters are intended to be released back in the wild (Burnette 1994). The goal, called "hacking out", is to introduce the otter to the wild while it is under controlled conditions and release it only after it is able to function on its own. Animals need to be supplied natural food items, taught natural living and hunting skills (i.e. so they can catch their own food etc.), be kept in natural enclosures and exposed to as many natural environmental conditions and items as possible, and be gradually removed from human contact well-before release. Appropriate giant otter habitat also must be found and scientifically studied beforehand, to help ensure survival upon release.

Methods used to teach wild orphaned giant otters how to successfully live in the wild (i.e. hunting skills etc.) and how and where to release these otters have not been scientifically studied and no guidelines have been developed. How it is best to house and expose the intended releasee to as many natural objects and conditions as possible, how and what natural food items should be supplied, and when and how to minimize human contact before release have not been studied in the aforementioned manner. The appropriate age to release otters and the appropriate places for release (i.e. undisturbed areas with plentiful food and den areas, minimal competition, mates to pair with etc.) have not been researched.

Scientific and long-term studies on the success of handreared orphans that are released into the wild and what factors before and after their release affect their success, from what is known at this time, have not been carried out. The ability to survive, find mates, form pairs, breed and rear cubs have not been assessed in long term scientific follow-up studies. How the otter's lack of experience (i.e. in skills for living in the wild, family group/social interactions, and cub-rearing assistance etc.), lack of exposure to diseases before release, and exposure to humans before release affect success has not been thoroughly investigated. How competition with other giant otters in the territory released and encounters with predators (e.g. caimans) and humans (i.e. releasees have lost their fear of humans and humans pose threats to otters) affect success is only known by general reports.

To date, scarce information and no known long-term scientific studies exist on any of the aforementioned issues concerning handreared wild orphaned giant otters that have been released back into the wild. These matters need immediate international attention. It is crucial that

action be taken to resolve these problems and that all institutions/persons involved undertake these goals and openly communicate and share information with the professional community.

"Hacking out is probably the best technique for release available, but it should be noted that this is controversial to some, and survival rates are questionable due to lack of experience and lack of exposure to diseases, among other problems." (Burnette 1994). This is regardless of whether the otter is released before or after it becomes sexually mature. It remains controversial to some because it is thought that even with the best scientific techniques, otter caretakers cannot prepare or teach the otter how to deal with all of the potentially hazardous situations or challenging environmental conditions it may encounter in the wild. Caretakers can neither fully present handreared otters with the real life exposure they would have had if reared in the wild, nor can they fully substitute for the training and social interactions natural parents and siblings would have provided. (In the wild giant otters do not leave the family group until they are two to three years old and they are dependent on their family for survival until then.) Giant otters already inhabiting the territory the releasee is destined for, may prove too great of competition for the releasee (i.e. limiting denning and fishing areas, etc.) or they may kill the releasee. Released otters may also be unable to find mates or establish family groups and being solitary can make survival much more difficult. They also may not be successful at rearing their own litters, without the first-hand experience of being reared by parents or helping to rear younger siblings (as done in the wild). Whether the otter is already returned to the wild or it is exposed to wild conditions during the rearing/hacking out/rehabilitation process, predators (i.e. caiman) may kill the inexperienced otters or the otter may approach humans (i.e. because they have lost their fear of humans) and this may result in their harm, death, or capture. During the hacking out/rehabilitation process wild giant otters may also kill the inexperienced otters while they are being exposed to conditions in the wild. (Of course, this is dependent on the type of method that is used during hacking out/rearing.) Otters that are being hacked out/reared in conditions in the wild or releasees, which are generally not used to exposure to a wide variety of different diseases/pathogens, may be especially susceptible to contracting diseases which may cause their death.

Unfortunately, reports have shown the combined mortality rate of handreared orphaned wild giant otters that have been reared/rehabilitated/hacked out for release and those that were finally fully released back into the wild have been very high (i.e. the majority did not survive) because of some of the same problems as mentioned above. Most (either during the rearing/hacking out/rehabilitation process for release or after final release) got killed by wild giant otters, people, or caiman. Some attempts to finally release the giant otters have also been unsuccessful. It is important to note that, from what is known, it is generally rare that orphaned handreared giant otters have been released back into the wild and to date, the releases below are the only ones that are known to have occurred or been attempted.

To date, the only known cases that have been published about giant otter re-introduction and hacking out were in Colombia (Gomez, Jorgenson, & Valbuena 1999) and in Guyana at Karanambu Ranch (McTurk & Spelman 2004). The report by Gomez et. al. (1999) included very general notes on the hacking out procedure used. It is as follows. One orphaned wild otter was handreared for 6 months and the other was handreared for one month before their release. They were handreared for one month together and they were also released together. One animal was 5.5 months old and the other 8 months old at the time of their release. The study concludes that the release was successful and the authors (who carried out this project) determined it was a success based on the observations of these two animals three times in a one month period after their release. During these times, the two cubs were identified and the authors were "sure" that

both cubs were adopted by a wild otter family that resided within their study area. During this particular study, no other observations were made after that point. It has to be noted that this was not a long-term study nor was it scientific. The long term ability to survive, find a mate, and rear offspring can not truly be evaluated by 3 observations in a one month period. Update: in 2003, a follow up was published (Gomez 2003) which explains that three reports were received where the handreared female was identified five years after her original release. (The identification was made by three persons, who were not involved in the handrearing or rehabilitation program for the otters.) This female was observed with a family group which included four giant otters in total. The author explains, that these reports "indicate that this not so young otter (6 years old), is now the head (alpha female) of one small group comprising four otters, two adults and two juveniles (probably her cubs). This follow up study does not mention if the rehabilitated and released male otter was seen again since the conclusion of the first study. Gomez also states "As a preliminary conclusion, the rehabilitation process appears to have been successfully achieved, i.e. that the individuals were capable of surviving and behaved as normal wild giant otters, completely independent and able to breed." This follow-up report can not be considered scientific or to be carried out over a long-term. In another case, WSPA (World Society for the Protection of Animals) attempted to release a young confiscated handreared giant otter in Colombia. This attempt was unsuccessful as the otter kept on returning to the people that tried to release it. The otter was later placed at Cali Zoo where it still lives (Corredor, pers. comm.).

Unfortunately, no scientific long-term studies have been carried out on the survival success of the other handreared orphaned wild giant otters that are known to have been reared/hacked out/rehabilitated for release and returned back into the wild. Those animals, which went through these processes at Karanambu Ranch in Guyana, constitute the majority of the total number of giant otters that are known to have been rehabilitated for release and finally released. Reports have shown the combined mortality rate of those animals during the rearing/hacking out/rehabilitation process for release (which at Karanambu includes letting the otters have access to wild conditions or/and access to the wild when they are unmonitored and on their own) and those remaining surviving otters that were finally fully released was very high (i.e. the majority did not survive). This was because most of those otters were assumed or known to have been killed or were not seen again (i.e. see the reasons listed above and below). Below, are details on the aforementioned experiences.

"From 1985 to 2003, thirty-four orphaned giant otters (22 males, 12 females) were hand raised for eventual return to the wild at The Karanambu Cattle Company Limited Ranch (Karanambu), on the Rupununi River in Guyana, South America. Young giant otters brought to Karanambu ranged in age from 2 weeks to 9 months old; most were young cubs (8-10 weeks). Feeding, housing, exercising, veterinary care, and rehabilitation protocols for young giant otters were developed during this period. Six giant otter orphans died during the early stages of hand rearing; two of these were killed, one by a caiman and one by another orphaned otter. Twenty-eight orphans were successfully reared at Karanambu, and then began the process of rehabilitation. During the early stages of their return to the wild, the giant otters would spend days and then nights on the Rupununi River away from human care, often interacting with wild giant otters. One male giant otter was never rehabilitated, remaining at Karanambu for four years until wild otters killed it. Six giant otters were killed before they were considered completely rehabilitated, including three killed by people and three by other giant otters. Another four giant otters were presumed dead, presumably also killed by people. Sixteen of the orphaned giant otters (57% of those that began the process of rehabilitation) returned to the wild; these otters joined wild otter family groups in the area. Although long term monitoring was not possible, Karanambu staff observed the rehabilitated otters repeatedly: 13 of these 16 giant otters were observed 2-4 years

after their return to the river. The giant otter rehabilitation program at Karanambu offered residents and visitors a unique opportunity to closely observe and study this species in both captivity and in its natural habitat." (McTurk & Spelman 2004)

The international educational and awareness programs to inform persons living near giant otter habitat as to why they should not remove giant otters from the wild (i.e. for pets, etc.) and what to do if they see a stranded cub should be further expanded. Governments (both local and federal), wildlife authorities, conservation groups, park officials, police, zoological institutions, and wildlife rehabilitation centers/handrearers should be advised on how to deal with individuals illegally holding giant otters and the seriousness of this issue. The facilities that abandoned or confiscated otters can be taken to for appropriate care should also be made known when necessary.

Chapter 2:

Husbandry and Management Guidelines

Explanation of Terms and Mathematical Units Used Within This Manual

The definition of the following terms used within this manual are very specific (esp. the terms "enclosure" and "land" which can be easily interpreted in many ways), therefore they should be reviewed so that the guidelines within this manual can be properly interpreted. In addition to the explanations below, a definition will usually be presented only the first time that the term appears within Chapters 2-5.

Both metric and U.S. units are presented within this manual for all measurements. The U.S. unit is presented within parentheses ( ) and it follows each metric unit. Within this manual, the symbol . (a dot/period) indicates a fraction of a whole number follows after this symbol (e.g. 2.5 = 2 ½) . The symbol , (a comma) indicates that the entire number is separated into the unit of a thousand/thousands only to make the reading of that number easier (e.g. 24,000 = twenty four thousand).

"Cub" refers to a giant otter that is between approx. one day to six months old.

"Den" refers to an individual man-made room, usually small in size [e.g. 4 m² - 9m^2] (43.05 ft² - 96.88 ft²) and constructed with concrete, wood, etc., where an otter has access to. A nestbox can be placed or animals can be *briefly* held (i.e. for enclosure cleaning, etc.) in a den. Dens are off-exhibit and they do not serve as a nestbox. See the definition of "nestbox" below.

"Enclosure" and "exhibit" are used interchangeably. They refer to any/all areas, both indoors and outdoors, in which a captive otter is held or has access to, regardless of whether or not public/visitors can view these areas or the areas are intended for temporary or permanent use. They include such areas as dens, off-exhibit holding and quarantine areas, separable enclosure areas, areas on-exhibit (i.e. for public viewing), etc..

"Exhibit": see the term "*enclosure*" above.

"**Expansive enclosure/exhibit**" refers to any enclosure that is 600 m^2 (6,458.4 ft²) or larger.

"Furnishings and furniture" refer to any natural items (e.g. soft loose natural substrates, logs, boulders, trees, cut or growing bamboo etc.) that can be placed in an otter enclosure.

"Furniture": see the term "*furnishings*" above.

"Juvenile" refers to a giant otter that is approx. between six months to one year old.

"Land" refers to any base surface, whether man-made (e.g. concrete, tile, artificial rockwork, wood, floor etc.) or natural ground (e.g. soil, mulch, sand, rock etc.), within the giant otters' indoor and outdoor enclosures. These areas do not include the portion of the enclosure that is intended for water (i.e. a swimming/wading area). The term **"floor"** may be used in addition to the term "land" for greater clarification.

"Living area" refers to the same areas that an "enclosure/exhibit" refers to.

"Natural underground den": *see the term "underground den".*

"**Nestbox**" refers to areas that are only large enough for the otters (including cubs) to sleep. Nestboxes are man-made (i.e. constructed with wood, concrete, artificial rockwork etc.) and they are either placed above or beneath the ground/floor. See the term "den" above for comparison.

"Separable enclosure area": this word will be implied when the terms "enclosure", "indoor enclosure", or "outdoor enclosure" are used. This term although will be used at times when greater clarification is needed.

"Sub-adult" refers to a giant otter that is between approx. one year to two years old.

"**Successfully reared cub"** is a cub that lives to one year or older.

"**Successfully reared litter**" is where at least one cub in the litter survives to one year old or older.

"**Underground den" and "natural underground den**" refer to a den that has been dug by the otters themselves (i.e. dug into natural substrates and underground) and the otters can use this den to sleep/rest and keep cubs in. See the term "den" above for comparison.

Section 1
Part A. Overview of the Most Important Enclosure Design & Furnishing Requirements Necessary for the Husbandry of Giant otters

Note: The definition of the following terms should be reviewed to properly interpret the content below.

"Enclosure" and "exhibit" are used interchangeably. They refer to any/all areas, both indoors and outdoors, in which a captive otter is held or has access to, regardless of whether or not public/visitors can view these areas or the areas are intended for temporary or permanent use. They include such areas as dens, off-exhibit holding and quarantine areas, separable enclosure areas, and areas on-exhibit (i.e. for public viewing), etc.. The term "**separable enclosure area**" will be implied when the terms "enclosure", "indoor enclosure", or "outdoor enclosure" are used. This word although will be used at times when greater clarification is needed. **"Land"** refers to any base surface, whether man-made (e.g. concrete, tile, artificial rockwork, wood, floor etc.) or natural ground (e.g. soil, mulch, sand, rock etc.), within the giant otters' indoor and outdoor enclosures. These areas do not include the portion of the enclosure that is intended for water (i.e. a swimming/wading area). The term "floor" may be used in addition to the term "land" for greater clarification. **"Furnishings and furniture"** refer to any natural items (e.g. soft loose natural substrates, logs, boulders, trees, cut or growing bamboo etc.) that can be placed in an otter enclosure. "**Underground den" and "natural underground den**" refer to a den that has been dug by the otters themselves (i.e. dug into natural substrates and underground) and the otters can use this den to sleep/rest and keep cubs in. **"Den"** refers to an individual man-made room, usually small in size [e.g. 4 m^2 - 9m^2] (43.05 ft^2 - 96.88 ft^2) and constructed with concrete, wood, etc., where an otter has access to. A nestbox can be placed or animals can be *briefly* held (i.e. for enclosure cleaning, etc.) in a den. Dens are off-exhibit and they do not serve as a nestbox.

The following conditions (i.e. Numbers 1-10) **are among the most important requirements necessary for the husbandry of giant otters. They are required for every indoor and outdoor enclosure and separable enclosure area. When enclosures, whether already in use or being designed for use, do not fulfill the following conditions, it is necessary to modify them so that they do.** In most cases, even when the enclosure is already in use or being designed, such changes and additions are simple and inexpensive to make and maintain thereafter. E.g. the recommended mulch and soft sand types, qualities, and depths are ideal for both indoor and outdoor use to cover over inappropriate surfaces such as hard, artificial, tightly packed/compacted (e.g. soil with/without vegetation), poor draining, and slow drying surfaces. The required substrates are inexpensive, very effective, easy to care for, remain sanitary, and at each institution at least one or more of these substrates are easy to acquire. They also can be easily provided whether the giant otter enclosure is already in use or not and regardless of any existing surfaces within the enclosure. When land to water ratios provide smaller land proportions than recommended, artificial (e.g. concrete) or natural pools (when more than one exists) can be emptied or portions of pools can be divided with waterproof barriers/walls. These can then be filled in with appropriate substrates to create enough land. [Unless otherwise noted, the guidelines for the recommended enclosure conditions below are presented within Chapter 2.]

1. The provision of the recommended land to water area ratios. *The land to water ratios must provide at least the minimum size (proportion) land area required. Note: each indoor and outdoor enclosure and separable enclosure area below 240 m² (2,583.4 ft²) in size, requires a different land to water ratio based on its specific size.* (The land area percentage, in the ratio, must be proportionately increased and the water area percentage must be proportionately decreased, as the total enclosure or separable enclosure area size is decreased below 240 m^2. See the formula necessary to determine the ratios.) Enclosures between 240 m² to 600 m² (6,458.4 ft²) require other land to water ratios, as do those above 600 m². See Section 1B. Some indoor enclosures that are attached to outdoor enclosures may not need water areas or full size water areas (see Number 9 below). See Section 9 for when indoor enclosure water areas (e.g. pools/swim tanks) are necessary and for the type of indoor water area needed, as well as for water and air temperature recommendations.

2. The provision of the recommended soft loose natural substrate types, qualities, and depths that cover nearly the entire enclosure land and floor area. See Section 2. *Note: even when the enclosure surfaces that otters are directly exposed to are soft, loose, and natural as required*, only the specific soil, sand, and mulch types, qualities, and depths recommended are appropriate. E.g. soil, sand, or mulch that contains pebbles (smooth, rounded, or otherwise), gravel, small rocks, construction sand, or abrasive sand mixed throughout is coarse and it is therefore inappropriate. After continual use, soil with/without vegetation must remain loose enough that otters can easily dig into it and effectively groom on it. (Grooming includes digging into and scratching on/up substrates and vegetation to loosen the soil, sand, or mulch particles to cover the body). The soil must also remain easily drying and well draining after regular exposure to water, large areas of vegetation/turf have been cleared away, and the otters have regularly dug and groomed throughout their entire enclosure land area. Soil or any other substrate that cannot maintain all of these qualities are inappropriate for direct use. These substrates, therefore must not be offered for direct use and it is necessary that soil, sand, or mulch with the recommended qualities be used to replace or cover over them. When mulch or sand is below the recommended minimum depth or mulch bark pieces break down and new mulch is not added on top of the existing mulch, this can cause them to remain very damp/wet. Other inappropriate enclosure conditions can also cause surfaces to remain very damp/wet.

3. The provision of at least the minimum recommended deep digging area size and depth. The same substrate qualities and types and husbandry techniques needed for enclosure land and floors (see Number 2 above) are also necessary for the deep digging areas. See Section 2.

4. The provision of the recommended designs and locations for land and water areas, dens, nestboxes, and areas for natural underground dens needed to keep the land, dens, nestboxes and natural underground dens dry. See Section 5. (The land and water area designs in Section 5 are those that are needed in addition to the recommended land to water ratios to keep the land area dry. All enclosure conditions, e.g. hard surfaces, not enough land area etc., that cause land areas to remain very damp/wet are discussed within this section.)

5. The provision of the recommended locations, designs, and modifications for enclosures, nestboxes, dens, areas for natural underground dens, keeper access doors, and animal shift doors needed to isolate enclosures from human disturbances during cub-rearing. See Section 10B. (The husbandry practices needed to provide privacy during cub-rearing are also discussed in the same section.)

6. The provision of the recommended enclosure locations and designs needed to carry out visual-acoustic-olfactory introductions of otters that are unfamiliar with each other and those that have been temporarily separated (i.e. animals that were previously housed together). See Section 18. This section also describes the husbandry practices necessary to provide safe introductions.

7. The provision of the recommended shallow and deep water areas (note the exceptions in Sections 9 and 7) and the recommended water area designs that allow otters (esp. cubs, parents carrying cubs, and old animals) safe exits from the water. See Section 7.

8. The provision of at least the recommended minimum number of nestboxes and basic nestbox designs or the existence of multiple natural otter dug underground dens and the provision of the recommended hill designs and substrates needed to provide an area for such dens to be dug. The provision of at least the recommended minimum number of (off-exhibit) dens in indoor enclosures. See Sections 2, 12, 13, and 14.

9. In temperate climates, it is necessary that an outdoor enclosure (with or without heated outdoor water) provides access to a heated indoor enclosure. Indoor enclosures that attach to outdoor enclosures require all of the conditions above in Numbers 1-8 (as do all enclosures whether they are attached to outdoor or indoor enclosures or not). These indoor enclosures types must also be large enough that they provide ample quality land area for otters to carry-out the "*full range and extent of terrestrial activities"* that can not be performed outside because temperatures are too low. These activities include digging, grooming, playing, and exercising on land and raising young. The meaning of the *"full range and extent of terrestrial activities*" is very specific and it is often misinterpreted because of general misconceptions about how giant otters should behave; see Section 3B for a description. Note: in addition to the aforementioned land area, they require the dens and nestboxes as stated in Number 8 above. See Number 1 for a discussion on indoor water areas. See Sections 9 and 13 and Part C below.

10. Safety precautions must be considered during enclosure design, as otters can be dangerous and injurious to humans. See Section 8.

The provision of the conditions listed in Numbers 1-3 above are among the most crucial requirements necessary for the husbandry of giant otters. These provisions are just as important as the need for a swimming area. When indoor and/or outdoor enclosure land to water ratios offer smaller land proportions than recommended or/and land/floor surfaces are not nearly entirely covered with soft loose natural substrates (including appropriate depths, types, and qualities) or provided with sufficient size deep digging areas as recommended, health problems and/or abnormalities will occur. Other inappropriate land and water area locations and designs and unsuitable locations for nestboxes, dens and areas for natural underground dens can also cause or worsen health problems. Some of these problems are not uncommon among captive giant otters and some are very serious or have the potential to become very serious. Also originally, some were mistaken to be an exhibition of healthy physical condition or normal healthy behavior. It was although, after long-term studies, recently discovered that they are actually an exhibition of unhealthiness or abnormality for captive *Pteronura*, rather than the opposite. The ability of giant otters to successfully rear cubs and adjust to new/unusual situations can also be adversely affected or seriously compromised in the aforementioned conditions. See Sections 3 and 5 for more information. Also when parents are not provided with privacy/isolation from human disturbances during cub-rearing, cub-rearing success has been negatively affected. Normal/routine human activities tolerated before parturition can cause parents significant stress at and after parturition and can result in the parents' failure to care for their cubs properly (i.e. parents can neglect, abuse, or eat their cubs and litter/cub loss can occur as a result). See Section 10 and Chapter 1 Section 2 for more information. Reports of significant injury and death during improperly conducted giant otter introductions have not been uncommon. See Section 18. Cubs esp. may not be able to exit water areas safely or at all with inappropriate water area designs. See Section 7.

When cubs are reared to independence, unfamiliar and temporarily separated animals are introduced and then housed together, or otters are maintained to an old age in inappropriate enclosure conditions or/and with inappropriate husbandry practices, this does not validate that the enclosure conditions and/or husbandry practices used were appropriate. (I.e. this does not mean that these circumstances are appropriate because such outcomes have occurred.) It is essential that inappropriate enclosure conditions and husbandry practices are not repeated or used at any other institution based on the conclusions that such outcomes have occurred.

Pool drains, filters, skimmers, water filtration/cleaning systems, waterfalls, underwater viewing areas, swim tanks/tubs, and **all water areas must be able to accommodate the soft loose natural substrates that may be tracked**, pushed, dug etc. **into the water** from land and floor areas. The simple designs and furnishings described in Section 2C can help prevent substrates from entering water areas and blocking drains or causing other problems. Although, even with these methods, some substrates will enter the water. Because it is necessary that every indoor and outdoor enclosure land and floor surface is nearly entirely covered with soft loose natural substrates as recommended, enclosure water areas etc. should be designed or modified with these considerations in mind. (These methods will also help prevent leaves, sticks, bark, etc. that have fallen from trees, fish remains, natural furnishings other than substrates, and toys from blocking pool drains or causing other problems.)

Part B. Land to Water Area Ratios Necessary for Every Enclosure That Contains Water & How to Inexpensively Modify Land to Water Ratios to Offer Enough Land

The provision of the recommended land to water area ratio is one of the most crucial requirements necessary for the husbandry of giant otters. The land to water ratio must provide at least the minimum size (proportion) land area required within every indoor and outdoor enclosure and separable enclosure area. Each enclosure and separable enclosure area below 240 m² (2,583.4 ft²) in size, requires a different land to water area ratio based on its specific size. Enclosures between 240 m² to 600 m² (6,458 ft²) require other land to water ratios, as do enclosures above 600 m². (See below.) All areas intended for water, regardless of their size and how many there are within an enclosure or separable enclosure area, must be included when ratios are determined. **The ratio for each separable enclosure area that contains water (i.e. an indoor or outdoor enclosure, whether otters have continual access to both or not, or temporary living area) should be determined based only on the total size of that separable area.** Section 3 below describes the physical and behavioral health problems that develop and Section 5 describes how land, nestboxes etc. remain too damp/wet when enclosures have smaller land area proportions than recommended. Note: *within this manual the terms **"enclosure" and "exhibit"** are used interchangeably. They refer to any/all areas, both indoors and outdoors, in which a captive otter is held or has access to, regardless of whether or not public/visitors can view these areas or the areas are intended for temporary or permanent use. **"Land"** refers to any base surface, whether man-made or natural ground, within the giant otters' indoor and outdoor enclosures. The term "**floor**" may be used in addition to the term "land" for greater clarification.*

It is necessary to modify all enclosures, whether they are in use or not, when they do not fulfill the recommended land to water ratios, so that at least the minimum recommended land proportions (land area sizes) are offered. (I.e. this applies to any enclosure, whether it is already constructed and giant otters are being kept in it or the enclosure is being designed or modified to hold *P. brasiliensis* in the future. When the land to water ratios are inappropriate, in most cases the land area will not be large enough.) **Various simple methods can be used to effectively and inexpensively accomplish this in both indoor and outdoor enclosures.** E.g. when more than one pool is available within an enclosure and the land area is not large enough, at least one or more artificial (e.g. made of concrete) or natural **pools can be emptied and filled in with soft sand or mulch to increase the land area**. When the pool is natural, soft loose soil could also be used to create new land area. (See Chapter 2 Section 2 for the substrate types, qualities, and depths required. E.g. soil, sand, and mulch must not contain pebbles, small rocks, or gravel; soil must remain well draining, easily drying, soft and loose etc..) **In enclosures with only one main pool, part of the pool can be made into land area by constructing a waterproof** artificial wall to divide and seal off a portion of the pool. The new dry area can then be turned into land as aforementioned. Note: pre-existing pool drains can be modified, e.g. covered with mesh fence, or small holes can be drilled through pool bottoms, to assist drainage during heavy or extended rain periods.

When an indoor or outdoor enclosure or any separable enclosure area is smaller than 240 m^2 (2,583.4 ft²) it is necessary to provide the land to water ratios that the following formula determines. (Reminder: such locations include temporary holding and quarantine areas, indoor enclosures, whether connected to outdoor enclosures or not, and any enclosure or separable enclosure area below 240 m^2 in size. These recommendations apply to all circumstances, e.g. whether or not the otters have continual access to another separable enclosure area and regardless of the enclosure's size.) *The land area percentage (in the ratio) must be*

proportionately increased and the water area percentage must be proportionately decreased, as the total enclosure or separable enclosure area size is decreased below 240 m^2.

The formula to determine land to water ratios for enclosures and separable enclosure areas smaller than 240 m^2 (2,583.4 ft^2) is as follows: *(Note: the symbol* **.** *(a dot/period) indicates a fraction of a whole number follows after this symbol (e.g. 2.5 = 2 ½) . The symbol* **,** *(a comma) indicates that the entire number is separated into the unit of a thousand/thousands only to make the reading of that number easier (e.g. 24,000 = twenty four thousand).*

The total size of the enclosure or separable enclosure area should first be converted to square metric units, i.e. m^2, before continuing with the following calculations. Square feet x 0.093 = square meters. (– = minus) (÷ = divided by) (x = multiplied by) (2.5 = 2 ½) (+ = plus)
The m^2 symbol should be eliminated during the following calculations.
240 – the total size of the enclosure or separable enclosure area (with m^2 symbol removed) = A
A ÷ 24 = B
B x 2.5 = C
C + 60 = The minimum land area ratio percentage (%) that is necessary for the enclosure or separable enclosure area.
The total size of the enclosure or separable enclosure area (whether in m^2 or ft^2) x the land area ratio % just calculated for the area = The minimum land area size in m^2 or ft^2 required for the enclosure or separable enclosure area. <u>Each location must have no smaller amount of land area than the minimum size/proportion just calculated.</u>

For example:
The land to water ratio for an enclosure that is 150m^2 in size would be calculated as such:
240 – 150 = 90; 90 ÷ 24 = 3.75; 3.75 x 2.5 = 9.375; 9.375 + 60 = 69.37% land area. (150 x 69.37 % = 104.05 m^2 (1,120 ft^2) land area. [100 – 69.37 % = 30.63 % water area.]

In a 60 m^2 (645.84 ft^2) enclosure, the land area would constitute 78.75% [or 47.25 m^2 (508.6 ft^2) land area] of the total enclosure area. The water area would constitute 21.25% (or 12.75 m^2 [137.2 ft^2] water area) of the total enclosure area. In a 100 m^2 (1,076.4 ft^2) enclosure the land area would constitute 74.58% [or 74.58 m^2 (802.8 ft^2) land area] of the total area.

A written explanation of the aforementioned calculations follows:
It is necessary that calculations to determine land to water ratios for enclosures and separable enclosure areas smaller than 240 m^2 (2,583.4 ft^2) are made and used as follows. The total size of the enclosure or separable enclosure area should first be converted to square metric units, i.e. m^2. (To convert square feet to square meters multiply square feet by 0.093). The m^2 symbol should then be eliminated during the remaining calculations. The total size of the enclosure or separable enclosure area (that is smaller than 240 m^2) should be subtracted from the number 240. This new number should then be taken and divided by 24. This newly calculated number should then be multiplied by 2.5 (i.e. 2 ½). This new number should then be added to the number 60. This last aforementioned newly calculated number is the minimum land area ratio percentage that is required for the enclosure or separable enclosure area. *(Note: Sixty percent land to 40% water area is used as the base land to water ratio and 240 m^2 (2,583.4 ft^2) total enclosure size is used as the base enclosure size within the aforementioned calculations. This is based on the 60% land to 40% water ratio needed for enclosures between 240 m^2 (2,583.4 ft^2) to 600 m^2 (6,458.4 ft^2) in total size.)*

When an indoor or outdoor enclosure or separable enclosure area is between 240 m^2 (2,583.4 ft^2) to 600 m^2 (6,458.4 ft^2) in total size it is necessary to provide at least 60% land area in each of these locations (Duplaix-Hall 1972 &1975; Duplaix pers. comm. 2001; Sykes-Gatz 2001 & unpublished reports). I.e. **each aforementioned location must not have less than 60% land area and it should have 40% water area.** E.g. a 240 m^2 enclosure would require a 144 m^2 (1,550 ft^2) land area and a 96 m^2 [1,033.3 ft^2] water area.

Enclosures that are 600 m^2 (6,458 ft^2) or larger should have at least 60% land area, although when these expansive enclosures have very large areas of useable quality dry land available **somewhat** smaller land proportions (%) will offer otters with sufficient land area. As well, within these enclosures, water area proportions that are smaller by a reasonable amount will offer otters with sufficient water area. P*roviding enough land area is crucial although even within enclosures that are 600 m^2 or larger. Great caution must be taken when land area proportions are reduced below 60% within such enclosures. The amount that the land proportion is reduced should be in a reasonable proportion compared to how much the enclosure is actually above 600 m^2 (6,458 ft^2) in size. If the total enclosure size is only a small amount above 600 m^2 the land area ratio % should not be decreased below 60%.* For example, *Americana Zoo's* (Brazil) 895 m^2 (9,633 ft^2) enclosure has a 42% land to 58% water ratio. Although these dimensions do not provide at least 60% land area, the otters are provided with sufficient land area because the enclosure is well above 600 m^2 in size. Also, in an expansive exhibit, such as the 635 m^2 (6,835 ft^2) exhibit in *Brasilia Zoo* (Brazil) that has an 85% land to 15% water ratio, sufficient water area is available.

Part C. Minimum Enclosure Sizes

The provision of expansive[1] complexly and naturally enriched enclosures is optimal (Duplaix-Hall 1972 & 1975; Foster-Turley 1990; Wünnemann 1995; Genealogical Meeting…in Brazil" 1998; Duplaix pers. comm. 2001; Sykes-Gatz 2001 & unpublished reports). [1]*Within this manual "expansive enclosure/exhibit" means any enclosure that is 600 m^2 [6,458.4 ft^2] or larger.* The larger, more complex, and natural the enclosure, the more benefits gained. (The enclosure also requires the recommended land and water area designs and locations [esp. appropriate land to water ratios that provide enough land], substrates, and deep digging area sizes to offer these benefits.) This type of living area provides optimal enrichment and living conditions for giant otters. An "expansive" exhibit that offers otters ample area to dig underground dens is very important to help aid successful cub-rearing. This is because the larger the enclosure, the further parents can get away from human disturbances and presence during cub-rearing (i.e. the more privacy they have) and as well, natural underground dens provide additional visual and acoustic isolation. Also offered is an optimal area where otters can carry out, to the fullest extent possible in captivity, the innate terrestrial behaviors that are among the most important activities needed to allow them to significantly reduce or prevent the negative responses that can occur and cause significant problems during cub-rearing, new/unusual situations, and typical daily circumstances. (See Section 3 below for the aforementioned terrestrial activities.) Negative responses such as stress, nervousness, boredom, frustration, or fear etc. can cause problems such as litter loss, serious fights during introductions of unfamiliar animals, less/non directed or non goal oriented behaviors, stereotypical behaviors etc..

The minimum size enclosure for one giant otter pair should be at least 240 m^2 (2,583.4 ft^2) (Duplaix-Hall* 1972 & 1975). Extra room should be considered for offspring. Minimum size

does not offer the same advantages of a large enclosure, although **the quality of an enclosure is more important than the quantity of an enclosure.** Concerning quality, **an enriched complex enclosure can be made easily and inexpensively with the recommended simple natural furnishings, even after an enclosure** (i.e. even those with hard base surfaces such as concrete) **has been in use**. This will not only benefit the otters, but it will also provide zoo visitors with an educational and enjoyable experience. Of course although, any enclosure intended for giant otters should be designed and furnished properly before the otters are placed in it.

Giant otters should be provided with an outdoor enclosure. See the recommendations throughout Chapter 2 for the necessary outdoor enclosure furnishings and designs. "In temperate zones the giant otter needs both indoor and outdoor enclosures…. They are quite adaptable to colder outdoor temperatures as long as they can choose between the warm indoor and the outdoor enclosures." (Wünnemann 1995).

In temperate climates, it is necessary that an outdoor enclosure (with or without heated outdoor water) provides access to a heated indoor enclosure. Indoor enclosures that attach to outdoor enclosures must provide ample quality land area for otters to carry-out the "*full range and extent of terrestrial activities*" that can not be performed outside because temperatures are too low. These activities include digging, grooming, playing, and exercising on land and raising young. The meaning of the *"full range and extent of terrestrial activities*" is very specific and it is often misinterpreted because of general misconceptions about how giant otters should behave; see Section 3B for a description. In some cases water areas are needed in these indoor enclosures as well. (See Chapter 2 Section 9 for when and what type of indoor water areas are needed.) It is crucial that indoor enclosures that attach to outdoor enclosures have the recommended land to water ratios (to provide enough land if they have water areas), soft loose natural substrate types, qualities, and depths that cover nearly the entire land/floor area (including dens), and deep digging area sizes. (See Section 2 below and Part A & B above). (Different enclosure sizes require different land to water ratios.) In addition they must include dens[1] and nestboxes (see Sections 13-14 below) and the recommended land and water area locations and designs and locations for the dens and nestboxes (see Section 5 below for what is needed to keep these areas dry). They should include the natural furnishings recommended in Section 4 below and the water area design (if water areas are needed) recommended in Sections 7 & 9 below (some designs are required for safety). These enclosures also need the designs that can offer privacy from human disturbances during cub-rearing (see Section 10 below). See the recommended minimum enclosure size below. [1]***"Den"*** *refers to an individual man-made room, usually small in size [e.g. 4 m² - 9m²] (43.05 ft² - 96.88 ft²) and constructed with concrete, wood, etc., where an otter has access to. A nestbox can be placed or animals can be briefly held (i.e. for enclosure*

Chapter 2 Section 3). **For example, during cub-rearing in colder temperatures otter families may need to be held in indoor enclosures, without outdoor access, for as long as 4-5 months.** This fact alone and the problems that can arise from the aforementioned inappropriate conditions must be given careful consideration when indoor enclosures are designed and furnished. E.g. problems can include very damp/wet conditions that can cause cub infection/death and other health problems, behavioral problems that negatively affect cub-rearing success, etc. Providing space that is large enough for the entire family to be able to sufficiently (i.e. to maintain behavioral and physical health) and comfortably carry out all of their terrestrial and aquatic activities during these long periods (or any extended cold periods, whether cub-rearing or not) must also be considered.

In temperate climates and when adjoining outdoor enclosures are at least 165 m² in size, indoor enclosures should provide at least a 60 m^2 (645.84 ft²) area where terrestrial, and when necessary aquatic activities, can be carried out. If water areas are not necessary indoors, the minimum size recommendation remains the same. Additional space for dens containing nestboxes is also needed. The total indoor enclosure area should be a minimum of 75 m^2 (807.3 ft²) in size when outdoor enclosures, that are at least 165 m² (1,776 ft²) in size or above, are provided in temperate climates and when otters have access to both enclosures. This is certainly not an optimal size, instead it is only minimal. In a 75 m^2 (807.3 ft²) enclosure (that requires a swim area), the land area must constitute approx. 77.19% (or 57.89 m^2 [623 ft²] land area) of the total enclosure area. A 165 m² enclosure requires 67.81% land area. Both outdoor and indoor enclosures combined should be at least a total minimum size of 240 m^2. **It is important to note that if indoor enclosures do not provide access to outdoor enclosures they should be at least 240 m^2 (2,583.4 ft²) in total size.**

Following are examples of giant otter enclosures:
Criatorio Crocodilo Safari (Brazil) has a huge natural outdoor giant otter exhibit that is 14 hectares (34.6 acres) in size. *Cuiabá Zoo's* (Brazil) very expansive natural outdoor enclosure measures 4,282 m^2 (46,091.4 ft²) (Marcato de Oliveira 1995; Louzada da Silva, pers. comm. 1998). The enclosure has natural underground dens. *Americana Zoo's* (Brazil) 895 m^2 (9,633.78 ft²) expansive natural outdoor enclosure contains a 519 m^2 (5,586.51 ft²) natural pool and 376 m^2 (4,047.26 ft²) land area. *Chestnut Centre's* (UK) 767 m^2 (8,255.98 ft²) natural deciduous forest outdoor exhibit, with a 1:1 land to water area, connects to a 64 m^2 (688.9 ft²) heated indoor living area plus additional area for dens with nestboxes. Otters are given access to both areas all year. The outdoor enclosure includes a natural pond (with a maximum pond depth of 2 m [6.56 ft]), stream, and swamp area, all with aquatic vegetation. The pond, dug by man, is naturally fed with flow through spring water via the stream. Vegetation is allowed to grow naturally throughout the enclosure and areas of deep sand are additionally provided. *Brasilia Zoo* (Brazil) has two expansive semi-natural outdoor exhibits covered with soft loose soil and vegetation. The enclosures have plentiful hillsides where the otters have dug many underground dens. Each exhibit measures 635 m^2 (6,835.14ft²) with a 105 m^2 (1,130.22 ft²) pool and an 85% land to 15% water ratio. *Dortmund Zoo's* (Germany) 350 m^2 (3,767.4 ft²) outdoor enclosure connects to a 90m^2 (968.76 ft²) heated indoor exhibit. Otters have access to both enclosures all year. The indoor and outdoor enclosure land is covered with mulch and/or sand, deep digging areas, deep leaf piles, live growing and "man-made bamboo stands", and logs etc.. Trees and bushes are also provided outdoors. All pools are furnished with large logs, branches, and boulders. *Sorocaba Zoo* (Brazil) has a 314 m^2 (3,379.89 ft²) outdoor enclosure with a 119 m^2 (1,280.91 ft²) pool and an approx. 60% land to 40% water ratio.

**Note: Duplaix's guidelines for otters are species specific and based on extensive research and long-term studies both in captivity and in the field (esp. on giant otters). These guidelines have been frequently recognized and used internationally, since the 1970's to the present, as the desired minimum housing standards for various river otter species in captivity.*

Section 2

Note: The definition of the following terms should be reviewed to properly interpret the content below.
"Enclosure" and "exhibit" *are used interchangeably. They refer to any/all areas, both indoors and outdoors, in which a captive otter is held or has access to, regardless of whether or not public/visitors can view these areas or the areas are intended for temporary or permanent use. They include such areas as dens, off-exhibit holding and quarantine areas, separable enclosure areas, and areas on-exhibit (i.e. for public viewing), etc..*
"Land" *refers to any base surface, whether man-made (e.g. concrete, tile, artificial rockwork, wood, floor etc.) or natural ground (e.g. soil, mulch, sand, rock etc.), within the giant otters' indoor and outdoor enclosures. These areas do not include the portion of the enclosure that is intended for water (i.e. a swimming/wading area). The term "***floor***" may be used in addition to the term "land" for greater clarification.*

Introduction to Substrates & How to Easily Make Inappropriate Land and Floor Surfaces Appropriate

The necessity of the following provisions can not be overemphasized as they are just as important as providing a swimming area. There are particular substrate types, qualities, and depths and husbandry techniques that are needed to ensure that the substrate provided is functionally effective, that it can be appropriately used by the otters, and that it will maintain or improve the otter's physical and mental/behavioral health and normality. The recommended furnishings are inexpensive, very effective, easy to care for, remain sanitary, and at each institution at least one or more of these substrates are easy to acquire. **They also can be easily provided in both indoor and outdoor enclosures whether the giant otter enclosure is already in use or not and regardless of any existing substrate/surface within the enclosure**. The reasons why these provisions are necessary are not explained within this section. See Chapter 2 Section 3 for an explanation.

Nearly the entire area of enclosure land and floor substrates that otters are directly exposed to must not be hard, tightly packed/compacted (i.e. they are not loose enough for otters to easily dig into), artificial, continually wet or very damp, slow drying, or poor draining and no area must be coarse (e.g. contain pebbles, gravel, small rocks, construction sand)**, rough, or abrasive.** When otters are not offered these conditions health problems and/or abnormalities will result; see Chapter 2 Section 3. **Other than within a small area/proportion of their indoor and outdoor enclosures, otters must not have direct exposure to the following land and floor substrates: <u>concrete, cement, gunnite, tile, artificial or natural rockwork, bricks, wood; soil (with/without vegetation) that is poor draining, slow drying, or tightly packed/compacted; boulders, smooth rounded rocks/river rocks > approx. 20 cm diameter, or any other hard, tightly packed/compacted (i.e. they are not loose enough for</u>**

otters to easily dig into), artificial, continually very damp or wet, slow drying, or poor draining substrate. Otters must not be directly exposed to any of the following land and floor substrates within any area of their indoor and outdoor enclosures: areas of small rocks < approx. 20 cm diameter, gravel, or pebbles (smooth, rounded, or otherwise), areas of soil, sand, or mulch mixed with any kind of pebbles, gravel, small rocks, construction sand, or abrasive sand throughout, areas of construction or abrasive sand or any substrates mixed with these, fence areas, and any other areas of coarse, rough, or abrasive substrates. Note: soil, sand, or mulch that contains pebbles, gravel, or small rocks (smooth, rounded, or otherwise) or construction or abrasive sand mixed throughout or any substrate with many larger rocks throughout **is coarse.** Builder's/construction sand is abrasive/coarse and areas of pebbles, small rocks, or gravel are coarse.

Inefficiencies and **problems can also develop when the recommended minimum substrate depths** (i.e. when substrate depths are shallower than recommended) **and quality** (esp. when new mulch is not added on top of existing mulch that has broken into small pieces and packed down) **are not maintained.** I.e. the substrates can remain very damp/wet and otters cannot effectively or will not use them, esp. for grooming and digging, and health problems or abnormalities will develop. (See Parts A-B below.) **Problems can develop when the deep digging area is not sufficient in size;** see the recommended minimum size needed in Part B below. **Inappropriate land and water area locations and designs** (esp. land to water ratios that do not provide enough land) **and unsuitable locations for nestboxes, dens and areas for natural underground dens will also cause surfaces to remain wet/very damp** or worsen conditions; see Section 5 below.

It is necessary that nearly the entire base surface area that otters are directly exposed to in every indoor and outdoor enclosure is soft, well-draining, easily drying, and loose enough in texture so that otters can effectively groom on (which includes digging and scratching on/into substrate) **and very importantly, easily dig into it.** In addition, soil substrates should not erode easily. At least, the recommended substrate types, quality, and minimum depths to cover nearly the entire land and floor area and minimum deep digging area size and depth must be provided in every enclosure (see Part A-B below for more information).

For a significant number of institutions, i.e. primarily those outside of South America, finding an appropriate soil type that possesses and can retain all of the aforementioned necessary qualities may be difficult or impossible. (At present the only soil type that can be recommended for use [i.e. it is known to serve as an appropriate/effective soil] within giant otter enclosures is Non-Ferric Red Latosol and it is found in Brazil, although most of the soil types found to exist in nature in South America are likely appropriate for use. See Part B below. Obviously, many institutions do not have access to these particular soil types.) **The following has to be considered: will the soil become, after continual use, too tightly packed/compacted for otters to effectively, comfortably, and easily use for all grooming and digging activities**. **Soil, with/without vegetation/turf, must remain loose enough that when otters rub, roll, scratch, and dig on/into its surface to groom themselves**, **the soil particles move freely about and the otters can cover their body/fur with the freed soil particles.** Whether the animals are grooming or not, substrates must also allow digging to be easily carried out throughout nearly the entire enclosure land area. (These activities are described in Section 3 below.) **When soil hillsides are provided for the necessary deep digging areas, otters must also be able to dig at least 40 cm to 60 cm (16" to 24") in depth in these areas.** (Even when hills are provided for deep digging, the hillsides cannot be effectively used when the soil is inadequate.) **It also has to be considered if the soil can still**

dry easily, drain well, and be resistant to eroding easily **after otters dig large areas of vegetation/turf away, regularly groom and dig into the soil throughout the entire enclosure, and regularly carry/track water onto the land. Soil, with/without vegetation or hills, needs to be able to retain all of the necessary qualities even after these uses** (see Section 3 below for why).

Any substrate, with/without vegetation/turf, that does not possess or cannot retain all of the aforementioned necessary qualities is an inappropriate substrate to offer for direct use. When inappropriate substrates exist within any indoor or outdoor giant otter enclosure, whether the enclosure is already in use or not, it is crucial that the appropriate soft sand, mulch, or soft loose soil types, depths, and qualities be furnished as recommended to provide the necessary surfaces (see below). These methods are also essential when the quality and effectiveness of any substrate to function as it should is questionable (esp. in the case of soil). Otters either will not or cannot use or cannot use without difficulty, inefficiency, lack of comfort, and/or harm to their health and/or normality, inappropriate substrates or insufficient deep digging area sizes to dig, groom, play, exercise, or simply live on. See Parts A-B and below for the mulch, sand, and soil depths that are needed to cover over inappropriate surfaces. Also described are the mulch bark piece sizes that are too large for otters to use and the recommended size for use, as well as the specific mulch type and sand qualities needed. The required soil qualities are discussed above. Note: soil should only be used on natural outdoor land areas; see why below.

When land and water area designs and locations that are necessary to prevent the land from becoming very damp/wet are not provided as recommended (esp. enclosure land to water ratios that offer smaller land area proportions than recommended) **land and floors should be covered with the appropriate sand and/or mulch types, rather than soil.** This is because sand and mulch drain and dry more easily than soils. Although **it is also necessary, whether the enclosure is already in use or not, that the inappropriate land and water area designs and locations be corrected so that at least the minimum recommended requirements for these are fulfilled.** This is essential to prevent health problems.

All hard or artificial floor and land surfaces (i.e. concrete, tile, rockwork, gunnite, wood etc.) **other than pebbles, gravel, and small rocks, must be nearly entirely covered over with mulch and/or soft sand as recommended in** Parts A-B below. Soil should not be used to cover over these surfaces. [Soil will not be able to drain properly or dry easily if it is used to cover over (i.e. if it is placed on top of) hard or artificial surfaces such as concrete etc..] Areas of **pebbles, gravel, and small rocks must be** removed or covered over differently (see below).

Soil, sand, or mulch mixed with pebbles, gravel or small rocks (smooth, rounded, or otherwise) throughout, construction or abrasive sand and any substrates that contain these mixed throughout, and areas of pebbles, gravel, and small rocks must not be used within any enclosure. **If areas of these substrates are already within enclosures they should be totally removed.** After these unsuitable substrates are removed, then it is necessary to cover over nearly the entire base surface area with mulch, sand, and/or soil as recommended in Parts A-B. (Mulch generally does not contain pebbles or small rocks and soil usually does not contain many larger rocks throughout, although if they or any other substrate does, they should be removed as well.) Giant otters can easily dig 100 cm (3.28 ft) deep and this behavior is carried out frequently. They may dig into inappropriate substrates if no other better digging area exists, but digging and other activities carried out on these surfaces, will harm the otters. Removing the inappropriate substrates will also prevent otters from digging them up and

mixing them in with appropriate furnishings after they are added. **In the rare case that these furnishings cannot be removed, then they must be completely covered over with mulch and/or soft sand that is at least 60 cm** (24") **in depth. Deeper depths, i.e. at least 100 cm** (3.28 ft)**, are highly advisable although. A depth of at least 100 cm is needed when land or floor areas with the aforementioned unsuitable substrates are intended to serve as the deep digging areas.** When the outdoor enclosure has natural land under those non-removable substrates, appropriate soft loose soil can also be used as recommended to cover over the unsuitable surfaces. Very deep soil depths are necessary in all outdoor enclosure locations.

When a soil does not have pebbles, gravel, small rocks, construction sand, or abrasive sand mixed throughout it and it does not possess or cannot retain all of the aforementioned necessary qualities (see above) **and this soil already exists within an enclosure, it is essential** that the following be carried out to provide appropriate surfaces. This is regardless of whether or not the soil is covered with vegetation/turf or it contains hills. **It is necessary that nearly the entire enclosure land area be covered over with soft sand, mulch or/and soil as recommended in** Parts A-B below. (If the enclosure is expansive in size, i.e. 600 m^2 [6,458 ft^2] or over, a significant portion should be covered over as just described.) Any remaining land area can be left with the original soil.

Coarse, abrasive, sharp, or rough solid fixed surfaces that can not be removed should be smoothed down if possible before appropriate substrates are added or before otters are introduced to the enclosure. This includes the land and floor area, all pool surfaces, and all enclosure walls/containment barriers that are within the otter's reach (i.e. when they are standing on their hind legs, logs, nestboxes etc.). For example, walls made of rough artificial rockwork within the otters' reach may cause health problems, as otters can rub / lie against or dig on the wall. (Sometimes giant otters will make strong digging motions on walls with their front feet and they often stand on their hind feet during this activity.) See under Section 18 for when containment barriers and land/floor areas adjacent to them can be excessively dug on/into.

Part A. **Contains the following two categories:**
Land and Floor Substrates Necessary For Each Enclosure
Deep Digging Area Necessary For Each Enclosure

The provision of the recommended enclosure land and floor substrates and deep digging area for each enclosure are among the most crucial requirements necessary for the husbandry of giant otters. (See Section 3 below for why these provisions are required.) **The qualities that the recommended substrates and all substrates need are listed in the introduction above**; they are only briefly discussed below. **The substrates that otters must not be directly exposed to or must only be minimally exposed to are described in the introduction above. How to easily modify inappropriate substrates, in both indoor and outdoor enclosures, so they provide appropriate surfaces are discussed both above and below**. It is important that the introduction above is reviewed before the following parts are read.

Land and Floor Substrates Necessary For Each Enclosure
(See deep digging area needed for each enclosure in the next category below.)

Note: **an "enclosure**" **refers to any area an otter is held or has access to**; e.g. this includes off-exhibit areas **such as dens**, temporary holding and **quarantine areas** etc.. "Land**"** refers to all indoor and outdoor base surfaces, whether man-made or natural ground.

It is necessary that every indoor and outdoor enclosure land and floor surface is nearly entirely covered with soft non-abrasive sand or mulch (i.e. tree bark pieces only), **at least 10 cm to 20 cm** (4" to 8") **in depth, or when applicable, deep soft loose soil with the recommended qualities** (see above)**.** (Soil should not be used to cover over hard or artificial surfaces.) **Mulch and soft sand covering land and floors should although be at least 40 cm to 60 cm** (16" to 24") **in depth**. The **soil, sand, and mulch provided must not have pebbles, gravel, or small rocks (smooth, rounded, or otherwise), construction sand, or abrasive sand mixed throughout them**; **additionally if areas of any of these aforementioned individual or combined substrates** (e.g. an area of small rocks alone or mixed with sand) **already exist within the enclosure they should be totally removed** from the enclosure **before** the recommended substrates are added. (See the introduction above for other options.) **After continual use, soil with/without vegetation must remain** loose enough that otters can easily dig into it and effectively groom on it throughout nearly the entire enclosure land area. (Grooming includes digging into and scratching on/up substrates and vegetation to loosen the soil, sand, or mulch particles to cover the body). The soil must also remain easily drying and well draining after regular exposure to water, large areas of vegetation/turf have been cleared away, and the otters have regularly dug and groomed throughout their entire enclosure land area. In addition, soil should not erode easily. **Mulch, made from** pieces of bark from trees, **is the only mulch type** that should be used. **Using mulch with bark pieces** approx. 10 cm long x 4 cm wide (4" long x 1.5" wide) in size, rather than smaller sizes, is highly recommended (see below). Bark pieces with a significantly larger average size are too large for otters to use. Ten cm to 20 cm mulch and sand depths are only minimal; shallower substrate depths can remain wet/very damp and/or otters cannot effectively or will not use them, esp. for grooming and digging. **When the existing mulch breaks and packs down**, new mulch must be added on top of the existing layer, otherwise the same problems will occur. Additionally, **when substrate depths fall below minimum**, new substrates must be added on top of the existing layer. These procedures are usually necessary (depending on area size) only one or two times per year. **Mulch kept in very dry areas should** be lightly misted on its surface with water from a hose for several seconds once daily to help prevent over-drying, dusting, and breakage. See Part B below. Soil should be very deep to allow proper drainage. Substrates should be as deep as possible in the areas near the water's edge. **The deeper the substrate depth, the more advantages gained.** E.g. with depths of at least 40 cm to 60 cm, the necessary deep digging areas, that should cover nearly the entire or the majority of the land and floor surface area in every indoor and outdoor enclosure, can be provided. If soil alone is offered, hillsides must also be provided for deep digging areas. (See below for deep digging areas needed for all enclosures). **Providing a variety of the aforementioned necessary furnishing types,** kept adjacent to each other and not mixed, **is highly recommended.**

It is essential that any enclosure, whether it is already in use or not, that does not provide at least the recommended minimum requirements within Section 2 be modified so that it does. I.e. this applies to any enclosure, whether it is already constructed and giant otters are being kept in it or the enclosure is being designed or modified to hold *P. brasiliensis* in the future. (See the introduction above for modification methods.) **It is necessary that nearly the entire base surface area that otters are directly exposed to in every enclosure is soft, well-draining, easily drying, and loose enough in texture so that otters can effectively groom on** (which includes digging and scratching on/into substrate) **and very importantly, easily dig into it.** The recommended mulch, sand, or soil types, qualities and depths are needed to make the modifications. **Mulch and soft sand are ideal for both indoor and outdoor use to cover over hard, artificial, tightly packed/compacted (e.g. soil** with/without vegetation)**, poor draining, slow drying, easily eroding, and natural land surfaces** and enclosures with inappropriate land

and water area designs and locations. See the introduction above. (Soil should only be used on natural outdoor land areas as it will not drain properly or dry easily when it is used to cover over hard or artificial surfaces.) Even **after continual use**, **soil** (as all substrates), with/without vegetation, **needs to retain all of the aforementioned necessary qualities. When it can not,** it is essential that **sand, mulch,** or soil with the necessary qualities **be used as recommended to cover over the inappropriate areas**.

Providing turf/vegetation on natural outdoor land areas with soft loose soil will help maintain land dryness and prevent soil erosion, although the **otters must not be prevented from carrying out the aforementioned activities** (clearing away vegetation/turf, digging etc.). These are very important strong natural behaviors that otters must be allowed to perform to the full extent throughout nearly their entire enclosure land area. (See Section 3 below for why.) When the recommended soil type, quality, and depth and land and water area designs and locations are provided, problems should not occur with the land area remaining dry enough or eroding when the animals fully use the land. Trees, large bushes, or large tree stumps with long extended roots may help prevent soil erosion, so these are highly recommended. (See Sections 4 & 6 below for these and other land area furnishings.)

Note: giant otters in zoos seem to particularly favor soft sand when it has the qualities and depths recommended **and hillsides made of the specific soft loose soil types that possess the necessary qualities and that are used in some South American institutions**, above all other natural substrates to groom and dig in/on (most especially) and carry out other terrestrial activities on. (See part B below for the specific soil type.) The type, quality and depth of mulch recommended although, is also well liked and well-used and it has excellent qualities to keep the otters and their indoor and outdoor enclosures dry and clean (as does sand). When necessary, mulch can be similarly used in the same way as sand for an effective and suitable alternative furnishing. Note: some vegetation types will grow freely in deep mulch and sand.

Nestboxes[1] must remain dry and they should have bedding materials within them. Mulch and soft sand are highly recommended for use within nestboxes, esp. during cub-rearing when these areas need to be isolated from human disturbances. These substrates should be at least 10 cm to 20 cm (4" to 8") in depth within the nestboxes (dens etc.). The recommended mulch and sand types and qualities mentioned above are needed. A deep layer of straw, leaves, or wood wool can also be used. (Woodwool is also called excelsior and it is a material used for packing fragile items.) Otters esp. like woodwool or leaves as a bedding and play material for their nestbox, but sand and mulch is also well liked. **Caution: before parturition, nestbox bedding materials such as straw, hay, or leaves should be replaced with mulch or sand. Wood wool should be totally removed during cub-rearing for safety to the cubs.** (Woodwool should also be kept away from feeding areas so that fish does not become entangled/coated with the woodwool and ingested.) It is natural for giant otters to dig, groom, and play in the soft loose substrates within their nestbox, although they may in the process dig some or a lot of these materials out of it. This does not mean they do not want these materials in their sleeping area with them. Instead, it is just a result of their naturally strong digging and grooming behavior which they will perform throughout their entire enclosure area. (See Part B below for more information on substrates for nestboxes.) [1] *"**Nestbox**" refers to areas that are only large enough for the otters (including cubs) to sleep. Nestboxes are man-made (i.e. constructed with wood, concrete, artificial rockwork etc.) and they are either placed above or beneath the ground/floor.*

Deep Digging Area Necessary For Each Enclosure

In addition to the necessary land and floor substrates aforementioned, each indoor enclosure (see exceptions below) **and each outdoor enclosure must have at least a 40 m^2** (430.56 ft^2) **area or significantly larger area, where soft non-abrasive sand or mulch, a minimum of 40 cm to 60 cm** (16" to 24") **in depth, or hillsides, with the recommended designs and soil qualities**, **allow for deep digging**. **The same substrate qualities, types and husbandry techniques needed** *for enclosure land and floors are also necessary for the deep digging areas (see above and below).* **E.g.** ***soil, sand, and mulch must not have pebbles, gravel, or small rocks (smooth, rounded, or otherwise), or construction or abrasive sand mixed throughout them.*** *Soil requires additional specific qualities.* When an indoor enclosure 75 m^2 (807.3 ft^2) or below in size attaches to an outdoor enclosure that provides at least a 40 m^2 deep digging area and otters have access to both enclosures, the indoor enclosure requires at least a 20 m^2 (215.28 ft^2) area where soft sand or mulch, a minimum of 40 cm to 60 cm (16" to 24") in depth, allows for deep digging. **When soil is not used within enclosures, the mulch and/or sand deep digging areas should instead cover the majority of the land and floor surface area or nearly the entire land and floor surface area in every indoor and outdoor enclosure and they should be as deep as possible. They should have at least 100 cm** (3.28 ft) **mulch and sand depths** (see below). When enclosure terrain is fairly flat and soft loose soil (with/without turf or vegetation) is provided, otters will not be able to dig deeply, therefore **plentiful hillsides, rather than the minimum size** area above, **should be provided. They should border nearly the entire length of the enclosure land area contour line**. **The hillsides provided should be at least 1.8 to 2 m** (5.9 ft to 6.56 ft) **high and have an angle of 40-45°. They must be made of a soft soil type that remains, after continual use, loose enough that otters can easily dig deeply into it**, as well as, effectively groom on it. Otters **must be able to dig at least 40 cm to 60 cm** (16" to 24") **in depth in these areas.** The hills should not be steeper or much less steep than a 40-45° angle and it is recommended that they be located behind and near the water area shoreline (see Section 5 below). For multiple reasons, **it is highly recommended to provide soft sand, at least the minimum size area and depth recommended, for deep digging, in addition to the mulch or hillsides offered for these purposes** (see above). **It is necessary that any enclosure, whether it is already in use or not, that does not provide at least the minimum recommended deep digging area size, depth and substrate qualities and types, be modified so that it does.** (See the introduction above for modification methods.)

The recommended minimum size and depth for the deep digging area is not optimal, only minimal. E.g. captive *Pteronura* can easily dig 100 cm (3.28 ft) deep into soft sand and mulch throughout the entire expanse of their enclosures (e.g. within enclosures well above minimum size). They as well can dig many deep underground dens throughout extensive hillsides (e.g. a 500 m^2 [5,382 ft^2] area composed of hills) that have the recommended designs and substrate furnishings. **Substrate depths should be as deep as possible and deep digging areas as large as possible.** It is important although that plentiful level land area is offered when hills are provided. (E.g. level land can be located at the top of the hills, along the water's edge, or/and elsewhere within outdoor enclosures and some areas can also be furnished with deep soft sand). When otters dig significant size areas of mulch and sand to the maximum depth possible, i.e. when significant size holes are created, these holes should be filled in again, with the substrates dug away, so they can be re-dug. (Underground dens that are dug into soil should not be filled in so they can be used for sleeping and keeping cubs in etc..) It is **highly recommended to additionally give a deep pile of leaves** (esp. where the leaves can remain dry) **for variety (i.e. not as substitute for the required deep digging areas or substrates).** Giant otters also particularly enjoy digging, playing, rolling, and grooming in this. Leaves that have fallen from deciduous trees are ideal. Leaves from coniferous trees or that have thorns, thistles, poisonous

fruits, or that have been sprayed with pesticides or other dangerous chemicals should not be used to make leaf piles. They should not be infested with ticks or other insects or have harmful (i.e. artificial) debris. Leaves can be collected and stored in large bins so that they are available all year around. (Containers holding leaves should be covered if they are placed outdoors.)

Hills/banks with the designs as aforementioned and specific soil types can enable captive giant otters to dig underground dens to sleep and keep their cubs in. This provision **is therefore highly recommended as underground dens are very important for aiding successful cub-rearing.** Among the other necessary recommended qualities, soil used for these purposes also needs the capability to support many and deep underground dens so that den cave-ins can be avoided or at least reduced to a minimum. At this time, Non-ferric Red Latosol is the only soil type known that can be recommended for these purposes. See Part B below for specific soil types, the introduction above for necessary soil qualities, and Section 12 for more information on hill/bank designs and underground dens. Sections 1 and 5 describe the land and water area locations and designs (esp. land to water ratios) and locations for the hills/banks for natural underground dens that are needed (in addition to appropriate substrates) to keep the underground dens and other land areas dry. Section 10B describes the hill/bank locations needed to isolate underground dens from human disturbances during cub-rearing.

Trees, large bushes, or large tree stumps with long extended roots may help prevent natural underground den cave-ins and bank, hill, and soil erosion, so these are highly recommended. The discussion about vegetation/turf helping to prevent soil erosion can be found above under "Land and Floor Substrates Necessary For Each Enclosure".

Part B. Substrate Types and Husbandry Techniques

Inappropriate substrate types, qualities, depths, or husbandry techniques can cause health problems, substrates may fail to function effectively, or/and the otters will not be able to properly use the substrate. Note: inappropriate land and water area designs and locations (esp. land to water ratios that do not provide enough land) and unsuitable locations for nestboxes, dens, and areas for underground dens can cause substrates to remain wet/very damp or worsen these conditions (see Section 5).

Part B is divided into the following categories:
<u>Mulch and Sand Types and Husbandry Techniques</u>
<u>Specific Soil Types and Husbandry Techniques</u>
<u>Cleaning Procedures for Substrates and Maintaining Nestbox Bedding</u>

<u>Mulch and Sand Types and Husbandry Techniques</u>
Different mulch types (e.g. wood chips, bark pieces etc.) are used for horticultural purposes, e.g. as ground cover in gardens etc.. The only type of mulch that should be used in giant otter enclosures is that made from pieces of bark from trees. Other types are not appropriate/effective for use or/and they could harm the animals. The recommended mulch substrate can be acquired from stores/industries that provide products for horticulture. **Mulch pieces,** i.e. bark pieces, **approx. 10 cm** (4") **in length x 4 cm** (1.5") **wide do not break up or pack down as easily** as bark pieces with smaller dimensions. **This mulch size therefore stays drier and last a longer time than smaller sizes. Bark pieces with an average size significantly larger than that aforementioned should not be used,** as they are too large for otters to comfortably dig, groom,

play, exercise etc. on. Note: when a container of mulch is just acquired many bark pieces will often be significantly larger than 4 cm x 10 cm in size, although these individual pieces will break down more quickly than the smaller size pieces and they therefore should not cause a problem. **Mulch bark pieces 10cm x 4cm in size are therefore most highly recommended over smaller or larger size mulch.** Sand used in children's sand play boxes or other soft sands should be provided. Abrasive or sharp sand (e.g. builder's sand that is used for construction) and sand or mulch with any kind of pebbles, gravel, small rocks or larger rocks throughout must not be used.

If minimum substrate depths and substrate quality (esp. quality of mulch) are not maintained inefficiencies/problems can develop. Water naturally drains through mulch and soft sand esp. well. These land furnishings therefore, used in both indoor and outdoor enclosures and over most all surface types (see the introduction above) dry easily and quickly if they are maintained properly. **Substrate depths shallower than 10 cm to 20 cm** (4" to 8") **will not dry as easily or quickly, they can remain wet/very damp, otters cannot effectively/will not use them esp. for grooming and digging, and health problems can develop. When mulch breaks and packs down,** i.e. bark pieces have broken into small pieces and they pack tightly together, **the same problems will occur.** (See Section 3 below for the health problems that can develop.) Giant otters cannot effectively/will not use very damp or wet substrates, shallow substrates (as described), or broken down mulch to groom and dig in.

In the aforementioned cases, new furnishings simply need to be added to restore the substrates efficacy and quality and to provide appropriate depths. **In both indoor and outdoor enclosures mulch and sand last long periods of time** (i.e. many months to a year depending on the size of the area) **before new substrate needs to be added on top of the existing layer.** Leaving the existing substrates will help increase substrate depths. Unless the existing substrates are in a very small well-used area, they do not need to be removed, only added to. Mulch might need to be removed and then replaced (with totally new mulch) in very small well-used areas, i.e. such as small dens around 3 m² - 4 m^2 (32.29 ft² - 43.05 ft^2), one or two times per year. When necessary although, such as during cub-rearing, it can remain unserviced for longer periods. Such areas although may only just need to be added to. Mulch can pack and/or break down more quickly in very small well-used areas. Small well-used areas or areas adjacent to water, may require depths deeper than the 10 cm (4") to 20 cm (8") minimum recommended. The deeper the mulch or sand, the drier it will remain. Substrate depths and quality must be monitored.

Mulch kept in very dry areas, e.g. indoors, should be lightly misted on its surface with water from a hose (except for during cub-rearing). Misting only needs to be carried out for several seconds once daily. This will help keep mulch from becoming overly-dry and breaking up and dusting. The mulch should only be misted long enough so that it becomes slightly damp, not wet, which is counter-productive. Mulch that does not become too dry, does not need to be misted.

<u>Specific Soil Types and Husbandry Techniques</u>

Unfortunately, because few studies exist, recommendations for specific (i.e. by scientific classification) soil types that would be appropriate/effective or optimal for use in giant otter enclosures are limited at this time. (The introduction above describes the qualities that soil must possess and the qualities that are inappropriate/harmful.) At present, the only soil type that can be recommended for use is Non-Ferric Red Latosol and it is found in Brazil, although most of the soils found in nature in South America are likely appropriate for use. Non-ferric Red Latosol dries easily, is well-draining, soft, and loose in texture, and it does not erode easily.

It does not contain small rocks, gravel, or pebbles throughout. Otters can effectively groom and easily dig on/into the surface of this soil throughout their enclosures and they can dig deep into hillsides made of this furnishing. It can retain these qualities, with/without vegetation, and function very effectively within a giant otter enclosure for many years with only some natural erosion of the hillsides over the years. At least one zoo (*Brasilia Zoo*) is known to have successfully used this soil for many years (see the paragraph below). These qualities therefore are those that a soil should possess to be considered an appropriate/effective soil type for *Pteronura* enclosures. This soil type can also support many underground dens that are naturally dug by giant otters and giant otters can successfully rear their cubs in the dens. (See Chapter 2 Section 12 and below.) This substrate type is also therefore an optimal soil type for giant otter enclosures. Because the successful soil types used in some of the South American zoos are obviously not available for use in every enclosure, research should be conducted to identify appropriate and optimal soil types that can be provided in enclosures world-wide. (The functional soil types now used should be identified by scientific classification so their properties can be more closely studied and compared with other soils and so they can be recommended for use.) Soil types recommended should offer the same/similar qualities as those successful soils. Mixing soft sand with soft soil may help loosen a soil's texture, although this technique has not been tried and it is unknown at this time if it would be appropriate for use.

Non-ferric Red Latosol forms the approx. 2 m (6.56 ft) high (and higher) 40-45^{o} angle extensive hillsides and land area within *Brasilia Zoo's* expansive giant otter enclosures. Over the many years the hillsides at this institution are slowly reducing in size and degree of angle because of natural erosion and continual digging. The otters although, are still able to effectively use the hillsides for daily terrestrial activities, underground den building, and cub-rearing. This soil remains loose in texture, even though it is exposed to full sun and hot Brazilian temperatures. When it is completely dry it easily breaks apart into tiny grains/particles that either are sand like-in appearance or are actually sand particles, as the soil contains sand. This quality seems to make it a very successful substrate for otters to groom and dig on/into the surface and dig deep into. This is also probably the quality that makes the soil drain well. This soil type can have an approximately 53% clay content. The clay content may help prevent underground dens from caving in. (A soil must not have so much clay that water can not drain easily.)

"Latosol: *A soil class in the Brazilian Soil Classification System. Latosols are very deep, very well drained, homogeneous and highly weathered and leached soils. They tend to have medium to very high clay contents... These soils are similar to non-aquic Oxisols in soil taxonomy... Non-ferric Red Latosols are abundant all over the Cerrado [this area includes Brasilia]. Non-ferric Red Latosols are quite variable in texture, which ranges from medium to very clayey. [They can have a] 53% clay content....* ***Texture: [means]*** *The proportion of sand, silt, and clay in a soil. Very clayey soils have more than 60% clay. Clayey soils have between 35 and 60% clay. Silty soils have more than 65% silt and sandy soils more than 70 or 85% sand. Medium textured soils have approximately equal amounts of sand, silt and clay."*
(http://www.dcs.ufla.br/cerrado/cerrado2.htm internet site 2003).

Giant otters found in the wild near *Brasilia Zoo* likely use/used this soil type (Latosol) for den building as well. In the wild giant otters will use a variety of soil types to dig their underground dens within. They will use soil that has a significant clay content as well as sandy soils and other types. For example, "While sandy soils cave in more often they are still used and the dens [den] is repaired until it is abandoned." (Duplaix 1980).

Cleaning Procedures for Substrates and Maintaining Nestbox Bedding

The aforementioned recommended substrates are easy and inexpensive to maintain and they remain sanitary with daily dry spot cleaning (i.e. removing) of feces, urine soaked substrates, debris, left-over fish/fish pieces, and contaminated substrates. Enclosures will remain more sanitary, drier, and cleaner for longer time periods with these furnishings, as opposed to without them. This is esp. important when enclosure cleaning must be eliminated/minimized to offer parents privacy from human disturbances during cub-rearing (see Section 10B). This type of cleaning is also beneficial to perform during cub-rearing because it can be accomplished simply, quietly, and quickly. Giant otters normally only defecate and urinate, which they usually do simultaneously, in one small place in each separate enclosure and that place is used exclusively. E.g. one small area in the indoor enclosure and one small area in the connecting outdoor enclosure will be used. They do not eliminate in nestboxes or underground dens. Note: any areas with hard surfaces (e.g. tile, artificial rockwork, concrete etc.) should be cleaned, i.e. hosed and scrubbed etc., daily when they are soiled with feces-urine and fish remains. (This cleaning type also has to be minimized/eliminated during cub-rearing). All hard areas need to be dried thoroughly after cleaning. To help maintain dryness and the otters' scent nestboxes, enclosure furniture with hard surfaces, toys etc. should only be cleaned when they are soiled with grease, feces, or fish etc.

Fish should be fed in amounts that otters can finish so that excess uneaten fish is not left in enclosures during the day and overnight. Uneaten fish can attract rats and rats could transmit leptospirosis to the otters. A couple giant otters have contracted leptospirosis and this is suspected to have occurred because large amounts of uneaten fish were left daily in enclosures overnight/during the day. When fish remains exist, they should be removed from all water and land areas daily. Otters will eat fish in pools or take their fish into the water, as well as eat fish on land. Caution must be taken, as illness may also occur if otters (esp. cubs) eat spoiled fish remains or are exposed to harmful bacteria ridden swim water (other than exposure to leptospirosis, neither of these events have been reported to occur). Also, if a significant amount of left-over uneaten fish that has been sitting in the enclosure for a while, is regularly consumed, vitamin deficiencies may occur. Note: it is not uncommon that otters will pick up small pieces of left over fish within their pools and land area and eat them; this although has not been reported to cause problems. It is nearly impossible, even with filtration systems, to remove all small fish pieces from the water.

Mulch, soft sand, or any bedding substrate placed within a nestbox needs to be replaced with a fresh supply when it becomes very damp or wet. **With the following conditions mulch and sand within nestboxes (and dens) will remain dry enough that they do not have to be changed or added to often (e.g. for many months or longer) and natural underground dens will remain dry.** These conditions include providing the recommended enclosure land and water area locations and designs (esp. land to water ratios) and land and floor substrate types, qualities, and depths, as well as locating nestboxes, dens, and hills for natural underground dens the recommended distance away from the water's edge. (See above and Sections 1 & 5). Without any or all of the aforementioned provisions nestboxes and any bedding substrates, as well as dens and other land areas, can remain very damp/wet. As well, natural underground dens may not stay dry enough. [Several health problems can occur in these conditions. E.g. cub sickness and/or death can occur when cubs are reared in very damp/wet nestboxes (or land/floor areas).] Mulch and soft sand should also be at least 10 cm to 20 cm (4" to 8") in depth within nestboxes (dens etc.). Shallower depths can become/remain wet or very damp. Mulch and sand should be added to, when nestbox (den etc.) substrate depths become insufficient or mulch breaks into small pieces and packs down. (Nestboxes should be designed, i.e. with lips on

nestbox entrances etc., so that substrates can not be easily dug/pushed out of them. When the recommended mulch size etc. is offered, mulch will last for many months or longer, before it breaks down.) *When straw, hay, woodwool or leaves are provided within nestboxes, they must be changed often, usually daily, because they will stay dry for much shorter periods than mulch or sand.* Unsoiled woodwool can be dried in the sun and reused, but this normally needs to be done every day or two days, depending on the amount given. Woodwool dries quickly after it is placed in the full sun for only a few hours and can be re-used for as long as e.g. two to seven days. *Caution: before parturition, nestbox bedding materials such as straw, hay, and leaves should be replaced with mulch or sand. This is to maintain nestbox dryness without human intervention. Also, wood wool should be totally removed* during cub-rearing for safety to the cubs. E.g. cubs may get entangled in the woodwool. Mulch and soft sand are therefore highly recommended for use within nestboxes, esp. during cub-rearing when the nestboxes need to be isolated from human disturbances.

Natural underground dens do not have to be serviced or maintained by keepers because with the appropriate enclosure conditions aforementioned, these dens will keep clean, dry, and sanitary. No bedding materials need to be offered within them because the substrates alone serve the same purpose. (Wild giant otters do not bring bedding materials into their underground dens and it is not necessary for them to do so for similar reasons.)

Part C. Designs To Help Prevent Land and Floor Substrates from Entering Water Areas and Blocking Pool Drains/Filters and Keeper and Animal Shift Doors/Gates

Pool drains, filters, skimmers, water filtration/cleaning systems, waterfalls, underwater viewing areas, swim tanks/tubs, and **all water areas must be able to accommodate the soft loose natural substrates that may be tracked,** pushed, dug etc. **into the water** from land and floor areas. The simple designs and furnishings described below can help prevent substrates from entering water areas and blocking drains or causing other problems. **Although, even with these methods, some substrates will enter the water.** *Because it is necessary that every indoor and outdoor enclosure land and floor surface is nearly entirely covered with soft loose natural substrates as recommended*, **enclosure water areas etc. should be designed or modified with these considerations in mind**. These methods will also help prevent leaves, sticks, bark, etc. that have fallen from trees, fish remains, natural furnishings other than substrates, and toys from blocking pool drains or causing other problems.

Raised borders/edges that are positioned somewhat behind the water's edge (e.g. 10 cm – 15 cm [4" - 6"] behind the water's edge) **can be created to help prevent substrates from being tracked etc. into the water area** while still allowing otters easy and safe pool exits and entrances. **These borders can be easily constructed by lining up or connecting logs that are small in diameter.** The logs must be high enough (i.e. large enough in diameter) to contain substrates behind them, yet not be too high to create difficult pool exits or entrances. (E.g. flexible metal brackets, with smooth non-sharp edges, can be screwed into the bottom facing side of the logs to connect them. The bottom facing side of the logs can also be cut so they lie flat, but this is usually not necessary. This would be helpful although when the log does not lie flat enough against the base surface. The more straight the log that can be found for use, the better.) Large rocks with relatively flat tops and bottoms or wood posts/timbers etc. could also be used in a similar way for the same purpose. During enclosure construction a concrete border / raised floor surface, e.g. raised approx. 10 cm [4"] from the floor/ground and extended 10 cm

[4”] in width, could be placed 10 to 15 cm (4” to 6”) behind the edge of the pool side for the same purpose. It should have a softly rounded edge for safety. This technique has not yet been reported to be used for giant otters. **All borders/edges used must still allow otters, esp. cubs, parents carrying cubs, and old animals, easy and safe pool exits and entrances**. I.e. these surfaces should not be raised too high above the land and floor surface, be placed directly against pool edges, or be slippery etc.. **Drain outlets, filters, and skimmers can also be covered or designed to help prevent furnishings from blocking them.** E.g. drains can be covered with simple fence covers or fitted with pipe extensions or a capped pipe that allows water through (drilled) holes or just underneath a small gap created between the pipe and pool floor. Although **these systems have been very effective** to help prevent pool water drainage / filtration problems, some substrates do end up in the water with these methods.

Keeper access doors/gates to enclosures and animal shift doors/gates should be designed so that substrates (or even toys etc.) **will not block the door or gates' path/movement/tracks**. The animal shift and keeper door/gate **frames should be positioned (raised) somewhat above, e.g. approx. 10 cm** [4”]**, the surface height of the intended substrates to help prevent this from occurring**. If the keeper doors or shift gates are not already designed (e.g. raised) to help prevent substrates from blocking them, **simple modifications can be made for the same purpose**. **Log borders can be placed** near the front/back of keeper or shift doors/gates to keep substrates behind and away from the doors or gates. If necessary, only a small area, just wide enough for the passage of the door, should be left without the recommended substrates, although other designs/modifications could be made to avoid this. Logs, that extend just beyond the width of the shift door/gate frame and that raise about 10cm above the tracks, can be placed directly against the shift frame. **Shift doors can also be simply modified, if already constructed**, **with a**n approx. 10 cm (4”) **wooden lip** that is made to fit immediately in the front and back of the door/gate track to serve the same purpose.

A small border/edge (e.g. made of wood/plywood boards) **can be placed/fixed along the outside bottom edge of containment barriers that are not solid** (i.e. fence, lattice etc.) **to prevent loose floor and land substrates from pushing through containment barriers or to prevent cubs from crawling between barrier mesh.**

It is ideal to keep mulch and sand land and floor substrates adjacent to each other, **but not mixed** together. Simple borders can be made from logs (e.g. see above), large rocks, boulders, etc. to help keep the substrates separated. Mulch and sand can also be kept separate from soil with this method as well.

Section 3
Why The Recommended Soft Loose Natural Substrates, Land to Water Ratios (i.e. minimum size land/floor area) & Deep Digging Areas Are Necessary in Every Enclosure

Introduction

When land to water ratios offer smaller land proportions than recommended or substrates or deep digging areas are not provided as recommended, giant otters are susceptible to developing specific health problems or/and abnormalities. Some of these problems are not uncommon among captive giant otters and some are very serious or have the potential to become very serious. Also originally, **some were mistaken to be an exhibition of healthy physical condition or normal healthy behavior.** It was although, after long-term studies, recently discovered that they are actually an exhibition of unhealthiness or abnormality for captive *Pteronura*, rather than the opposite. **The ability of giant otters to successfully rear cubs and adjust to new/unusual situations has also been adversely affected or seriously compromised without the aforementioned provisions. Other inappropriate land and water area locations and designs and unsuitable locations for nestboxes, dens and areas for natural underground dens can also cause or worsen health problems.**

When cubs are reared to independence, unfamiliar and temporarily separated animals are introduced and then housed together, or otters are maintained to an old age in inappropriate enclosure conditions or/and with inappropriate husbandry practices, this does not validate that the enclosure conditions and/or husbandry practices used were appropriate. (I.e. this does not mean that these circumstances are appropriate because such outcomes have occurred.) **It is essential that inappropriate enclosure conditions and husbandry practices are not repeated or used at any other institution based on the conclusions that such outcomes have occurred.**

Observations of giant otters held in partially, or even totally, inappropriate enclosure conditions as described or of otters that have not recovered to full health because they have been exposed to appropriate enclosure conditions for only part of their life, have often led to misleading conclusions. When the animals observed have mistakenly been perceived to exhibit physical or behavioral health and normality, this has led to the assumption that the enclosure designs and furnishings that these otters are or have been provided with are/were appropriate. This in turn has led to misleading conclusions about how giant otter exhibits should be designed and furnished. Additionally, **in the past, river otters were thought to be aquatic mammals and unfortunately exhibits were designed with this misconception in mind** (Duplaix 1972 citing Hediger 1970)**.** Inappropriate enclosure conditions*, esp. improper land to water ratios that resulted in not enough land area or/and improper substrates,* were often the reason that health problems occurred. Contemporary giant otter health problems and inappropriate enclosure designs and furnishings seem to reflect that this misconception, as well as the others aforementioned, are still not uncommon. Otters cannot use, without inefficiency, difficulty, lack of comfort, and/or harm to their physical and/or behavioral health or normality, inappropriate substrate types, depths, or qualities, or insufficient land or digging areas to dig, groom, exercise, play, or to simply live on. For some of these activities, they will or cannot use them at all. Otters as well, will not be able to carry out grooming, digging, exercising, or playing on land to the full extent that is necessary, not only to maintain their behavioral health and normality, but also to promote successful cub-rearing and adjustment to new/unusual situations.

The aforementioned problems are caused when indoor and/or outdoor enclosure land to water ratios offer smaller land proportions than recommended or/and land/floor surfaces are not nearly entirely covered with soft loose natural substrates (including appropriate depths, types, and qualities) or provided with sufficient size deep digging areas as recommended. (Each enclosure below 240 m² (2,583.4 ft²) in size, requires a different land to water area ratio based on its specific size. Enclosures between 240 m² to 600 m² (6,458 ft²) require other land to water ratios, as do enclosures above 600 m².) Continual direct exposure to more than a small area/proportion of enclosure land/floor substrates that are hard, tightly packed/compacted (i.e. they are not loose enough for otters to easily dig into), artificial, continually wet or very damp (see below), slow drying, or poor draining or any direct exposure to coarse, rough, or abrasive substrates will cause health problems or/and abnormalities. Inappropriate substrates that create the aforementioned conditions that otters must not be directly exposed to include: concrete, cement, tile, artificial or natural rockwork, bricks, gunnite, wood, fence; soil (with/without vegetation) that is poor draining, slow drying, or tightly packed or compacted; small rocks, gravel, or pebbles (smooth, rounded, or otherwise), river rocks, construction sand, abrasive sand, and mulch, soil, or sand with any kind of pebbles, gravel, small rocks, construction sand, or abrasive sand mixed throughout. Various problems occur when the depth of soil, sand, or mulch fall below (i.e. become more shallow than) the minimum depth recommended or substrate quality (esp. when new mulch is not added on top of existing mulch that has broken into small pieces and packed down) is not maintained. Problems can develop when the deep digging area is insufficient in size (see the recommended minimum size needed in Section 2 above).

A significant amount of water will always be tracked, carried, or splashed onto the land by the otters. **Continually very damp or wet surfaces are caused by** not enough land area because of inappropriate land to water ratios, substrate depths that are below the recommended minimum depth, or inappropriate substrate types or qualities (esp. hard or artificial surfaces, poor draining/slow drying soil, mulch bark pieces that have broken into small pieces and packed down). (Note: new mulch must be added on top of existing mulch that has broken into small pieces and packed down and new sand, mulch, or soil must be added on top of the already existing layer when it falls below minimum depth.) Even after continual use (i.e. regular digging and grooming throughout the entire enclosure and digging away large areas of vegetation/turf [these natural behaviors must not be prevented] and exposure to water), soil (and all substrates) with/without vegetation, needs to retain all of the recommended qualities. When it can not, it will erode too easily, not remain dry enough, or become tightly packed/compacted. Surfaces will also remain very damp or wet when there is not enough land area bordering and extending away from the water's edge, more land area is exposed to the water's edge than recommended, inappropriate water area contour lines are used, or nestboxes, dens, or areas for natural underground dens are located too close to the water. Nestboxes (including bedding substrates), dens, and natural underground dens, as well as a significant proportion of the other land/floor areas, can remain very damp or wet when any of the inappropriate enclosure conditions aforementioned exist. Note: wet or damp conditions can occur easily and rapidly or become worsened from rain or high humidity, esp. extended periods. Daily enclosure cleaning with water is not necessary when the recommended substrates are offered, but when unsuitable substrates are offered (e.g. hard surfaces) this form of cleaning can cause land areas to remain damp/wet. Small or limited grooming areas will also remain very damp/wet when they are the only areas offered for grooming. The smaller the amount of land area available, the more difficult it is to keep the land dry. This is one crucial factor that determines land to water ratios for enclosures. It is also just one reason why land area percentages (in the land to water ratio)

must be increased proportionately and water area percentages must be decreased proportionately, as the enclosure size is decreased below 240 m^2 (2,583 ft^2).

difficulties/abnormalities involving their hind legs and lower back. Covering nearly the entire enclosure land area with soft loose natural substrates (as recommended) seems to be the most important husbandry provision needed to maintain healthy walking abilities. This also seems to be the most important husbandry method needed to avoid or at least significantly reduce the chance that the aforementioned health problems will occur or to improve otter health if these problems have developed. This type of husbandry practice alone can help otters that have developed these difficulties/abnormalities to a moderate and even severe degree (because of the continual exposure to hard surfaces), **to return to a very significantly healthier or completely healthy state. Enclosures that do not provide enough land area (i.e. because of inappropriate land to water ratios) or/and digging area may also worsen or help to cause/predispose animals to the aforementioned problems. Appropriate land to water area ratios (this is esp. critical in small enclosures) and sufficient digging area sizes are therefore necessary as well.** These findings were in part based on the following studies.

Some giant otters that were kept, over a long period (i.e. 3 to 10 years), **in enclosures that were entirely or mostly composed of hard surfaces developed ongoing walking difficulties/abnormalities involving their hind legs and lower back** (Sykes-Gatz & Gatz unpublished study). The hard surfaces were made of concrete, natural rock, or tile. These otters were in their middle (e.g. around 4 years old) or late ages when they were observed to have these problems and they were not observed/reported to have any ongoing walking difficulties/abnormalities before they were housed in the aforementioned conditions. Before they were housed on hard surfaces as described, they had access to enclosures where the majority or all of the land area was covered with soft substrates and a sufficient amount of land area and at least some or expansive digging areas were available. Sufficient swimming areas and outdoor access, in temperate or South American climates, were available in every enclosure they were housed in.

The aforementioned otters showed **varying degrees of difficulty and abnormalities when walking. The degrees ranged from moderate to severe.** These included **shuffling their hind legs/feet rather than lifting them, walking very stiffly and/or abnormally, limping, showing moderate difficulty when walking, or/and having great difficulty when walking. At least one otter also exhibited abnormal walking in his front legs (i.e. walking very stiffly/abnormally) as well as his hind legs.** (Note: these animals displayed the aforementioned problems continually throughout the day. Although additionally to these problems and after the animal first rose from sleeping, the particular severity of its physical problem increased significantly above the degree that it would display throughout the day. This degree of severity would resolve shortly, e.g. within a few to several minutes or more after the animal first moved about, and then the animal's particular problem to the degree of severity as described above, would resume.) Additionally, during observations, it was noted that one severely affected otter (in his late age) exhibited difficulty when carrying out the physical actions necessary for mating and he was unable to successfully penetrate his partner. The failure to breed was most likely, at least to a significant degree, due to his aforementioned problems. I.e. the physical disorders which were expressed by his walking difficulties affected his ability to mate successfully. He sired no litters during the 8 months he was paired with his mate. (Previously and afterwards, his partner had many litters with another male. Below are examples of how easy and inexpensive enclosure modifications / furnishings can help to improve and maintain the giant otter's physical [as well as mental and behavioral] health.

When two of the affected otters were housed on enclosures where the majority or nearly all of the land and floor area was covered with soft loose natural substrates, their on-going walking difficulties/abnormalities were greatly reduced or fully resolved over time (during a ½ year to a year's time). **A third affected otter is also currently recovering in the same manner.** The third otter showed significant improvement within only 3 months. During recovery he was housed on an enclosure nearly entirely covered with soft loose substrates as opposed to an enclosure where only the majority (which is not sufficient) was appropriately furnished. (The third otter was more affected and he was more exposed to hard surfaces than the otter that fully recovered in a ½ year's time on an enclosure where only the majority was appropriately furnished. Both otters were although moderately affected. It seems that quicker recovery times are possible when enclosures are furnished as recommended.) During and after the recoveries, deep digging areas above the recommended minimum size, swimming areas, appropriate land to water ratios/ample land area, plentiful natural furnishings and enrichment, and outdoor access in temperate climates were/are also provided. The substrates consisted of soft sand and mulch.

The aforementioned otter whose problems were greatly reduced after one year of being housed on an enclosure nearly entirely covered with soft loose natural substrates, formerly showed severe walking difficulties and abnormalities. I.e. he had great difficulty when walking. This animal was exposed to hard surfaces longer than any of the other affected otters. After the full recovery of the other otter (i.e. this otter formerly showed very obvious significant abnormalities and moderate difficulty when walking), he was housed in an inappropriately furnished 65 m^2 (699 ft²) temporary holding area for 8 months. Within this holding area, was a 40 m^2 (430 ft²) indoor enclosure with only tile (i.e. hard) surfaces, small pools, and a nestbox with woodwool inside. He had access to the indoors 100% of the time and was only given access to a 25 m^2 (269 ft²) outdoor deep sand area a few or more hours per day or not at all in colder weather. Within eight months, this animal again developed significant and obviously abnormal walking patterns/difficulties and it was moderately difficult for him to walk. He although recovered fully again after being housed in the appropriate conditions needed for recovery and healthy maintenance. The temporary holding area has since been expanded to 90 m^2 (968 ft²) and all land areas are nearly entirely covered with either deep mulch or soft sand, including a 45 m^2 (484 ft²) deep sand digging area, and other plentiful natural furnishings and enrichment. An appropriate land to water ratio also exists and the original swimming areas offered were unchanged. The otters here are also given outdoor access the entire year and the third aforementioned otter, with moderate difficulties/abnormalities, was housed here during his first 3 months of recovery. (The addition of soft loose natural substrates was the only enclosure modification made for one of the recovered otters and the other two aforementioned otters were moved to totally new enclosures furnished as described.)

To date, these were the only animals, of the affected otters, that were given the new conditions mentioned (i.e. that are needed for recovery and healthy maintenance). No medical treatment was given to these otters for their ongoing problems. The extent of difficulties/abnormalities and recovery was/is assessed by visual observations alone for all of the affected and recovered otters. Recovery was/is easily observed as the walking difficulties/abnormalities were very obvious. The otters' body weight remained constant both before, during, and after their recoveries. None of the affected otters (i.e. of all of the animals known to have displayed this on-going problem) were exposed to stairs within any of their enclosures and the otters did not encounter other structures/surfaces where they had to regularly climb on to access or utilize it. Stairs or any structure/surface that otters must climb every day in a significant manner to access or utilize it should not be used within giant otter enclosures as there may be a possibility that

they could cause similar walking difficulties/abnormalities (Wünnemann, pers. comm. 2003). They are also difficult for otters to use. (Climbing stairs or the other structures/surfaces aforementioned should not be confused with other types of climbing which giant otters naturally do in captivity and in the wild. E.g. giant otters often climb onto the top of their nestboxes, large logs, tree stumps, etc. and this is not harmful to their health.) See Chapter 2 Section 12 for more information on stairs etc.. Although the known number of giant otters that recovered as aforementioned were limited, the results obviously indicate that the chance that other individuals can make similar recoveries, if given such an opportunity, is very significant and therefore reasonable conclusions can be drawn.

Some of the affected otters, in addition to hard surfaces as described, also did not have any digging areas and they did not have sufficient land area (i.e. the enclosure land to water area ratio allowed for little land area). (Two of these otters, one severely affected and one moderately affected, recovered as aforementioned after being provided with the new living conditions described above.) The inability to exercise the body in the natural manner done when digging into soft loose substrates or using the land area in other normal ways may also have contributed to the development of this physical problem. **Without sufficient and comfortable land and digging areas otters will/can not use their bodies to their full normal physical extent/capability and they can/will not carry out the full range or extent of innate terrestrial activities that are possible in captivity (i.e. exercising, playing, digging, and grooming throughout the entire expanse of their land area).** Hard surfaces are uncomfortable and insufficient land area literally limits the physical space that otters have available to freely use the land to play, exercise, dig, and groom on. **This is just one reason why appropriate land to water ratios (esp. in enclosures around or below 240m² [**2,583 ft²**]) and sufficient size digging areas are also crucial.**

It is important to note that when walking difficulties develop gradually and progressively the early stages of development could be easily missed if the animals are not closely monitored and these observations are not recorded in detail so that a progression can be detected. For example, in the early stages these animals may only display symptoms, e.g. stiffness of the hind legs, over a very short period of time, such as only after the animal has first risen from sleeping. The problem could then resolve shortly, e.g. within a few to several minutes or more after the animal first moved about. Problems may also be seen to occur only on days with rain or colder temperatures. This may occur at first, only rarely or occasionally, but it may develop to greater problems in the following months/years if the enclosure conditions causing these problems are not changed.

"**Intervertebral disc disease is … [a] common entity reported in …otters,** and other mustelids. **Exhibit space, housing, handling procedures and activity can predispose animals to vertebral problems and should be carefully evaluated."** (Petrini 2001). "Degenerative spinal conditions are not uncommon in older animals [mustelids]. …Spinal arthritis or spondylosis deformans has been seen in many old mustelids, including … otter in the UK." (Lewis 1995). **It is interesting to note that two 14.5 year old giant otters (i.e. this is very old) housed at one institution** (Brasilia Zoo), **were observed to have no walking problems / difficulties** (Gatz, pers. comm. 2002). **This male and female are each housed in (two separate) 635 m² (6,835 ft²) enclosures with expansive land areas (85% land) nearly entirely covered with soft loose natural substrates** and an ample pool area. These otters have dug many underground dens in the plentiful hillsides/banks that are also provided. They have lived in these enclosures for their entire lives and the male successfully reared multiple litters

with his mate in the underground dens. **It seems that the inadequate housing conditions aforementioned can predispose giant otters to vertebral problems.**

Optimal housing conditions or/and simply appropriately furnished and designed housing seems to play a significant role to help reduce, avoid, or eliminate the chance that giant otters develop the aforementioned problems. These conditions also help improve health, once problems have already developed. It also seems that the longer the otter has been exposed to hard surfaces or/and the greater the percentage of enclosure area covered with hard surfaces, the greater the resulting health problems. On a different note: soft substrates will also soften the surface for cubs that are dropped or pushed around by parents and therefore reduce the chance of cub injury.

Health problems with pads, webbing, and skin on feet/toes . Are pink foot/toe pads healthy?

This species has sensitive delicate feet. Healthy pads, skin, and webbing on giant otters' feet and toes are entirely brown, not pink, in color and supple, smooth, and soft in condition. If any part of the foot appears differently, then the otter has unhealthy damaged feet and inappropriate substrate types, qualities, or depths (aside from any obvious accidental injury) **are causing the problem**. **Insufficient land area size, because of inappropriate land to water ratios (or other inappropriate land and water area designs and locations), can also worsen foot condition or be a cause in itself.** *Infections, can develop if enclosure or foot conditions decline too far.*

It was previously reported that "Giant otters have delicate feet. Hard or rough surfaces all over the floor of the enclosure will result in cut feet." (Wünnemann 1995). Lesions of the skin of the feet were treated with medication. Duplaix-Hall (1972 & 1975) also described that captive river otters "which are kept on damp concrete floors are prone to these tenacious [fungal] infections, which usually start on the interdigital webbing but may soon spread to other areas, particularly axillary regions." Individuals kept in such conditions "...often have cracked webbing between their toes, which may become the site of persistent fungus infections".

It was although only recently found that the simple occurrence of pink foot or toe pads is also a health problem, i.e. that it represents irritation and damage rather than normality or health, and that it is directly caused by inappropriate enclosure conditions (Sykes-Gatz and Gatz, unpublished study, 1996-2003). **Unfortunately, captive giant otters are often observed or reported to have the aforementioned foot condition. This occurs most often because otters are kept on hard surfaces and soft natural substrates are not covering nearly the entire enclosure land/floor areas.** (If hard surfaces are not responsible for this problem then other inappropriate surface conditions, such as continually very damp/wet surfaces (whether soft or loose or not) or other inappropriate substrates, e.g. sand or soil mixed with pebbles or small rocks throughout, are responsible.) **Even when the greater portion of enclosures are covered with soft natural substrates, continual exposure to just those lesser areas with hard surfaces causes pink foot/toe pads. The longer the otter has been exposed to hard surfaces or/and the greater the percentage of enclosure area covered with such, the greater the resulting health problems.**

It is not uncommon that pink foot/toe pads develop into a more unhealthy state (i.e. cracks, cuts, small red sores, rawness, dried out appearance, moderate to dark pink or worse red color, etc. are not that uncommon of an occurrence on pads and webbing, see more descriptions below). **This is because** pink foot/toe pads **can quickly and easily develop into a more unhealthy state when land/floor substrates**/surfaces **remain very damp or wet** or other inappropriate provisions exist. **Continual exposure to rough, coarse, abrasive, all hard, wet or very damp, slow drying or poor draining enclosure substrates/surfaces results in very unhealthy feet** (see the introduction above for a list of these substrates). **E.g. pebbles, gravel, and small rocks (whether smooth, rounded, or not) are coarse and hard and when they are provided alone or they are mixed throughout soil or sand** they will damage the otters feet and they are not comfortable for otters to use**.** See the introduction above **for the inappropriate substrate types, depths, and qualities, land and water area locations and designs, and locations for nestboxes, dens and areas for natural underground dens which cause land areas (including sleeping areas) to remain very damp/wet.** An infection could result if foot and/or enclosure conditions continue to decline. E.g. wet or damp conditions can occur easily and rapidly or become worsened from rain or high humidity (esp. extended periods), enclosure cleaning, and water that is normally tracked/carried onto land by the otters.

Irritation and damage are present when any part of the pads, skin, or webbing on the feet or toes becomes or remains pink in color. (Note: see exceptions below for feet that have recovered from being unhealthy.) Most often the pads on unhealthy feet and toes become or remain pink. Although, when the webbing on the foot bottom is also similarly affected (either the edges of the webbing or worse, the larger area of skin between the toes), the feet are considerably more unhealthy. When the webbing on the top of the feet becomes pink, as well as the bottom of the webbing, this indicates a more serious problem is evident. The darker the pink color (whether on the pads or webbing) the more unhealthy the feet are. When foot health condition worsens, pads, webbing, or skin can become darker pink (e.g. moderate to very/dark pink) or even red in color, raw, cracked, cut, dried out in appearance, and small red sores can develop. Bleeding may also occur. In worst cases an infection may be possible. The following foot conditions were observed when soft natural substrates were not covering hard enclosure floors/land, when only some soft substrates were available, when coarse surfaces, such as smooth pebbles, were present, or/and when conditions were very damp or wet for an extended period. In some cases the lack of sufficient land area, because of inappropriate land to water ratios, also existed. The giant otters housed in these conditions were observed to have dark pink or red and irritated looking foot/toe pads and they sometimes also had obvious and irritated cracks, small sores, and cuts within their pads. As well, the edges of the foot webbing and when severe even the main webbing area between the toes (both on the foot's bottom or/and top side) and the foot/toe skin also appeared sore and pink to dark pink or even red and raw. Cracks or cuts were also evident in the webbing. Unfortunately, some of the more serious foot conditions just described are not that uncommon of an occurrence.

All indoor and outdoor enclosure land and floor surfaces must be nearly entirely covered with soft sand, mulch, or/and soil, as recommended, i.e. with appropriate substrate depths, types, and qualities, to prevent foot and toe pads from becoming pink. Additionally, unhealthy feet can not fully recover until this provision is offered. It has recently been discovered that **this is the most important husbandry method needed to maintain healthy natural foot condition, prevent foot problems, and improve unhealthy feet**. **This** type of husbandry **practice alone can help unhealthy feet,** affected by continual exposure to inappropriate surfaces**, recover to a very significantly healthier state or a completely healthy natural state. Appropriate land to water area ratios, as well as the recommended**

substrates, are needed to keep surfaces dry enough, so they also must be provided to prevent foot problems. The other recommended land and water area locations and designs should be provided for similar reasons. See the study below on which these conclusions are, in part, based on.

It seems that giant otters that have had unhealthy feet for only a short period, because of temporary exposure to hard surfaces, can return to 100% healthy normal foot condition after they are housed on appropriate substrates and land to water ratios. (It is important to note that only one otter was studied who was in this situation and that more research should be conducted to draw more definitive conclusions. This affected otter developed very unhealthy feet after just over one week of exposure to all concrete. See the study below.)

On the other hand, **giant otters that have recovered from having unhealthy foot conditions for a long time (i.e. for years) may only exhibit after recovery off-white/light pink color foot and toe pads** (i.e. pads appear healthy in all other aspects) **with all other parts of the foot returned to full health**. Sometimes permanent scars from deep cracks/cuts may occur. **Such recovery can occur within a few months after otters are provided with the recommended substrates and land to water ratios**. **It is unknown at this time whether the off-white/light pink pads represent that the feet are permanently damaged to some extent** (i.e. they can never recover to full 100% health/normality) **or if these pads can simply never recover to a brown color and off-white/light pink does represent 100% full recovery for these otters.** It does although represent a very significant recovery. It seems that these off-white/light pink pads can easily become, at least temporarily, a pink color when substrates remain very damp or wet for even short periods (i.e. for days) or during extended rainy or very humid periods. **Otters that have had completely healthy feet** (i.e. all brown etc.) **throughout their lifetime or that have recovered from having unhealthy feet for only a short period, seem resistant to developing problems** (i.e. will not be negatively affected) **during such aforementioned conditions, as long as substrates and land to water ratios are provided as recommended.** Otters that have recovered from having unhealthy foot conditions for a long time seem to develop problems readily during the aforementioned situations. Pads on feet recovered from long-term unhealthiness can also briefly turn a pink color during and/or just after the otter has been active (e.g. digging, exercising on land, swimming etc.). Even when the otter has just been swimming in the water and has spent very little time on land (e.g. after waking) or the otter has just woken (but not walked) and vocalizes for extended periods, the foot pads can change in the manner just described. (Note: such pads can also remain off-white/light pink during activity.) It seems that when blood circulation is significantly increased the pads can turn from an off-white/light pink to a pink color because of the increased blood circulation alone. Possibly, because of long-term damage to the foot pads, the pad pigmentation has been lost and therefore such changes can be easily seen. These changes can not be seen on giant otters that have always had healthy foot condition or that have recovered from short-term damage [as in the aforementioned study].)

Although the known number of giant otters that recovered as aforementioned in the last paragraph, were limited, the results obviously indicate that the chance that other individuals can make similar recoveries, if given such an opportunity, is very significant and therefore reasonable conclusions can be drawn. (Four individuals recovered in this matter. At least one other giant otter was known to have been offered appropriate enclosure conditions after living in inappropriate conditions, although no reports are known on this otter's recovery. The enclosure conditions of two other otters have been improved, but only partially, and reports indicated that their foot health improved in correlation with the amount of enclosure condition improvements.

No additional or detailed information was available. Additionally, at least four other giant otters were observed to have off-white/light pink pads (with all other foot parts normal and healthy in appearance) when they were kept in appropriate enclosure conditions. These otters are believed to have recovered in the same manner as described, although the detailed history of foot problems with these individuals is unknown.)

The degree to which pink foot/toe pads are unhealthy or problematic, should be compared to the obvious health problems that can exist if this unhealthy condition becomes even somewhat worse, which can happen easily and quickly even in typical conditions. This occurrence is unfortunately not uncommon. It must also be taken into consideration how frequently abnormal (i.e. pink) foot/toe pad conditions occur in captivity. It also should be compared to the (unknown) degree that the otter is caused discomfort because of this (typical) existing condition. The evaluation of the amount of unhealthiness or potential that this condition has to cause serious harm, seems quite significant when the typical captive otter is compared to a wild otter or a captive otter housed in appropriate situations. I.e. pink, which means pads are irritated and damaged, is quite a different appearance and health condition compared to healthy normal foot and toe pads that are totally brown. This also indicates that too often zoos/institutions are not providing enclosure substrates (or/and land to water ratios) in an appropriate way to maintain otters in their most healthy and natural state.

In a long-term comparison study, **the only otters observed in captivity with healthy and natural appearing** (i.e. most esp. in color) **pads, webbing, and skin on the feet and toes were those that were housed on soft loose natural substrates that covered nearly the entire enclosure land/floor area. Appropriate land to water ratios were also offered.** These otters were/are housed at *Brasilia Zoo* (most of them for their entire lives) where they had two similar expansive outdoor enclosures each sized 635 m^2 [6,835 ft^2], sufficient swimming areas, and 85% land to 15% water area ratios. Non-ferric Red Latosol soil (a recommended soil type) covered nearly the entire land areas and the otters dug many underground dens throughout the extensive area of hillsides provided. Most of the thirteen otters housed and observed at Brasilia during the study period had healthy normal appearing feet as described, although the remainder had off-white/light pink color pads (with all other foot parts normal and healthy in condition). This indicated that these otters had recovered (within this exhibit) from having unhealthy feet. Additionally, one otter that was transferred from Brasilia Zoo, also exhibited completely healthy foot condition after it was housed at *Dortmund Zoo* in two of their three different giant otter enclosures. The land and floors of these three enclosures are nearly entirely covered with soft sand and/or mulch as recommended, they have appropriate land to water ratios, deep digging areas above minimum size, and indoor/outdoor access all year. (This zoo is located in a temperate climate.) In these same enclosures, four other otters had pads that were off-white/light pink in color and the remaining foot parts were healthy in condition. These four otters had recovered from having unhealthy foot condition caused by long-term exposure (i.e. many years) to hard surfaces and in some cases as well, insufficient land area because of inappropriate land to water ratios.

The comparison study was limited to observations made at six zoos, where the giant otters' feet could be closely seen (Sykes-Gatz and Gatz, unpublished study and pers. obs.). (Each zoo had one or more giant otter enclosures.) The comparison of foot and toe webbing, skin, and pad condition within each zoo was made based on the experiences/study of the observers and close observations. The observers learned what the foot condition of wild giant otters are because of the appearance described by Groenendijk (Groenendijk, pers. comm.) who closely observes and researches wild giant otters in Peru. **The skin, pads, and webbing on the feet and toes of**

giant otters living in the wild are totally brown and soft, smooth, and supple in condition. In addition, at the time of their birth, giant otters' feet and toes in captivity have the same appearance as just described. From this information, it was concluded that a giant otter in captivity should and would have the same foot condition, if its feet were natural and healthy. The enclosure furnishings and designs of an otter exhibiting this condition would therefore indicate those conditions that are necessary to maintain healthy giant otter feet.

Of the six total zoos in this comparison study (five of which are located outside of South America), Brasilia and Dortmund Zoos were the only zoos that offered giant otter enclosures with land/floor surfaces that were nearly entirely covered by soft substrates. (Note: this included comparisons of all the indoor and/or outdoor enclosures at the six zoos. When the otters had access to both indoor and outdoor enclosures (at the same time) these indoor and outdoor areas combined were considered to be "one" enclosure.

In 1998 four otters (in two separate similar enclosures) and in 2002 eleven otters (in two separate similar enclosures) that were all housed at *Brasilia Zoo*, were closely observed. (All but one of these otters lived their entire lives at this institution. The otters ranged in age from young to very old and eight of the otters were adults or close to adult age when they were observed. Only two of the otters observed in 1998 were also re-observed in 2002. See the description of their enclosures in the introduction paragraph to this comparison study.) **Most of these otters had healthy natural appearing pads, webbing, and skin. I.e. their entire feet were totally brown, soft, smooth and supple.** (Their feet remained healthy during their development and lifetime at this institution. It is important to note that their feet do not become unhealthy even during rainy or very humid periods when the soft loose soil can become very damp or wet for extended periods. These otters do not have indoor enclosures.) **The remainder of these giant otters had off-white/light pink color pads** (with all other foot parts normal and healthy in condition). **This indicated that these otters had recovered** (within this exhibit) **from having unhealthy feet**.

General information was known about the history of four of the giant otters at Brasilia where recovery from unhealthy foot condition was indicated. These otters were separated from either their mates (on multiple occasions) or their parents, but during separation either their mate or father was kept on the opposite adjacent exhibit side during their long periods of separation (i.e. at least many months). The separated otters had visual-olfactory-acoustic contact with each other during separation. (The mother was also separated from her young offspring, but she was kept in an enclosure far away from the exhibit and she was not returned to the exhibit.) An approx. 1 meter wide cement floor area borders the entire length of the fence containment barrier that separates the two expansive exhibits (to help prevent the otters from digging under the fence). When these otters were separated it is likely they damaged their feet (to a significant degree) during separation on the containment barrier fence and/or its accompanying cement floor area by trying to dig out/through (in an excessive manner) to get to their family member on the opposite side. (Note: when giant otters are separated from their family members or familiar partners (or even separated unfamiliar animals), but are still in visual-olfactory-acoustic contact with the animal/s that they have been separated from, the following can occur. They will likely for a time excessively dig on/into land surfaces immediately adjacent to the containment barriers that allow vision etc. and dig directly on such containment barriers (e.g. fence) in attempts to dig out or through to the otter/s that have been separated. This should not be confused with the behavior of excessively digging throughout the entire enclosure land area to relieve their stress. It is necessary that nearly the entire enclosure (including the area next to the containment barriers that might be dug into) is covered with soft loose substrates and deep digging areas are

provided as recommended, so that otters can not only relieve their stress, but they can also avoid damaging their feet. Digging is a strong natural behavior that behaviorally healthy giant otters, such as these animals, typically carry out frequently throughout the day and throughout their entire enclosure. They will likely, with an extraordinarily high/excessive degree, dig throughout their entire enclosure during stressful or unusual events to relieve and/or counteract stress. See Part B below.) Because these otters' enclosures had appropriate land to water ratios and soft substrates the otters would have been able to recover from this unhealthy foot condition within the same enclosure. The animals were young when they were separated from their parents and they were almost 2 years old when they were observed with off-white/light pink pads in 1998. The aforementioned mates were separated multiple times during their lives and they were old when first observed in 1998. Detailed information about these events are not known. The otters with healthy normal (i.e. brown pads etc.) were not known to be separated as aforementioned.

The otters observed at the other five zoos were also young to very late in age and observations did not include cubs[1]. This included ten otters that were observed closely enough to determine foot condition, between the years 1996-2004. At these zoos, every otter throughout the majority or all of its lifetime, except for one, was either kept on all (in at least one zoo), mostly, or at least "some" hard surfaces. (I.e. "Some" means, the greater portion of the total enclosure land and floor area at these zoos are/were covered with soft substrates. Two of these zoos, in addition to their outdoor exhibits with soft substrates, had indoor housing with no or very little soft substrates on their concrete floors.) As well, some of these enclosures had insufficient land area because of inappropriate land to water ratios. All of the otters in these five zoos, except for the one just aforementioned, were observed to have pink toe/foot pads of varying severity or worse foot conditions. The more hard surfaces that the otter was exposed to, the worse the foot condition appeared. In the cases where the otters were also exposed to coarse, entirely damp/wet surfaces, or/and a lack of sufficient land area because of improper land to water ratios, foot condition appeared significantly worse. (These foot conditions were comparable to those listed in the general description pages above.) During this study four of these individuals recovered from having unhealthy feet, which they had for a long time. After recovery they had off-white/light pink color toe and foot pads and the remaining parts of their feet appeared healthy (i.e. brown etc.). These otters achieved this significant degree of recovery only after they were housed in enclosures where the land and floor areas were nearly entirely covered with mulch and/or soft sand as recommended and land to water ratios were appropriate. Their recovery took place at

Their remaining foot parts were healthy, natural, and brown in appearance. Although, 3 to 4 years before, these otters were housed in enclosures where the majority of the enclosure land/floor area or all of it was hard surfaces and in some cases the land area was also insufficient because of inappropriate land to water ratios. They lived in the aforementioned circumstances for most of their lives. See the foot recovery history of these individuals in the paragraph below. Foot condition studies will be continued at Dortmund. It is highly recommended that other institutions carry out similar studies.

One recovered otter, at the time of Groenendijk's observation, **had been housed in an enclosure nearly entirely covered with soft substrates (mostly sand and the remaining mulch) for only the past 2 months of his life.** He, at that time, was housed with the otter transferred from Brasilia Zoo and was in the process of recovering from unhealthy foot condition. **After the third month of his recovery, all of his toe and foot pads became off-white/light pink in color and the webbing and skin on his feet appeared healthy and brown in color.** This otter was previously housed on entirely concrete surfaces for the last 7 years (including insufficient land area) and was housed in an enclosure where the greater portion of the enclosure was covered with soft substrates for 4 years before this.

Of the otters (3 in total) that were kept for several or more years at Dortmund, their foot condition was in significantly worse condition than before recovery (Gatz pers. comm.). Before these otters recovered they all showed varying degrees of unhealthy foot condition, from moderately unhealthy to very unhealthy (esp. when the addition of wet/damp conditions aggravated the situation). The simple change of covering nearly the entire enclosure land and floor area, which the majority or all was hard and smooth, with mulch or soft sand was the only method used/needed to help the foot condition of these otters to recover. The recommended substrate depths & types were provided. The land to water ratios had always been appropriate in 2 of their 3 enclosures, and the 3rd enclosure with insufficient land area because of inappropriate ratios, was corrected. I.e. one pool was emptied and permanently filled with deep mulch to create an appropriate ratio. When enclosure substrates become very damp or wet for even short periods (i.e. days) or esp. during extended periods (e.g. during rainy periods or very humid weather), their pads can become pink at least temporarily. The foot and toe pads of the otter with completely healthy feet who is housed at the same zoo, remained totally brown during these periods. I.e. this otters' feet remained healthy during these times.

It is also interesting to note that the foot condition of the otter, previously discussed, reached full recovery in only 3 months after being housed on an enclosure nearly entirely covered with soft substrates as recommended. This otter was the only otter of the four aforementioned otters (all of whom had long-term exposure to hard surfaces) that recovered so quickly. With the other three otters, soft substrates were increasingly added, over the course of 1 to 2 years, until the point where nearly all of the enclosure floor/land area was covered with soft surfaces. During this time, these three otters underwent a slow, but very significant recovery. They did not have off-white/light pink pads until nearly the entire surface was covered. No medical treatment was administered to any of the recovered animals for their foot problems. Only the enclosure conditions mentioned were changed. It is evident that full recovery can not be achieved and recovery cannot be maintained until soft loose substrates and land to water ratios are provided as recommended. It seems also that quicker recovery times can be achieved when nearly the entire or all of the area is soft, as opposed to slowly increasing soft substrate cover. It also may be that soft sand allows for quicker recovery than mulch. This is because the enclosure that the otter with the quickest recovery time was housed in during recovery contained/s a significantly greater ratio of sand to mulch compared to the enclosures in which the other three otters are

housed. It also may be that the longer that otters are exposed to hard surfaces (and certainly the greater the amount of/enclosure area with hard surfaces), the longer it may take the otters' feet to recover to a significantly healthier state.

The one otter observed with feet that were/are totally brown, at Dortmund Zoo, had been housed at Brasilia Zoo for most of her life. Nine months before the observation by Groenendijk occurred, she was housed at Brasilia Zoo in the conditions aforementioned and she was at this zoo since her birth, 3 years ago. When this otter was separated from her large family group, for physical examination and holding, just over a week or so before her transfer to Dortmund, she was held in a small temporary holding enclosure surfaced only with concrete and a very small wading area. This enclosure was sheltered from the rain, as it had a roof and 3 concrete walls and the concrete was not rough or abrasive in texture. One containment barrier was made of metal lattice and the separated animals had visual-olfactory-acoustic contact during separation. (Staff were unable to re-introduce her with her family because of fighting upon re-introduction attempts. The otters held at Brasilia normally do not have access to this small holding enclosure.) The fact that she was exposed to all hard surfaces as well as tried to dig into the concrete land area and fence with an extraordinarily high degree of frequency, duration, and intensity, made her foot condition very unhealthy. (See the comments above about digging on land/floor surfaces and containment barriers during separation and stress.) Her foot and toe pads and webbing became very irritated, dark pink to red in color (with a brown under tone), cut, cracked, raw, and red sores developed, because of exposure to hard surfaces during this short period.

After the aforementioned otter's transport to Dortmund, she was housed in a temporary holding enclosure for almost one year. In this enclosure, within about 2 months, her webbing and pads returned to the color and healthy natural appearance/condition that her other family members were observed to have at Brasilia Zoo. The aforementioned temporary holding enclosure is $90m^2$ total and it had an appropriate land to water ratio. The indoor housing area (45% of the total enclosure area) consists of land nearly totally (except for of the very small area in front of the keeper doors and the very small area just in front of the swim basins) covered by deep mulch. (The mulch used is the recommended type and was deep enough to allow deep digging.) The outdoor area (55% of the total enclosure area) is totally covered by deep soft sand for digging. (Additional plentiful natural furnishings (logs, "man-made bamboo stands", etc. and play toys were also offered.) It is important to note that only soft substrates were used to help this animal's feet to return to a healthy condition and no medical treatment was used.

Fur Coat Condition, Grooming, Infections and Related Health Problems

Observations of wild giant otter grooming and marking behavior in Suriname:

*In the wild, "The otters divide their time almost equally between hunting (feeding) and resting ashore…**Pteronura spends a large portion of its time ashore engaged in grooming activities…***[In the wild this activity includes grooming themselves and each other, as well as the following activity described.]*...The otters dry themselves immediately after leaving the water by rubbing and rolling against the substrate…. Rubbing apparently functions to dry the guard hairs and press the water from the underfur. Rubbing is energetic and thorough, the otter first rubbing its neck and thorax by pressing them against the ground and rubbing the*

body back and forth or in a sideways snaking movement. The otter then rolls over on its back with the back of its head and neck pressed against the ground and repeats the process. The substrate may or may not be scratched prior or between rubbing bouts. The rubbing is so vigorous that particles of dirt and vegetation cling to the fur like sawdust after the otter has dried itself…. Rubbing may last 4 to 11 minutes continuously…Grooming… activities…occur before the otter(s) enter(s) the water [as well]…. Otters rubbing the substrate cover themselves with the scent they are spreading and later, while resting they rub themselves against the ground and against each other until a composite scent characteristic of a pair or even a group may evolve." (Duplaix 1980)"

Poor fur coat condition and associated poor health and death by infections have occurred among captive giant otters because of exposure to continually very damp/wet surfaces (see the introduction for how these enclosure conditions are caused). **It is also important to note that giant otters will/can not groom on substrates when they become or remain very damp or wet.**

In the past, river otters were thought to be aquatic animals and unfortunately exhibits were designed with this misconception in mind (Duplaix 1972 citing Hediger 1970). Inappropriate enclosure conditions, esp. improper land to water ratios resulting in not enough land area or/and improper substrates, were often the reason that health problems, such as poor coat condition, among other serious health problems, occurred. Continued stress, improper diets, dermatological or other diseases, or excessive chemicals (e.g. chlorine or ozone) in pool water can also be causes, although no reports of this nature have been reported to cause poor coat condition or related problems among captive giant otters. Immediate action must be taken to identify and solve the problem, or if continued, death could result. Otters should not be forced or encouraged to swim when they have poor coat condition.

"Otters possess a dense, water-resistant two-layered pelt which provides warmth, insulation and buoyancy, but [the coat] remains a particularly vulnerable point. ...rubbing and other grooming patterns keep the guard hairs and under-fur clean, unmatted and dry..." (Duplaix-Hall 1972). **Otters' fur coats must remain clean, shiny, and waterproof** (i.e. water does not penetrate or even dampen the white underfur), **otherwise animals will become unhealthy, they may refuse to swim, or/and pneumonia, enteritis, or death may result** (Duplaix-Hall 1972 & 1975). If water does not form droplets and cannot be easily shaken off the guard hairs (i.e. brown fur), the otters' guard hairs clump together (e.g. the fur becomes matted with dirt or mud), and water penetrates the guard hairs or the underfur becomes exposed, then otters will become waterlogged. When an otter is waterlogged the gray/white underfur, which is not waterproof, will become wet and the otter will have no ability to keep dry. An otter in this condition may not swim in an effort to remain as dry as possible. If the otter does swim and it cannot keep dry "The body temperature of a chilled otter drops rapidly and shivering is frequent, even during sleep. Enteritis usually develops and if measures are not taken, death can follow in a matter of days through pneumonia and/or gastro-intestinal complications." (Duplaix-Hall1972).

To maintain health, otters must be able to adequately dry and groom themselves and stay clean and dry when they are on land. Health problems, occurring when animals do not have these possibilities, are especially evident when the otter's fur coat is in poor condition. In these cases, health can easily and quickly decline, esp. if normally fast changing enclosure conditions worsen (e.g. wet or damp conditions can occur easily and rapidly or become worsened from rain

or high humidity, esp. extended periods). Eventually serious health problems, such as aforementioned, could develop.

A lack of sufficient land area, resulting from inappropriate land to water area ratios, may not offer otters enough area for the aforementioned necessities. Continual exposure to wet, very damp, muddy, unclean, slow drying, or poor draining surfaces/substrates can cause poor fur coat condition. Additionally, abrasive (e.g. abrasive sands such as builder's sharp construction sand), rough, or sharp surfaces (sometimes found in artificial rockwork) **can wear away guard furs and result in poor coat condition as well.**

It is difficult, unenriching or/and uncomfortable for otters to dry and groom themselves when hard, coarse, or tightly packed/compacted (i.e. any substrate that is not loose enough for otters to easily dig into) **substrates or insufficient land area must be used for these activities.** These surfaces are listed in Chapter 2 Section 2. It is important to note that **pebbles, gravel, or small rocks (whether they are smooth and rounded or not), soil that is not loose enough for otters to easily dig into, river rocks, and mulch, sand or soil mixed with any kind of pebbles, gravel, small rocks or construction sand throughout are included within this category as well as the other inappropriate substrates**. (Hard surfaces, e.g. concrete, tile etc. are not absorbent and water cannot drain through them. When such surfaces are wet or damp it is impossible for otters to effectively dry and groom themselves on them.) **It is just as difficult for otters to dry and groom themselves when the only soft loose substrates available are those provided in nestboxes, small or limited grooming areas or/and small digging pits. Even freshly offered bedding material, such as straw, woodwool, etc., or small areas for grooming become wet and lose their absorbent drying qualities quickly.**

As well, when not enough land area (because of inappropriate land to water ratios), **limited (size) grooming areas, or inappropriate substrate depths, types, or qualities are provided, otters will not be able to carry out the full extent of their innate grooming behaviors as is necessary to maintain the otter's health.** Giant otters with healthy behavior and appropriate enclosure conditions will use the entire expanse of their land area to groom and/or dry themselves**,** by rubbing, rolling, scratching, and digging on the surface of/into soft loose natural substrates. Giant otters groom themselves when they are dry as well as wet. Digging and scratching on/into surface substrates are a function of grooming and/or drying as well as marking territory, forming/clearing "campsites", creating dens, and simply digging. (Note: giant otters dig deeply into substrates whether they can create underground dens or not. They also rub on substrates to help mark their territory.) During grooming and drying substrate particles are moved/dug freely about and otters' often cover their body/fur with the freed particles. Being avid groomers, this species grooms frequently throughout the day. See in Part C below, the mental and behavioral health problems/abnormalities that can develop when grooming and/or digging behaviors can not be carried out to their full extent. Otters either will not or cannot use, or cannot use without inefficiency, difficulty, lack of comfort, and/or harm to their health and/or normality, inappropriate substrate types, qualities, or depths, or insufficient land area to groom on. E.g. otters may groom on smooth rounded pebbles, abrasive sand, concrete, gunnite, or sand or soil mixed with pebbles, gravel, or small rocks throughout, if no other better grooming area exists.

Inappropriate substrate types, depths, or qualities, land and water area locations or designs (esp. inappropriate land to water ratios that do not offer enough land)**, or/and locations for nestboxes, dens or areas for natural underground dens cause** the following. (See the introduction above for more information). **The dens, nestboxes (including bedding**

substrates) or natural underground dens, the land around these locations, the land around the water, and/or the remaining/other enclosure land areas can remain very damp or wet. (Note: how wet nestboxes, dens and natural underground dens themselves become/remain is not only dependent upon how close these areas are to the water, but it is also dependent on all of the enclosure conditions.) E.g. when the otters leave the water to enter their sleeping areas, water will be easily tracked and carried into the nestboxes and underground dens, as well as onto the land that lies between these resting places and the water. (Note: because giant otters take naps throughout the day, numerous trips of this nature can be made during the day, although they also rest on other land areas as well.) Otters will also quickly dampen/wet these areas when they use them to dry off and groom on because sufficient land area and/or adequate substrates are not conveniently available for them to use for these activities before they enter their sleeping areas. Without sufficient land area and/or adequate substrates, the aforementioned areas will likely remain very damp or wet. **Note: young cubs will primarily stay/be kept by their parents in and near their nestboxes, dens, and natural underground dens and on the land near the water's edge. In the above inappropriate conditions, otters will be exposed to damp/wet conditions for long/extended periods and poor health, serious health problems, or even death can result. E.g. cub death by infection has occurred during cub-rearing because of these conditions** (see below). Parents, with no other choice, will be subject to keeping their cubs as well as themselves in such conditions. Also when insufficient land area exists, parents may be encouraged to put their cubs into the water more frequently than they should.

Some examples of how inappropriate conditions resulted in poor giant otter health and/or death follow. Poor coat condition affected the well-being of one confiscated wild born giant otter that was housed for a significant period on a wet/damp land area in an enclosure at one institution (Groenendijk, pers. comm.). The otter did not have sufficient area where it could remain dry and clean. Its fur became matted and dirty and the guard hairs clumped together. This young captive held otter stopped swimming because its fur coat was in such a poor condition that the coat was unable to keep the otter dry. The otter would have become waterlogged if it entered the water. Actions were taken to improve the otter's enclosure condition.

In at least one case, two giant otter cubs from the same litter were suspected to contract an infection because of the wet/damp conditions (i.e. in the den) that they were reared in. The wet/damp condition, that was responsible for the infection, caused the deaths of these parent reared captive born cubs (Corredor, pers. comm.). Fortunately, action (i.e. by the frequent addition of fresh dry deep sand in the den) could be taken, without disturbing the family rearing cubs, to provide a temporary solution to quickly reduce the wetness/dampness in the den. The remaining cub, that survived, was also given medical treatment.

Appropriate land to water ratios (i.e. sufficient land area) **and enclosure land and floors nearly entirely covered with soft sand, mulch, or/and soft loose soil** (i.e. with the substrate types, depths, and quality as recommended) **are the most important husbandry provisions needed to offer optimal grooming area and keep the land, floors, nestboxes and otters on land dry and clean.** In such conditions the otter's fur coat, body, and feet will remain in a healthy condition and otters can carry out the full extent of their innate grooming behaviors. **The other recommended land and water area locations and designs and locations for nestboxes, dens, and areas for natural underground dens should be provided for similar reasons. It is also especially important that the areas where young cubs primarily stay/are kept, remain as dry as possible. Additional furnishings (large diameter logs with bark, hollow logs large enough for entrance, nestboxes with bedding substrates etc.) that provide**

dry areas in enclosures should also be offered. This is esp. important when indoor enclosures are not available (see Section 4 below)**.** Natural underground dens that otters dig into hillsides / banks (constructed as recommended) also provide additional dry areas. Note: giant otters try to stay out of the rain so they can remain dry when they are on land. (See Sections 7 and 11 below for the recommended land area designs necessary to help keep land areas, including dens/nestboxes, dry.)

Part B. Mental and Behavioral Health Problems

Inappropriate enclosure conditions that can negatively affect the ability to successfully rear cubs, adjust to new/unusual situations, and maintain mental and behavioral health:

Observations of wild giant otters in the wild

> *"After the group returned from a hunting trip to the cubs which stayed in the den, intense grooming and play phases with the cubs could be observed.….Besides the grooming, the otters showed significant play behavior during the hunting breaks. Chasing and wrestling were typical play elements. Usually the otters play with each other. Branches, twigs and bark pieces are also incorporated from time to time. On one occasion, it was observed how the otters used a tin can that was thrown away by tourists as a play toy….The members of a group play often and extensively. The younger the otters were, the more playful they seemed. Often the young otters initiated the play, but often the whole group played also. Sometimes only parts of the group played. Adult males and females were observed playing as well."(Translation of Staib 2002) "Pteronura spends a large portion of its time ashore engaged in grooming activities…" (Duplaix 1980).*

Pteronura is extremely inquisitive and very aware of its surroundings and in captivity they require plentiful quality land area to carry out their many essential natural terrestrial behaviors (Duplaix-Hall 1972; Duplaix 1980). "The Giant Otter is primarily terrestrial but has become exceptionally well adapted to the pursuit of its prey in aquatic environments. When on land, it appears somewhat hunched and clumsy but in fact may travel a considerable distance between water bodies, tending to use well-worn paths." (Groenendijk 1998). [This species has adapted very well to using the water to find their food and move about their territory. Wild giant otters usually use the waterways to travel long distances to get from one area in their territory to another, but they also can travel as mentioned above. They are totally dependent on eating fresh water fish to survive, but they are also totally dependent on the land area located next to the water to carry out the rest of their lives. Without this land area they would not be able to survive.] *Giant otters are land mammals that swim*. In zoos, this diurnal species will spend more of its daytime hours (including day-time resting hours) on land than in the water (Salvo Souza & Best 1982; Carter & Rosas 1997). This species is intelligent, social, highly active/energetic, curious, and playful. "Giant otters belong to the carnivores with the highest degree of cephalisation (brain development) (Rohrs 1986)." (Wünnemann 1995). For many reasons, *this species requires "a lot of" complexly furnished dry land area in captivity* (Duplaix-Hall 1972 & 1975; Wünnemann 1995).

When indoor and/or outdoor enclosure land to water ratios offer smaller land proportions than recommended or/and land/floor surfaces are not nearly entirely covered with soft loose natural substrates (including appropriate depths, types, and qualities) or provided with sufficient size deep digging areas as recommended, the following problems will occur. Some essential innate terrestrial behaviors, that are among the most important activities that giant otters need to perform to maintain their mental/behavioral health and normality as well as to promote successful cub-rearing and adjustment to new/unusual situations, can/will not be carried out to their full extent or at all. As a result, otters can not carry out their behaviors in a normal and healthy way as compared to captive otters held in the recommended conditions. They, as a result, can develop mental/behavioral health problems (in addition to the abnormalities) and their ability to successfully rear cubs and adjust to new/unusual situations can also be adversely affected or significantly impaired. The more inappropriate the provisions, the greater the resulting problems and abnormalities. As well, zoo visitors will not benefit, in an educational or enjoyable way, when otters are not carrying out their behaviors in a normal healthy manner. Note: **in addition to unsuitable land to water ratios, other inappropriate land and water area designs and locations can cause the land area to become inappropriate and worsen the aforementioned conditions.**

Substrates, deep digging areas, and land to water ratios (i.e. enough land area) as recommended are the most important husbandry provisions needed to prevent mental/behavioral health problems and abnormalities and to improve and maintain otter health and normality if such problems have developed. This type of husbandry practice alone can help otters that have developed problems, because of continual exposure to inappropriate enclosure conditions, to return to a very significantly improved or completely healthy state. Giant otters have recovered from even the most severe unhealthy behaviors (i.e. stereotypical behaviors, very dulled/lack of alertness, attentiveness, and curiosity etc.) in this way. As well, those recovered animals, who encountered new/unusual situations after their rehabilitation, had the ability to successfully adjust to these situations without abnormally elevated or excessive levels of negative responses as they had shown before recovery. They exhibited the behaviors that a behaviorally healthy o

These husbandry provisions produce the aforementioned benefits by allowing and encouraging essential innate goal-oriented terrestrial behaviors to be carried out to the fullest range and extent that is possible in captivity. The most crucial of these behaviors are **digging (both deep and shallow) and grooming** as they **are among the giant otters' most favored and most frequently performed terrestrial activities in captivity** (see below for a description of how otters groom and dig). These therefore **constitute a significant proportion of their goal oriented activities. Digging and grooming carried out to their full extent** (as described below) **are among the most important activities that giant otters need to perform to maintain their mental/behavioral health and normality as well as to promote successful cub-rearing and adjustment to new/unusual situations.** Because **playing and exercising on land also constitute a significant proportion of their goal oriented activities**, *Pteronura* **must be able to carry these out to the fullest extent** for the same reasons aforementioned. Digging, grooming, playing, and exercising on land constitute a significant proportion of a behaviorally healthy giant otter's daily goal oriented activities.

The type, frequency, duration, intensity, and location of each daily behavior/activity that a giant otter carries out can, to a large degree, help determine if the needs of that captive animal are adequately satisfied/met. (Location refers to where the otter performs each activity/behavior in the enclosure.) It is very important to note that **these factors are greatly effected by enclosure quality and design.**

Giant otters with <u>healthy behavior</u> and that are **<u>kept in the recommended enclosure conditions</u>**, **dig deep into and groom, dry, rub, roll, dig and scratch on/into soft loose natural substrates throughout the entire expanse of their land area**. **As instinctively avid diggers and groomers, they carry these behaviors out with a high degree of frequency and intensity, and long** (relatively speaking) **duration throughout the day. They do not just limit the location of these activities to a specific enclosure area,** e.g. to just limited digging and grooming areas that may be provided, **they instead use the entire enclosure land area to perform these behaviors.** *Obviously the enclosure must have the appropriate land area designs and locations and the entire land area must be covered with the recommended substrate types, depths and qualities that allow these activities to take place or else otters can not use the entire land area for such behaviors*. See below. **Giant otters groom and/or dry themselves by rubbing, rolling, scratching, and digging on the surface of/into soft loose natural substrates. During these activities substrate particles are moved/dug freely about and otters' often cover their body/fur with the freed particles. They groom themselves when they are dry as well as wet and also rub on substrates to help mark their territory**. *Pteronura* also dig and scratch on/into the surface of soft loose substrates to help mark their territory and simply dig. [In the wild they use these behaviors to help form/clear "campsites" to help mark their territory.] **Captive giant otters also dig deeply into substrates whether they can create underground dens or not** (they can easily dig 100 cm (3.28 ft) deep). **They dig both deep and shallow into substrates.** Most of their activities on land are spent engaged in grooming, digging (both deeply and on the surface), marking, playing, exercising, and eating. **Behaviorally healthy otters also use the entire land area, when they are given the recommended conditions (sufficient land size and soft substrates), to frequently play and exercise on because this environment allows them to perform these activities in a comfortable and unrestricted manner.** I.e. sufficient land to water ratios allow them enough land area and soft substrates provide a comfortable surface. **In an appropriate enclosure, this diurnal species will also spend more of its daytime hours (including daytime resting hours) on land than in the water**.

It is not uncommon that institutions report that their giant otters do not dig, groom, play and/or exercise on land, or use the land area to the same degree as just described. (See why in the following pages.)

When otters are faced with new/unusual situations or are cub-rearing they can easily become stressed, tense, bored, frustrated, fearful, or nervous etc. During these times, some negative responses can normally be expected to occur to a certain degree in most all enclosure conditions. **When giant otters have been exposed to new/unusual situations, the full extent of digging and grooming activities were performed with an extraordinarily increased amount of frequency, duration, and intensity compared to otters during normal circumstances.** (Some otters that had access to live growing and/or "man-made bamboo stands" also manipulated and played with the bamboo to the same extraordinary degree.) **They used the entire expanse of their indoor and/or outdoor land areas to carry out all of these behaviors. Of their daily typical behaviors and in appropriate enclosure conditions, these were the only activities that were carried out in such an exaggerated way during new/unusual situations.** (I.e. many other appropriate options, such as swimming etc., were available to be focused on in this way.) **Because the otters could carry out these behaviors to the full extent, that allowed them to focus/divert their attentions and actions away from the stressful, frustrating, frightening, or uninteresting situations that normally can be caused because of new/unusual circumstances.** This therefore significantly reduced/counteracted the negative responses that could have developed or that could have abnormally elevated, if the otters had focused on the stressful etc. situations. These animals were able to successfully adjust to their new/unusual circumstances and they did so in a normal and healthy manner (i.e. without abnormally elevated or excessive levels of negative responses that adversely affect/significantly impair successful adjustment to new situations). **During cub-rearing, giant otters have also carried out digging in the same way as described during new/unusual situations** (i.e. with extraordinarily increased frequency, duration, etc.) **and this also provides the same benefits as just aforementioned. In captivity, negative responses (stress, frustration etc.) can develop even during typical situations.** Because digging and grooming behaviors are normally carried out to a significant degree on a daily basis in typical situations, this indicates that these behaviors help otters prevent, counteract or significantly reduce the chance that negative responses develop in these circumstances. **Digging and grooming, carried out to their full extent, are obviously among the most important activities that giant otters need to perform to prevent, counteract, or significantly reduce the negative responses, i.e. stress, boredom, nervousness, fear, frustration etc., that can occur during new/unusual situations, cub-rearing, and typical daily circumstances.**

Substrates, deep digging areas and land to water ratios as recommended are necessary to focus or divert these animals' attentions and actions in a healthy and normal way in atypical and typical circumstances and during cub-rearing. **These provisions allow and encourage otters to focus/divert their attentions and actions on an enriched and positively challenging and stimulating situation rather than on a stressful, frustrating, frightening, or uninteresting situation. The other recommended natural furnishings are important for the same reasons** (see above and Section 4 below)**.**

Additionally, the more natural, complex, and expansive the enclosure, the more benefit gained. For example, wild *Pteronura* use the multiple underground dens that they dig within their expansive territory, to rear cubs and sleep in. When given the appropriate conditions, captive *Pteronura* will dig many underground dens within their enclosures and use them for the same purposes. Natural soft loose soil hillsides, designed and furnished as recommended, promote

underground den building which is a challenging goal-oriented natural behavior. The greater the amount of the aforementioned qualities offered, the more stimulating the enclosure will be. (The quality of the enclosure is more important than the quantity of the enclosure.) Natural underground dens and expansive enclosures (enclosures that are 600 m^2 (6,458 ft^2) or larger) also help isolate parents rearing cubs from human disturbances and presence and this is crucially important to aid successful cub-rearing (Duplaix-Hall 1975; Louzada da Silva, pers. comm. 1998, Genealogical Meeting…in Brazil" 1998, Sykes 1998; Sykes-Gatz 2001).

In the wild, an animal is faced with many challenges and new situations created by the unpredictable, changing, and very complex natural world in which it lives. As an animal travels throughout its territorial boundaries, it must encounter new situations using the wide variety of complex behaviors that it has learned or are innate. The captive environment is often unchanging, predictable, non-challenging, and does not offer a widely varying and complex environment. This invariably becomes a less mentally and physically stimulating environment, giving the individual fewer opportunities to use the wide variety of behaviors it has available (Hancocks 1980). In these cases, the occurrence of non/less directed or non goal-oriented behaviors, or less complicated behaviors will rise replacing the more directed intentional and/or complex behaviors. For some, boredom, frustration, stress, and even stereotypical behaviors etc. may develop. The larger, more natural and complexly structured the enclosure (including both land and pool), the better the chance to stimulate natural goal-oriented behaviors and give the animal a sense of control in its environment. An individual will be faced with more choices, variety, challenges, behavioral opportunities, and very importantly a healthier more stimulating environment. These provisions in themselves will help reduce the chance that mental and behavioral health problems will occur (Hancocks 1980; Worley and Hare 1995).

When indoor or/and outdoor enclosure land to water ratios offer smaller land proportions than recommended or/and land/floor surfaces are not nearly entirely covered with soft loose natural substrates (including appropriate types, qualities, and depths) or provided with sufficient size deep digging areas as recommended, the following problems will occur.

Not enough land area because of improper land to water ratios, small or limited deep digging and grooming areas, inappropriate substrate types, qualities, and depths, and enclosure land areas only partially covered with soft loose substrates are not uncommonly the only areas offered for terrestrial activities to take place. All of these areas are insufficient for any of the necessary behaviors to be carried out to their full extent. In such conditions, surfaces can/will not be dug into or groomed, played, or exercised on effectively, comfortably, or at all. Digging and full grooming behaviors can only be carried out in small or limited areas, rather than the entire land area, therefore this behavior is significantly restricted. Too often, giant otters are kept on hard or artificial surfaces (e.g. concrete, tile, rock etc.), pebbles, small/river rocks, or sand or soil mixed with pebbles, gravel, or small rocks throughout. Because the land area that is offered is usually not soft and/or large enough it does not allow or encourage otters to use it as they should. Otters can not play and exercise in an unrestricted and comfortable manner in such areas. (Hard or coarse surfaces are not only uncomfortable for otters to play and exercise on, but they also cause physical health problems. Insufficient land area literally limits the physical space that otters have available to freely play and exercise.) Digging can not be carried out on hard surfaces and if otters dig in soil or sand mixed with pebbles or small rocks throughout or pebbles alone, their feet will be harmed, they can not carry out the behavior to its full extent, and a comfortable surface is not provided for these activities. Grooming can not be carried out to its full extent on the aforementioned surfaces and these surfaces do not provide comfortable areas to do such. As well, substrates that are not deep enough (i.e. below the recommended minimum

depths) or loose enough (e.g. tightly packed/compacted soil) to allow sufficient and easy digging (both deep and shallow) or full grooming behaviors are sometimes offered. Land with soft loose soil, but no, not enough, or only small areas of hills for deep digging, are also sometimes offered. When enclosure terrain is fairly flat and soft loose soil (with/without grass, turf, or vegetation) is provided, otters will not be able to dig deeply, so hills/banks, with the recommended designs and substrates, must be provided for this activity when only soil substrate is offered. Otters will/can not groom on very damp or wet surfaces, whether they are soft and loose or not. See the introduction above for the inappropriate substrate types, depths, and qualities, land and water area locations and designs, and locations for nestboxes, dens and areas for natural underground dens which cause land areas (including sleeping areas) to remain very damp/wet. Small or limited grooming areas will also remain very damp/wet when they are the only areas offered for grooming.

Otters either will not or can not use or cannot use without inefficiency, difficulty, lack of comfort, and/or harm to their physical and/or behavioral health or normality, inappropriate substrate types, qualities, or depths, or insufficient land or digging areas to dig, groom, play, exercise, or simply live on. **Such land area will not be able to be used to the full extent that is natural and normal in captivity and the more insufficient these provisions are, the greater the resulting problems and abnormalities.** The giant otters' enclosure will not be enriched, positively challenging, or stimulating and **it will not offer the appropriate digging, grooming, and terrestrial playing and exercising opportunities that are necessary to maintain health in captivity**.

The full range or/and extent of goal oriented terrestrial behaviors that giant otters normally could perform in captivity will decrease and become limited. The most important of their essential innate terrestrial behaviors will not be encouraged, carried out, or carried out to the full extent they innately could be. The type, frequency, duration, intensity, and location of the daily behaviors/activities performed will become unbalanced and abnormal **compared to that of a *healthy captive otter housed in appropriate conditions**. There are essentially significantly fewer alternatives on which their attentions and actions can be healthy and normally directed and focused on. Digging, grooming, playing and exercising on land, and the amount of time otters spend on land (vs. in the water)** are the behaviors that will become most often affected in these negative ways. ***Healthy giant otters will perform behaviors to a different extent than an otter that has not always been exposed to appropriate enclosure conditions. See this discussion below.* ****The misinterpretations that can occur during studies/observations evaluating land vs. water use and aquatic and terrestrial activities are discussed below.*

Digging and grooming behaviors will significantly and abnormally decrease in frequency and duration. The location where these behaviors will be carried out within the enclosure will become very limited (e.g. to limited or small digging or grooming areas rather than the entire land area). **The amount of time otters play and exercise on land will also significantly decrease and otters will likely only use limited land areas, rather than the entire land expanse.** [E.g. hard, artificial, or coarse (e.g. pebbles, river rocks or sand/soil mixed with pebbles, gravel, or small rocks throughout etc.) surfaces are uncomfortable for otters to play and exercise on. Insufficient land area (size), because of inappropriate land to water ratios, literally limits the physical space that otters have available to freely play and exercise.] **All of these behaviors will be carried out with decreased intensity. Giant otters will also spend a significantly greater percentage of their entire day in the water than on land because there are far fewer opportunities for them to carry out goal-oriented behaviors on land.** These animals will spend less time on land than an otter housed in the recommended conditions. **The**

more unsuitable the enclosure land area, the more time otters will spend in the water vs. on the land. There is simply less for them to do on land in these poorly enriched and less stimulating and challenging environments. **The otters have no area where they can fully carry out their most important natural terrestrial behaviors and this constitutes a significant proportion of the giant otters' daily goal oriented activities.** Without these activities, non/less directed, intentional, or goal oriented behaviors, which are unhealthy, will be performed as substitute. **Giant otters will swim aimlessly or swim pace in the water rather than walk aimlessly or pace on land**. Swimming aimlessly means that the otter is swimming without real purpose to accomplish something. E.g. it is not swimming to exercise, play/interact with other otters, catch fish, etc..

When giant otters behave in the aforementioned ways in captivity, they are not carrying out their behaviors in a normal and healthy way compared to captive otters that can carry out their behaviors to the full extent, therefore these animals, in comparison to the aforementioned otters, are not exhibiting normal and healthy behavior. Unfortunately giant otters are not uncommonly reported to behave as such, therefore a significant number of institutions mistakenly assume that this is an exhibition of normal and healthy behavior in captivity. Observations of giant otters held in partially, or even totally, inadequate enclosure conditions as described or of otters that have not recovered to full health because they have been exposed to appropriate enclosure conditions for only part of their life (see below), have often caused these misconceptions. **Otter enclosures are often designed and furnished with these misconceptions, as well as the misconception that river otters are aquatic mammals, in mind.** Giant otters are reacting in these ways because their enclosures do not offer land area where they can/will carry out digging, grooming, playing, and exercising on land to the full extent. The entire land area can not be used in the way that is necessary to maintain normal healthy behavior. I.e. inadequate environments do not offer sufficient area on which otters can focus on or divert their attentions and actions to in a healthy and normal manner.

When the behaviors, that are among the most important needed to help prevent, counteract, or significantly reduce the chance that negative reactions develop (i.e. stress, boredom, nervousness, fear, frustration etc.), become severely impaired, the chance that negative responses will occur are significantly increased. I.e. because the otters can not carry out digging, grooming, playing, and exercising on land to the full extent, their opportunities to focus/divert their attentions and actions away from the stressful, frustrating, frightening, or uninteresting situations that can occur during typical daily, new/unusual, or cub-rearing situations, are significantly limited. The negative responses that can develop or abnormally elevate in such circumstances cannot therefore be significantly reduced/counteracted, when the otters focus on the stressful etc. situations. Abnormally elevated and excessive levels of negative responses can occur when the recommended enclosure conditions are not offered. The more inappropriate the enclosure conditions, the more limited their opportunities are to carry out normal healthy behavior, the less the ability they have to counteract/reduce the negative responses, and the greater the resulting health problems.

As a result, mental/behavioral health problems (in addition to the abnormalities) have occurred, among a significant number of giant otters, in typical daily circumstances in varying intensities from mild to severe. Stereotypical behaviors (esp. swim pacing), less/non directed or non-goal oriented behaviors (esp. swimming aimlessly/without purpose sometimes to an excessive extent), frustration, stress, tension, very dulled/lack of alertness, attentiveness, and curiosity, depression, dulled responsiveness, nervousness, fear of change, and other abnormal behaviors have occurred. Additionally, as a result, the negative

responses that usually/normally or easily occur during cub-rearing or new/unusual situations can be increased. Abnormally elevated and excessive levels of negative responses have occurred and these reactions in turn have caused greater problems. I.e. **the ability of giant otters to successfully rear cubs and adjust to new/unusual situations has been adversely affected or seriously compromised.** (Increased negative responses, resulting from the new/unusual or cub-rearing situation, can occur alone or in addition to any already existing mental and behavioral health problems that have been caused by inappropriate enclosure conditions. Other additional stressful situations during these times, e.g. when otters are captured, examined, anesthetized, held in very small enclosures, will only aggravate the problems.)

For example, stress to giant otter parents rearing cubs has been responsible for many litter losses. (See the affects of stress etc. on cub-rearing success in Section 10.) Stress, most especially results from human disturbances and presence during cub-rearing, although inadequate enclosure conditions (as described) can increase stress caused from these sources and/or in itself create additional new stresses during cub-rearing. E.g. bored or stressed parents or older siblings can excessively focus on, handle, play with, abuse, or kill cubs or be responsible indirectly or directly for the cubs' death, as a result of having nothing else better to focus their attentions on. Additionally, sometimes during cub-rearing giant otters may have to be held in indoor enclosures (e.g. during cold weather or to offer privacy) and locked out of their adjoining outdoor enclosures. It is very important that these generally smaller indoor enclosures are properly furnished and designed to counteract the frustration, boredom, etc. that otters, who normally have year-around outdoor access can likely experience. This is also crucial in all small enclosures [i.e. enclosures below 240m² (2,583.4 ft²)] such as temporary holding areas, quarantine, or any enclosure, whether permanent or temporary. When animals are moved to new enclosures or held in quarantine or temporary holding areas fear, stress, boredom, and nervousness can be significantly reduced with just the appropriate provisions aforementioned. Without such provisions, negative responses can increase, so that the ability to successfully adjust to these new situations can be adversely affected or seriously compromised and future healthy behavior (if the enclosure is a permanent/long-term home) will not be possible in such conditions.

(Note: when appropriate conditions are provided during quarantine (or at any other time), enclosures can easily be kept sanitary and otters will be able to stay clean and dry when they are on land. Also, when just a very small area of hard surfaces are left without soft loose substrates, giant otters will usually eliminate only on this area, so fecal samples can be easily collected.)

During introductions of unfamiliar animals and temporarily separated familiar otters, animals need to take frequent breaks from the intensity and tension (and possibly fear) of the new situation by having stimulating enclosures to focus their activities and attentions on. They also need to refocus their attention on something else other than solely each other. (It is important to remember that in addition to the otters having to adjust to each other, they also have to adjust to a new enclosure, husbandry practices, keepers, etc. when they are moved from other locations and this can cause additional stress. Also when otters are held in very small temporary holding enclosures, such as in quarantine or separable enclosure areas (during visual introductions), this may likely cause additional stress.) It is especially important that they have adequately furnished and sufficient land area to focus on to relieve their stress etc. and focus on something else other than the other otter. They also need sufficient land area to get away from each other and rest alone. Focusing solely on each other and/or abnormally elevated or excessive negative responses can cause introduction difficulties. It can result in serious fights and injuries. (Refer to Chapter 2 Sections 18 and 10C for injuries and/or deaths caused during the introduction of

unfamiliar and temporarily separated animals.) The other natural furnishings as recommended (see Chapter 2 Section 4), in addition to the aforementioned essential enclosure conditions, helps further to reduce stress, boredom etc. in all situations. Natural furnishings, such as plentiful large logs, bamboo stands (both live growing and/or "man-made"), etc. and the aforementioned essential enclosure conditions will also provide the following: enough land area and safe furnishings to allow an otter to get away from the other animal, stay out of the other's view, and rest alone in semi-private places when it needs to take a break from the other otter or the intensity of the situation. (Note: nestboxes must be closed during physical full-contact introductions.)

The recommended land to water ratios (i.e. enough land area), substrates, and deep digging areas are the most important enclosure conditions/husbandry provisions and otters being able to carry out digging, grooming, exercising and playing on land to their "*full extent*" are among the most important behaviors, that giant otters require to reduce stress and other negative responses during all situations. They are also the most important husbandry provisions and behaviors needed to resolve the aforementioned problems. These essential enclosure requirements are necessary to promote successful cub rearing and adjustment to the new/unusual situations, provide adequate enrichment, and maintain mental/behavioral health and normality. It is necessary that enclosures are as enriched as possible during new/unusual situations and cub-rearing. Note: the recommended enclosure furnishings and designs already described above are the most important forms of environmental and behavioral enrichment. If although, additional enrichment can be offered, this should be provided. For example, it is highly advisable to provide toys for additional behavioral enrichment. ***Toys for behavioral enrichment should only be used as addition to and never as a substitute for the recommended enclosure furnishings and designs.*** (See Section 15 for toys for additional enrichment.)

***Giant otters that have not had exposure to appropriate enclosure conditions during their entire lives or developmental stages, or for a long period, may take some time to "adjust to activating/using" their innate terrestrial behaviors after appropriate environments are offered. They then can carry these activities out to a full or at least moderate degree of normality and healthiness, as compared to an otter that has had proper exposure throughout its lifetime.** I.e. after recovery grooming, digging, playing, and exercising on land are carried out with a moderate degree of frequency, duration, and intensity. Totally healthy otters although, carry these activities out with a high degree of each. The recovered otters although have significantly improved, as without the recommended conditions these activities are not carried out at all or are carried out only to a minimal degree. The amount of time a recovered otter spends on land as opposed to in the water will also increase accordingly, most esp. because goal-oriented behaviors are carried out on land more frequently and for a longer duration. (Including resting/sleeping, they spend more of their day time hours on land than in the water.) These otters will spend significantly more time on land than an otter without the recommended circumstances that may spend most of its day in the water. These "rehabilitated" otters will although use the entire expanse of their land area to carry these terrestrial behaviors out. This represents a full recovery as they use the land area to the same extent that a totally healthy otter would. Otters without the recommended provisions will only use a limited or small part of their land area. (See the discussion below about the number of animals that have made recovery.)

These recoveries are accomplished only by making simple changes to the enclosure in which the animal lives or by moving the animal to a new enclosure so that a suitable environment is

offered. I.e. it is only necessary to correct the conditions that are responsible for causing their abnormalities and unhealthiness and no other techniques are needed.

The otters that do not recover to 100% health and normality, because they do not carry out all of their essential terrestrial behaviors to the full extent they innately could, **are unfortunately sometimes misinterpreted as being a totally healthy otter**. This behavior should although not be considered normal, but rather an animal that is displaying a very significant improvement in mental and behavioral health. Because a very significant, rather than full recovery, may occur this *should not be considered as a reason to not provide the necessary furnishings and designs*.

The period of "adjustment", i.e. how long it takes the otters to activate their innate terrestrial behaviors, seems to vary upon how much exposure to appropriate conditions the otters previously had and if they were paired with another otter who exhibited "healthy" behaviors. An otter with more exposure to suitable circumstances in the past or an otter that is paired with another animal who is completely behaviorally healthy seems to have shorter periods of adjustment than an otter without these benefits. It seems that the longer that a deprived otter has lived in suitable enclosures in its past, especially during its development, the more frequently and intensely and the longer, it may carry out terrestrial activities, once it is again reintroduced to a sufficient living area.

Additionally, **giant otters who have been offered the recommended enclosure conditions alone, have been able to make a very significant or full recovery from even the most severe unhealthy behaviors** (see those listed above under negative behaviors oc

exposed to similar situations as just aforementioned [partial improvements in enclosure conditions] and reports indicated that their behavioral health improved as well. No additional or detailed information was available.)

****When the percentage of day-time hours that an otter spends on land vs. in the water or terrestrial and aquatic activities are studied in captivity, the following must be taken into account and analyzed when results are interpreted and conclusions are drawn.** The presence and extent/degree of appropriate and inappropriate enclosure designs and furnishings (i.e. esp. whether the recommended land to water ratios, land and floor substrates, and deep digging areas are offered), husbandry and management practices, and particular/non-typical life events (i.e. whether parents are rearing cubs or otters are in unusual/unfamiliar circumstances etc.) must be evaluated. Natural environmental conditions (i.e. weather conditions, e.g. such as extended rainy, hot, or very cold periods etc.), how much exposure animals have had in their past to inappropriate and/or appropriate enclosure conditions, animal health and social structure must also be evaluated. **These factors can significantly affect otter behavior and activities and therefore the results of such studies. When one or more of these factors are not accounted for, misleading conclusions can be made that other captive otters will or should also act in similar ways in other conditions,** whether these conditions are similar to those in the study or not. **Behavior exhibited by otters kept in inappropriate enclosure conditions or by those that did not recover to 100% normality and health after they were offered appropriate conditions, may also be misinterpreted as being completely normal healthy behavior, when the relevant factors are not taken into consideration.**

****Specific considerations must also be accounted for when attempts are made to compare the percentage of day-time hours that a wild otter spends on land vs. in the water to that of the same in otters in captivity.** Such comparisons can not accurately be made on the premise that captive and wild otters should act similarly, because such a premise is incorrect. (The same/similar considerations should also be taken into account when other particular terrestrial and aquatic activity/behavior studies are compared.) In captivity, otters live in a very different environment compared to the natural habitat that their wild relatives live in. A giant otter or any otter species in the wild will act, at least in certain aspects, differently than its relative held in captivity. This is because on a daily basis a wild otter encounters and must respond to (with a wide variety of behaviors) a very different situation than a captive otter. The unpredictability and varied and challenging conditions found in the wild can never be fully replicated in captivity. (Of course although it is important to provide these conditions to the greatest degree that is possible in captivity.) E.g. giant otters in captivity are not dependent upon fishing or searching for fish over a large expanse or significantly varied and highly challenging environment to acquire their fooeic le

Following are excerpts from an unpublished long-term study and some examples on which these conclusions are partly based. Reports and observations of giant otters held in numerous institutions world-wide and historically were gathered and analyzed for comparison (Sykes-Gatz & Gatz, unpublished study 1996-2004). The information was gathered from publications, unpublished reports, survey results (Sykes 1997-99 and follow-up surveys), pers. communications, and pers. observations. The activities that giant otters carried out on a daily basis and their corresponding mental/behavioral health and enclosure conditions were used to make comparisons and draw conclusions. The following additional factors were also considered: group social structure, husbandry and management practices, particular/non-typical life events, natural environmental conditions (i.e. weather conditions: at least general estimates and sometimes more specific estimates were able to be made), and how much exposure the otters had in their past to inappropriate and/or appropriate enclosure conditions and physical health (in some cases full histories were not known about the last two factors). The land activities considered included playing with each other, playing with objects (overhanging/standing bamboo, toys etc.), investigating, moving about the land area to exercise (e.g. walking, running, etc.), eating, elimination, territorial marking, deep and shallow digging, and grooming (which includes rubbing, rolling, scratching and digging on/into the surface of substrates and this can also include drying). Aquatic activities, i.e. swimming, diving, wading, playing, exercising, investigating, eating, and chasing fish or other otters, and sleeping/resting (which was not considered an "activity") were also considered. Grooming, digging, playing, and exercising on land, the extent of land use vs. water use, and general aquatic activities were primarily focused on to make general categorical comparisons. **The type and a general approximation of the frequency, duration and intensity of each category of daily behavior/activity and the location of where the otter performed each activity/behavior** within the enclosure were evaluated. Usually this information was gathered by casual daily visual observations over varying time periods (i.e. from many years to days). Qualifications were only specified by use of the terms, "high, moderate, low or minimal, none, long, and short" or/and by percentages. The mental and behavioral health status/abnormalities were qualified by the terms "healthy, normal, not healthy or normal, abnormal, unhealthy, or mildly, moderately, or severely unhealthy, or fully, partially, or significantly recovered/rehabilitated to a healthy state, or abnormally elevated or excessive levels of negative responses." Abilities to successfully rear cubs and adjust to new/unusual situations were qualified as "successful, adversely affected, or seriously compromised". The evaluation of the quality of enclosure conditions offered was based on the extent that the recommended land to water ratios, substrate furnishings, and deep digging areas were satisfied.

The conclusions revealed that when indoor or/and outdoor enclosure land to water ratios offered smaller land proportions than recommended or/and land/floor surfaces were not covered with soft natural loose substrates or sufficient size deep digging areas as recommended, that the otters housed in these conditions carried out their terrestrial behaviors in an abnormal and unhealthy way. They did not therefore exhibit normal and healthy behavior. Other behavioral/mental health problems, from mild to severe, were also obviously evident (reported/observed) in a significant number of cases. Of the aforementioned unhealthy individuals that encountered new/unusual situations or reared cubs and whose behaviors, mental/behavioral health, and enclosure conditions were observed or reported during those situations, these animals exhibited abnormally elevated or excessive levels of negative responses during those situations. Their ability to successfully rear cubs and/or adjust to new/unusual situations was therefore seriously compromised or adversely affected. These animals were housed in enclosure conditions that were not appropriate (i.e. as described above) during these atypical circumstances. The more

inappropriate the enclosure condition that these animals were exposed to, the worse their mental and behavioral health was.

On the other hand, otters offered appropriate conditions as recommended, carried out their terrestrial behaviors in a healthy and normal manner and behavioral/mental health problems were not observed and/or reported. (Additionally, see below and above descriptions for animals that recovered from unhealthy behavior because of being housed in inappropriate enclosure conditions.) Of the aforementioned healthy individuals that encountered new/unusual situations or reared cubs and whose behaviors, mental/behavioral health, and enclosure conditions were observed or reported during those situations, these animals did not exhibit abnormally elevated or excessive levels of negative responses during those situations. Their ability to successfully rear cubs and/or adjust to new/unusual situations was therefore not seriously compromised or adversely affected. They were housed in appropriate enclosure conditions during these situations. (The details of these behaviors and problems and reasoning for them are the same as what has been presented above.) Because of space limitations it is only possible to give a couple detailed examples and brief discussions to illustrate these issues. Also see Chapter 2 Section 10 for other examples.

The following otters were observed (Sykes-Gatz & Gatz, pers. obs.). In 1998 four giant otters (in two separate enclosures) and in 2002 eleven giant otters (in two separate enclosures) that were all housed at *Brasilia Zoo* were used for comparison studies. (All but one of these otters lived their entire lives at this institution. The otters ranged in age from young to very old. Only two of the otters observed in 1998 were also re-observed in 2002.) Brasilia Zoo provides optimal enclosures therefore these animals were used as a base standard for the exhibition of completely "healthy and normal" behaviors. (See Part A of this section and throughout Chapter 2 for an enclosure description.) E.g. they dug and groomed with a high degree of frequency, duration, and intensity, they played and exercised on land frequently, and they used the entire extent of their land area to carry out these behaviors. They also spent more of their daytime hours (including daytime resting hours) on land than in the water. One of the otters who was born and reared at Brasilia Zoo and then moved to another institution at 2 years old, was also used to make comparison studies before and after she was moved to her new surroundings. Because her new environment provided appropriate housing conditions she continued to exhibit healthy normal behavior. I.e. she exhibited the same high degrees of land activities, land use times, general healthy behavior, etc. as the otters observed at Brasilia. (This study was concluded nearly a year after her move.) All of these otters were also physically healthy.

Additionally, eleven other giant otters in six other zoos were observed/monitored first hand and their activities, behavioral/mental health, and enclosure conditions were used to make comparisons. Note: one of the otters observed at Brasilia zoo and then transferred to a new zoo (i.e. within this category), is not included within this number to avoid redundancy.

The history of four giant otters that were monitored and eventually offered appropriate enclosure conditions after they had been housed in inappropriate conditions over a long-term period, follows. Two of these otters had significantly limited exposure to digging areas and soft substrates, one for 11 years and the other for 9 years (nearly their entire life span at that time). Their land to water ratio was sufficient (see the exception that follows), but they were housed in enclosures where the majority of their land area was made of tile, concrete, or natural rockwork. (In one indoor enclosure area the ratio was highly unsuitable and therefore a very limited land area was offered. For a limited period of time they were exposed to appropriate conditions during the aforementioned years.) Another otter had no exposure to any digging areas or soft

substrates for most of his life (i.e. 11 years at that time). This otter had very little land area, because of an unsuitable land to water ratio, and he was kept on all concrete surfaces. For the following year and in other enclosures he was offered mostly hard surfaces (both with appropriate land to water ratios). The remaining fourth otter had limited exposure to a small digging pit and soft substrates that could not be dug into or no soft substrates for 4 years. Appropriate land to water ratios were offered. In the following 7 years (11 years was his life span at that time) no digging areas or soft substrates were offered. This animal was housed on all concrete surfaces and a very small land area. (The aforementioned otters were housed in at least 2 or more different institutions during their life times.) These otters obviously had no sufficient area to carry out the full extent of their innate digging and grooming behaviors and in some cases no opportunity to perform digging behaviors at all. They also, for most of their lives, had no or little comfortable land area on which they could play and exercise. The frequency, duration, and intensity of these behaviors were significantly and abnormally decreased as compared to a healthy otter and the location where these behaviors were carried out within their enclosures were very limited (e.g. to just small digging or grooming areas). **They carried these terrestrial behaviors out to a minimal degree or not at all. They spent much more of their day in the water than on land (including their resting hours) and most of their water activities were limited to swimming aimlessly or at times swim pacing** (i.e. a stereotypical behavior performed in the water). These animals also exhibited daily either some or all of the following behaviors: nervousness, fear of change, tension, stress, depression, boredom, frustration, and/or very dulled/lack of alertness, attentiveness, and curiosity. During new/unusual situations and additionally for two otters during cub-rearing, abnormally elevated or excessive levels of stress were exhibited and successful adjustment to these situations was seriously compromised. (See Section 10 for detailed information on such occurrences).

Three of these four animals (the first 3 described) were first exposed to enclosures which offered the recommended deep digging areas and "nearly appropriate" grooming and land areas at approx. the latest ages that were reported above. I.e. "nearly appropriate" means that the majority (rather than the entire or nearly all as recommended) of the land areas were covered with soft loose substrates (mulch/sand). Although, eventually their enclosures were improved so that they were offered digging, grooming, and land areas (i.e. appropriate substrates nearly entirely covered all the land and floor areas) as recommended. The fourth animal was first exposed to an enclosure that was appropriately furnished as recommended, but this only occurred 5 months before the conclusion of this particular study. Appropriate land to water ratios and other important natural enrichment furnishings (i.e. large logs both on land and in the water, bamboo stands etc.) were also offered to all of these animals. After these animals were first exposed to appropriate or nearly appropriate enclosure conditions and underwent an "adjustment period", they all dug, groomed, played and exercised on land with a moderate degree of frequency, duration, and intensity as compared to a healthy otter. They also spent much more of their day (including their resting hours) on land than in the water. They although used the entire land area to carry out their terrestrial behaviors. The stereotypical swim pacing was no longer performed and their other abnormal unhealthy behaviors either were significantly reduced (i.e. aimless swimming etc.) or completely eliminated (i.e. very dulled/lack of alertness, attentiveness, and curiosity; depression, nervousness etc.). **Just with appropriate enclosure conditions alone** (i.e. appropriate substrates, land to water ratios, and deep digging areas) **they were able to make significant or full recovery from their mental and behavioral health problems and abnormalities.** (Either the animals were moved to a totally new enclosure or only the conditions aforementioned were changed within the enclosure they had been living in.) These recoveries were achieved within approx. a half a year to one year's time. These animals are still behaving in the same way, i.e. either for a couple/few years after the conclusion of this

study. They also have been successfully adjusting to new/unusual situations. See the behaviors exhibited during cub-rearing before and during two of these animals' recoveries in Section 10 below.

The last or fourth aforementioned individual otter seemed to be very "wary" of soft loose natural substrates in the first week of initial exposure to this surface. Within the next days he became more comfortable with the substrates. (Initially he walked on top of and investigated the mulch and sand in a very cautious, suspicious, and fearful manner. He also had the same fear for the bamboo and cardboard boxes in his enclosure. He was also fearful of any change to or within his enclosure or any movement made by his caretakers. He had just been moved to a new facility, although these reactions to such a change have not been reported to occur in other giant otters.) After the first 1 1/2 weeks, he was introduced to his new female mate, who had completely healthy terrestrial and mental/health behaviors, and whom he had been watching on the other side of his enclosure. This male who did not yet exhibit digging and grooming behaviors, initiated these behaviors to a extraordinarily high frequency, duration and intensity on the day that he was first physically introduced to his new mate. He also used the entire enclosure land area to carry out these behaviors. He used the bamboo with great frequency and played with the cardboard boxes on the same day. (See a full description in the paragraph below.) It although took him several more months after he was first introduced to his new housing conditions (and new mate), to act normally (i.e. without abnormally elevated or excessive levels of fear) to any new changes and his caretakers.

Although, the following events occurred when the last aforementioned animal and his new mate, which were first given a proper visual-acoustic-olfactory introduction because they were unfamiliar with each other, underwent their first day of a full physical contact introduction. (Their enclosures, which were adjacent to each other, had appropriate land to water ratios, substrates, and deep digging areas as well as plentiful natural furnishings and toys. Their two separate enclosures, which were divided by an introduction fence, were connected for the physical introduction.) Both individuals, with an extraordinarily increased amount of duration, intensity, and frequency, as compared to an otter under normal circumstances, groomed and dug deep into the mulch and sand throughout their entire enclosures. They also, to the same extraordinary degree, manipulated and played with the plentiful supply of standing, overhanging, or just pulled down "man-made bamboo stands" throughout their enclosures. (The bamboo stands were made as recommended, see Chapter 2 Section 4.) They carried out these behaviors, to an extraordinary degree, over several hours. (They had opportunity to carry out other behaviors, such as swimming etc. to this unique degree, but they did not.) This significantly reduced their stress and prevented them from focusing solely on each other during the full-contact introduction. The bamboo and logs in their enclosures also gave them plentiful area to lay or rest behind when they wanted to get away from the other otter for a break in the tension. The nestboxes were closed to prevent entrapment during the introduction. Although there was a significant degree of tension and stress during the first several hours of the introduction as could be expected, excessive or abnormally elevated stress and tension, and serious fighting did not develop. A worse situation could have easily developed if they were kept in inappropriate enclosure conditions and had nothing else better than each other or the intensity and tension etc. of the situation, to solely focus their attentions on. These animals were able to stay together permanently from their first full day of contact onwards. It was a highly successful introduction and the otters adjusted well to each other within the first day of full-contact.

Section 4
Natural Land Furnishings (other than substrates) for Every Enclosure

Note*:* the **substrates required for all enclosure floor and land areas are not discussed within this section.** *See Section 2 above.* **Natural furnishings for use within pools are only partially discussed here,** as is vegetation*. See Sections 6-7 below.* **"Furnishings *and* furniture"** *refer to any natural items (e.g. soft loose natural substrates, logs, boulders, trees, cut or growing bamboo etc.) that can be placed in an otter enclosure.*

A complex, plentiful amount, and variety of natural furnishings should be provided within all indoor and outdoor enclosures (i.e. this also includes off-exhibit living and temporary holding areas, quarantine, separable enclosure areas etc.) (Duplaix-Hall 1972 &1975; Wünnemann 1995; Sykes-Gatz 2001). Natural furnishings will help to offer shelter (e.g. from the wind, rain, and direct sun) and semi-private resting places. (See Section 9 for natural furnishings that should be used to provide shelter in outdoor enclosures.) Natural furnishings, other than the necessary land and floor substrates, can also provide a small amount of supplementary drying and grooming areas, as well as dry resting areas. They also can help otters to reduce their stress and provide additional enrichment. More challenging and stimulating places to exercise, play, and investigate will be available. This is necessary so the otter will be faced with more choices, variety, challenges, behavioral opportunities, and very importantly, a healthier more stimulating and enriched environment. This type of environment would, at least to a small degree, help to replicate what a giant otter would find in the wild. More choices allow otters more control within their environment and this reduces the chance that stress, frustration, boredom, fear etc. will develop (see Section 3B). This is especially important during cub-rearing and when otters are exposed to new/unusual situations (see Sections 10 and 18). Note: the recommended land and floor substrates are the most important and primary areas that otters need to dry and groom themselves. They (including the required deep digging areas) are also the most important furnishings and are among the most important husbandry provisions needed to help otters reduce their stress and other negative responses in all situations and to provide enrichment. (I.e. otters need the recommended substrates to maintain their mental/behavioral, as well as physical health.)

The following furnishings are especially favored and well used in captivity as most are similar to the natural items that a giant otter would often use in the wild (Duplaix-Hall 1972 *&* 1975; Duplaix 1980; Staib 2002). *All furniture should be checked for safety to make sure otters can not become trapped within, between, or under the items when they are on land or in the water or become pinned between floating or submerged large objects and the pool-sides.*

Giant otters very frequently use large diameter logs and hollow logs, that are large enough for entrance, to rest and play on / in, groom, dry, and sun themselves on, as well as eat on top of. Logs, esp. those with bark, and hollow logs can provide a small amount of supplementary drying and grooming areas as well as dry resting areas, as they are elevated from the ground surface and are somewhat absorbent and hollow logs also offer an enclosed space. In addition, these furnishings can offer semi-private resting areas when otters lie behind or in them. **These therefore are highly recommended for indoor and outdoor use**. **At least, logs that are large enough in diameter and long enough for otters to lay on** and that preferably still have their bark, **should be placed within indoor and outdoor enclosures**. It is ideal to place them esp. along the shoreline itself and around the dry land area just behind the shoreline / water area edge. It is although important to offer logs on inner land areas as well, so otters can play and chase each other around them and lay in areas that are farther removed from the water. (Such

furnishings will also remain drier in more inland areas.) Logs 35 cm - 40 cm (14" - 16") in diameter and upwards are ideal for the aforementioned purposes. They should be from deciduous trees and not coniferous trees*, as the latter tree may have sap that could foul the otter's fur.* It is ideal if the logs have bark and if more than one otter can lay on them. If some of them have large forks that the otters can lay or climb on, this will add some variety as well.

Partially submerged large diameter logs that span from the water/pool to the shoreline's edge are highly recommended as they are well used both in captivity and in the wild. Logs such as this should offer ample space for at least one and preferably two or more otters to lie in a full-extended position on and groom and dry themselves upon. **Logs with large forks can also be positioned so at least one fork is raised in the air.** Otters often like to climb and stand/lie on the raised fork above the water's surface as long as the fork is not angled (vertically) too sharply. Wild giant otters (including entire families) regularly use these to rest (while napping or eating), groom, and sun themselves upon (Staib 2002). **Logs with a smaller diameter** that otters are just able to rest part of their body on (e.g. their chests and front legs) while they are eating, playing etc. in the water can also **be provided in a similar way for variety**, as these are well used too. This provision would work esp. well in the deeper part of the water area where the logs could be slanted at a sharper angle. Totally and partially submerged logs and branches of varying sizes should be provided in water areas. The more forks that the logs and branches have, the better. Leaves on branches and bamboo can be removed if necessary to help prevent water filtration/drain blockage. (These furnishings will also help to provide some enrichment in the water area for swimming, playing, chasing fish around etc..)

A large diameter log that extends over and just above a body of water or/and land area (that otters can easily access/use as if it were a bridge) is highly recommended to offer in addition. Otters will frequently use this to rest/lay on. Log bridges can also be cut so they provide flat surfaces for otters (esp. those with cubs) to walk over. (A man-made wooden bridge/cross-over could also be offered.) Large felled trees could also be provided on land, over water/land areas, and partially and/or totally submerged in the water

Giant otters seem to naturally enjoy climbing as well as resting on the tops of surfaces that are elevated. They will often climb and rest on large logs, logs with forks, log/wooden bridges, the tops of large stumps or the tops of their extended roots, the tops of nestboxes, large boulders, and safe (heavy plastic or wooden) crates (e.g. bread tray etc.) that are turned upside down. Large diameter logs that are turned on their end and securely sunk into soft substrates or that are standing in some other secure manner will also be used to stand or rest on. Usually at least 2-3 or more logs should be on end and side by side to provide enough surface area for otters to climb and rest on.

Giant otters also esp. **like to dig underneath large diameter tree stumps that have extended long thick roots, so these are highly recommended for both indoor and outdoor use.** These should be placed in the mulch and/or sand deep digging areas, as well as hillside areas used for deep digging so that the otters can fully utilize them. Such furnishings may help prevent outdoor natural underground dens from caving in and hillside soil erosion. Live growing trees with some exposed roots could also be provided in the deep digging areas, esp. in areas with hillsides. It is very common for this species in the wild to dig their dens underneath tree roots (Duplaix 1980).

Submerged logs, tree stumps or boulders that extend close enough to the surface of the water, so that the otters can stand on / rest their bodies on these items and keep their head or other body parts above the water, are also well used by both captive and wild (Groenendijk

pers. comm.) giant otters. They will briefly rest and balance themselves upon these surfaces to eat and play on etc.. Additionally, **partially submerged *smooth* boulders** are well used for surfaces to rest and eat upon. Partially submerged logs may also be rested upon. Otters also like to lay and sun themselves on **large smooth boulders**, esp. those placed along a shoreline. These therefore are recommended for use as well. (The surface texture of the boulders should not be sharp, abrasive, or coarse.)

Observations of wild giant otter marking behavior in Suriname:

> *"Both adult males and females tear down the overhanging vegetation (see Olfactory Behavior), break all small saplings, scratch up the leaves, trample the substrate,[these actions are carried out to help mark the otters' territory]...The male goes ashore at 1037 and starts clutching armfuls of twigs and leaves by rearing up on his hindpaws and grasping small branches to his chest. He pushes them down his chest between his legs and begins to trample them…The male rises and knocks over a thin sapling with his extended right forepaw, digits fanned, and passes it under his body. He defecates. The female starts rubbing her forepaws on the ground and also knocks down a sapling 1.5 cm in diameter and defecate[s] over it. Both resume kneading the substrate for a minute before slipping into water…[the] vegetation is bedraggled, the leaves having been trampled into the ground….The palms are pushed backwards and forwards as well as sideways in a stiff-legged, almost jerky fashion….The sequence lasted 2 minutes but longer ones have been recorded, e.g. two lasting 16 minutes. That day the H pair marked on three separate areas within 50m of each other towards the top end of their territory."(Duplaix 1980).*

It is highly recommended to provide live growing bamboo stands and/or "man-made bamboo stands / overhanging bamboo" that have the recommended stalk sizes that are needed for successful utilization, **in both indoor and outdoor enclosures for daily use**. **The latter (i.e. bamboo cut and standing or overhanging for use) can be easily and inexpensively constructed** as the 2nd paragraph below explains. (See the stalk sizes needed below.) Pulling on/down, playing with, and manipulating lightweight overhanging and ground level items is one favorite giant otter activity. (Giant otters will manipulate items when they are lying down, standing, and standing on their hind legs.) As noted in the paragraph above, these behaviors are similar to those they would do in the wild. **Bamboo, the tall variety with the recommended diameter stalk sizes, that overhang or/and stand vertically and are within the otter's reach (whether cut or growing)** are most favored for this activity and **are used daily in captivity.** *Pteronura* will also rest and play under and stand on their hind legs to manipulate/play with overhanging bamboo (i.e. the top end of bamboo that has leaves). They will also groom, rest on, and play with fallen/bent down bamboo. **Because these provisions are used so often by giant otters for manipulation and play, it is advisable to offer them.** In addition, these furnishings have been beneficial to help reduce stress, boredom and other negative responses. They therefore are especially helpful during cub-rearing and when animals encounter new/unusual situations, as well as during typical daily circumstances. (See Chapter 2 Section 3B.) Visitors also enjoy watching otters engage in these activities. Resilient, soft, and flexible both live and cut bamboo **works especially well for both otters to use and caretakers to easily provide and maintain.** <u>It can be used/re-used by the otters for a long time after it has been cut and live growing bamboo (if tall enough) can withstand the daily play of the otters and grow normally without being damaged or destroyed.</u>

Live growing bamboo springs back up again unharmed after the otters play with it and it will continue to grow unharmed whether it is growing outdoors or within large containers indoors. *The otters will bend down/pull on flexible stalks that are thin in diameter so that they can reach the top (i.e. the widest part of the bamboo with leaves) or the middle of the bamboo and manipulate and play with the leaves and smaller branches*. When providing live growing bamboo, whether for indoor or outdoor use, only specific types of bamboo can be used by the otters for the aforementioned activity. **Bamboo species that grow tall are ideal to use, but the stalks must be small enough in diameter so that they are still easily flexible. Bamboo stalks that are approx. 0.5 cm to 0.75 cm** (0.2" to 0.3") **in diameter at their base and that are approx. 2m to 3 m** (6.56 ft to 9.84 ft) **in height should be used.** (The term "base" means the portion of the stalk that is at the ground level.) Bamboo species such as *Fargesia murielae* have worked very well both live growing and cut for use. **It is important to note that when growing bamboo has a stalk diameter thicker than the sizes aforementioned, it can not be used by the otters because the stalks are too large and therefore inflexible. Tall growing bamboo although should be offered to the otters when it has reached at least 1.5 m to 2 m** (4.92 ft to 6.56 ft) **or more in height**. Shorter heights may be destroyed by the otters as this size may not be able to withstand the significant use from the otters. **Very large pots, tubs, or containers of live growing bamboo can be provided indoors.** These containers can be hidden under deep substrates and they should be large enough so they can not be turned over or manipulated by the otters. This method has worked very well in indoor areas where it was not possible to place plantings directly into the enclosure base.

"Man-made bamboo stands / overhanging bamboo" can be easily made with cut bamboo stalk bases that are sunken deep into soft loose substrates etc. or pushed into fence/lattice mesh so the stalks (bamboo) stand vertically and/or overhang the otter and are within the otter's reach. The otter will bend or pull the stalk (bamboo) down so that it can play with the top end of the bamboo (i.e. the end with leaves). (The otters usually do not break the bamboo stalks as the stalks are flexible and resilient.) When constructing and offering this provision a wider range of stalk size, i.e. in comparison to the size needed for live growing bamboo, can be used. For example, stalk sizes as previously mentioned are good to use, but when stalks are cut, a slightly larger diameter size stalk will withstand more play and can often remain standing/overhanging somewhat longer than the smaller size. **Stalks with** 1 cm to 1.5 cm (0.4" to 0.6") diameter at their base and that are 2 m to 3 m (6.56 ft to 9.84 ft) in height are ideal for use. Slightly larger and smaller diameter stalk sizes and different heights can also be used for variety. Each stalk can be cut at its base. **The base of each cut tall bamboo stalk can be pushed deep into substrates** (esp. in deep soft loose soil or sand) and be pushed into/inbetween fence mesh/lattice, hollow logs, logs, various crevices in logs etc., tree stumps, roots etc.. (Stalk ends can be cut / shaped for easier placement, but usually this is not necessary.) Hollow logs can also be filled with soil or small holes can be drilled in logs to push stalk ends into. **The bamboo must overhang the otter or stand vertically so that in both situations, the otter can easily pull on/bend or pull down the stalk (bamboo) to reach the top of the bamboo (the largest flared part with leaves and branches). This method will not be effective otherwise**. (Otters mostly play with the top of the bamboo.) Bamboo can also be hung upside down (from lattice/fence containment barrier roofs etc.) or side ways (in fence, logs etc.) so that the top of the bamboo is in reach of the otter.

Many "man-made bamboo stands / overhanging bamboo" placed in both indoor and outdoor enclosures will naturally enrich the environment for both otters and visitors. Bamboo that has been pulled down must be re-hung/re-set (this usually needs to be done

daily) **for use for this method to be effective and some should be left on the ground as well.** This only takes a couple minutes or so to do, so it is a very quick and easy form of natural enrichment to provide and maintain. As well, the same bamboo can be left in the enclosures for a long period of time (months) and the otters will still use the bamboo after the leaves and stalks are brown. **Although, once the leaves begin to fall off (this can take months) the bamboo should be replaced as otters will not use bamboo when it has no leaves.** Fresh supplies can be given sooner for more enrichment as otters particularly enjoy fresh cut bamboo. Using water from a hose to occasionally mist the leaves of cut bamboo that is kept indoors can help the leaves to stay fresher longer. Bamboo, whether live growing or cut, that has been sprayed with pesticides or other dangerous chemicals must not be used.

If bamboo as described is unavailable, other flexible lightweight soft branch types with leaves or/and some bushes or deciduous trees with long overhanging branches that are within the otters' reach, might be able to be used at least somewhat for play and manipulation. (These will also provide necessary shaded areas within enclosures.) Weighted pots/tubs with live growing bushes, tall grasses, ferns, or small deciduous trees etc. can also be provided indoors. Plants (including their leaves, flowers, fruit, seeds etc.) should not be poisonous, thorny, or have thistles or have been sprayed with pesticides or other dangerous chemicals etc.. Plants offered should also be deciduous rather than coniferous.

Observations of wild giant otters in Peru

> *"Be*sides *the grooming, the otters showed significant play behavior during the hunting breaks. Chasing and wrestling were typical play elements. Usually the otters play with each other. Branches, twigs and bark pieces are also incorporated from time to time." (Translation from Staib 2002)*

Giant otters also frequently manipulate (with their paws) and push around, smooth small round rocks (esp. river rocks) that fit easily into their paws, so SEVERAL of these can be offered on land and in the water. **Only several should be offered.** Piles of rocks/land areas with rocks (whether smooth, rounded or otherwise), pebbles, gravel or soil, sand, or mulch mixed with these must not be placed anywhere within enclosures

Section 5
Locations and Designs for Land, Floor and Water Areas, Dens, Nestboxes & Areas for Natural Underground Dens

Note: the term **"land"** refers to any base surface, whether man-made (e.g. concrete, tile, artificial rockwork, wood, floor etc.) or natural ground (e.g. soil, mulch, sand, rock etc.), within the giant otters' indoor and outdoor enclosures. These areas do not include the portion of the enclosure that is intended for water (i.e. a swimming/wading area). The term "floor" may be used in addition to the term "land" for greater clarification. An **"enclosure**" refers to any area an otter is held or has access to; e.g. this includes off-exhibit areas such as separable enclosure or temporary holding areas etc..

Locations and Designs Necessary to Keep Land, Floors, Dens, Nestboxes & Natural Underground Dens Dry and What Makes Them Very Damp/Wet

In every indoor and outdoor enclosure the land/floor area bordering the water area should extend at least 5 m (16 ft) **in width in the direction leading away from the water's edge** (of course this does not refer to the total amount of land and floor area that is needed, see the necessary land to water ratios below). **This is only a minimal size width and the land and floor area should instead be much wider and plentiful in width.** (Section 9 describes when water areas are needed indoors.) **Dens, nestboxes, and areas for natural underground dens (i.e. hills/banks) should be located a distance of at least 3 m** (10 ft) **away from the edge of the water area. Concerning nestboxes and dens, this is only a minimal distance and larger distances should be provided.** The main land areas should not be totally surrounded by water (i.e. like islands are) and this is important when enclosures are less than 600 m^2 (6,458.4 ft²) in size. As the land area is decreased in size, the amount of land area that is exposed to the water's edge should also be decreased in size proportionately. The following recommendations are based on enclosures where the land to water ratios are provided as recommended. **In an enclosure that is smaller or somewhat larger than 75 m^2** (807.3 ft²) in size, **the land area should only be bordered by/adjacent to the water's edge on one of its sides. When enclosures are somewhat smaller or somewhat larger than 240m²** (2,583.4 ft²) **in size, no more than two sides of the land area should be bordered by/adjacent to the water's edge.** As well, **in the aforementioned enclosure sizes, long water area contour lines/edges should not be used, although varied water area contour lines/shapes are highly recommended. Providing the recommended land to water ratios** (i.e. enough land/floor area) **and substrate depths, qualities, and types are essential as these are among the most crucial of the conditions required for the husbandry of giant otters** (see Sections 1-2). Each enclosure below 240 m² (2,583.4 ft²) in size, requires a different land to water area ratio based on its specific size. Enclosures between 240 m² to 600 m² (6,458 ft²) require other land to water ratios, as do enclosures above 600 m². The land to water ratios must provide at least the minimum size (proportion) land area required. In addition, at least the recommended minimum substrate depths, types, and quality must be provided. See Section 7 below for further water area designs (e.g. contour lines for enclosures significantly above 240 m² in size etc.).

The aforementioned conditions are among the most important requirements necessary for the husbandry of giant otters. They are needed in every enclosure that has a water area to help keep the land around the water, the dens, nestboxes, and natural underground dens themselves and areas adjacent, as well as the remaining enclosure land, as dry as possible. Without them, such areas will likely remain very damp/wet and health problems can develop in these conditions. See Section 3 above for the physical as well as behavioral health

problems and abnormalities that develop when enclosures do not provide the recommended conditions above. **It is necessary that any enclosure, whether it is already in use or not, that does not provide at least the recommended minimum requirements be modified so that it does.** I.e. this applies to any enclosure, whether it is already constructed and giant otters are being kept in it or the enclosure is being designed or modified to hold *P. brasiliensis* in the future.

A significant amount of water will always be tracked, carried, or splashed onto the land by the otters. **Continually very damp or wet surfaces are caused by not enough land area because of inappropriate land to water ratios, substrates depths that are below the recommended minimum depth, or inappropriate substrate types or qualities** (esp. hard or artificial surfaces, poor draining/slow drying soil, mulch bark pieces that have broken into small pieces and packed down). **Surfaces also remain very damp or wet when there is not enough land area bordering and extending away from the water's edge, more land area is exposed to the water's edge than recommended, inappropriate water area contour lines are used, or nestboxes, dens, or areas for natural underground dens are located too close to the water. Nestboxes (including bedding substrates), dens, and natural underground dens, as well as a significant proportion of the other land/floor areas, can remain very damp or wet when any of the inappropriate enclosure conditions aforementioned exist.** Note: wet or damp conditions can occur easily and rapidly or become worsened from rain or high humidity, esp. extended periods. Daily enclosure cleaning with water is not necessary when the recommended substrates are offered, but when unsuitable substrates are offered (e.g. hard surfaces) this form of cleaning can cause land areas to remain damp/wet.

Surfaces will not remain dry enough when an insufficient amount of land area, because of an inappropriate land to water area ratio, is offered. It is important to note that the smaller the amount of land area available, the more difficult it is to keep the land dry. This is one crucial factor that determines land to water ratios for enclosures. It is also just one reason why land area percentages (in the land to water ratio) must be increased proportionately and water area percentages must be decreased proportionately, as the enclosure size is decreased below 240 m^2 (2,583 ft²). When more sides of the enclosure land area than recommended are bordered by and therefore exposed to water, a large amount of land will remain wet/very damp. In these situations, esp. when enclosures are smaller than 240m² (2,583.4 ft²), otters will not be provided with enough dry land. When the otters' water area is bordered only by small areas/thin strips of land or not enough land area that extends in width in the direction leading away from the water's edge (i.e. less than 5 m [16 ft] in width), this land will remain wet/very damp. When enclosures are smaller than 240m² (2,583.4 ft²) in size, long water area contour lines/edges can also create insufficient amounts of land area that extend behind the water. When long water area contour lines/edges are used in enclosures that are smaller or somewhat larger than 75 m^2 (807.3 ft²) a large amount of land will remain wet/very damp, because not enough land area will extend behind the water's edge. As well, with long contour lines in both situations above, a large amount of land area will be exposed to carried/tracked in water.

Substrates that are hard, poor draining, slow drying, non-absorbent, or artificial can also remain very damp or wet. These substrates include: concrete, cement, tile, artificial or natural rockwork, bricks, gunnite, wood, and poor draining or slow drying soil (with/without vegetation). (When otters are directly exposed to more than a small area of these land and floor substrates within their indoor and outdoor enclosures, these substrates are called "inappropriate substrates" within this manual.) E.g. even after continual use (i.e. regular digging and grooming throughout the entire enclosure and digging away large areas of vegetation/turf and exposure to water), soil (and

all substrates) with/without vegetation, needs to retain all of the recommended substrate qualities. When it can not it will not remain dry enough (it also will erode too easily or become tightly packed/compacted). [The otters' strong natural digging and grooming behaviors (grooming also involves digging/scratching into substrates) must not be prevented.] Hard surfaces are not absorbent and water cannot drain through them.

Surfaces may not remain dry enough when the depth of soil, sand, or mulch fall below the minimum depth recommended or substrate quality (esp. mulch quality) is not maintained as recommended. Water naturally drains through mulch and soft sand esp. well, therefore these land furnishings used in both indoor and outdoor enclosures and over most all surface types, dry easily and quickly if they are maintained properly. Substrate depths more shallow than the recommended minimum of 10 cm to 20 cm (4" to 8") will not dry as easily or quickly and they can remain wet/very damp. When mulch breaks and packs down (i.e. bark pieces have broken into small pieces and they pack tightly together) the same problems will occur. Note: new mulch must be added on top of existing mulch that has broken into small pieces and packed down and new sand, mulch, or soil must be added on top of the already existing layer when it falls below minimum depth. (Note: substrates should also be as deep as possible in the areas near the water's edge.) Small or limited grooming areas will also remain very damp/wet when they are the only areas offered for grooming.

How wet nestboxes, dens and natural underground dens themselves become/remain is not only dependent upon how close these areas are to the water, but it is also dependent on all enclosure conditions. The following can occur when nestboxes, dens, or areas for natural underground dens are located too close to the water (i.e. less than 3 m (10 ft) away from the water's edge) **or when any of the other inappropriate conditions mentioned above exist**. The dens, nestboxes (including bedding substrates) or natural underground dens and the land around these locations can remain very damp/wet. In addition, the land around the water and/or the remaining/other enclosure land areas can remain very damp/wet. E.g. when the otters leave the water to enter their sleeping areas, water will be easily tracked and carried into the nestboxes and underground dens, as well as onto the land that lies between these resting places and the water. (Note: because giant otters take naps throughout the day, numerous trips of this nature can be made during the day, although they also rest on other land areas as we

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during cub-rearing. This section also describes locations and designs for keeper access doors (to enclosures, buildings housing enclosures, dens, etc.) and animal shift doors/gates needed for the same reasons.

Locations and Designs for Visual-Acoustic-Olfactory Introductions of Unfamiliar and Temporarily Separated Otters

Chapter 2 Section 18 describes the enclosure designs and locations necessary to carry out introductions of giant otters that are unfamiliar with each other and those that have been temporarily separated (i.e. animals that were previously housed together).

Locations and Designs to Maintain Appropriate Temperatures Within All Enclosure Areas

Chapter 2 Section 9 discusses the enclosure, nestbox, and den locations and designs that are necessary to maintain dens, nestboxes, and other enclosure areas at appropriate temperatures. This section also describes locations and designs for animal shift doors/gates needed for the same reasons.

Locations and Designs For Husbandry Training

Chapter 2 Section 13 and Chapter 3 describe den and other enclosure areas where husbandry training can be carried out and designs that can accommodate husbandry training activities and procedures.

Section 6
Enclosure Vegetation

A plentiful amount and variety of vegetation should be provided in enclosures (Duplaix-Hall 1972 &1975). This will help to keep enclosures dry, enriched and complex, provide necessary shade, as well as help prevent soil and hill/bank erosion and the caving in of natural underground dens. See below for a discussion on the necessity that exists to allow vegetation/turf to be freely dug up and cleared away/destroyed by the otters.

It is highly recommended to provide live growing bamboo stands and/or "man-made bamboo stands / overhanging bamboo" that have the recommended stalk sizes that are needed for successful utilization**, in both indoor and outdoor enclosures.** The latter, which is bamboo cut and standing or overhanging for otters to play with, can be easily and inexpensively constructed as described in Section 4 above. (See the necessary stalk size/bamboo type below and Section 4 for a full description of bamboo types and uses.) **Because both of these provisions are used so often by giant otters for manipulation and play, it is advisable to offer them.** Resilient, soft, and flexible, both live and cut bamboo works especially well for both otters to use and play with and caretakers to easily provide and maintain. Live growing bamboo springs back up again undamaged after the otters play with it. After the animals continually use it and when it is tall enough, the **bamboo will continue to grow normally without being damaged or destroyed** whether it is growing outdoors or within large containers

indoors. **Otters can also use each cut bamboo piece for a long time** before it needs to be replaced.

Only specific types of bamboo although are useful for the otters. **Bamboo species that grow tall are ideal to use, but the stalks must be small enough in diameter so that they are still easily flexible. Bamboo stalks that are approx. 0.5 cm** (0.2") **to 0.75 cm** (0.3") **in diameter at their base and that are approx. 2 m** (6.56 ft) **to 3m** (9.84 ft) **in height should be used.** (The term "base" means the portion of the stalk that is at the ground level.) Bamboo species such as *Fargesia murielae* have worked very well both live growing and cut for use. **It is important to note that when growing bamboo has a stalk diameter thicker than the sizes aforementioned, it can not be used by the otters because the stalks are too large and therefore inflexible.** (The otter also must be able to easily reach the bamboo so it can bend the bamboo down and play with the top end of the bamboo, i.e. the end with the leaves.) **Tall growing bamboo should be offered to the otters when it has reached at least 1.5 m** (4.92 ft) **to 2 m** (6.56 ft) **or more in height**. Shorter heights may be destroyed by the otters as this size may not be able to withstand the significant use from the otters. Very large pots, tubs, or containers of live bamboo can be provided indoors. These containers can be hidden under deep substrates and they should be large enough so they can not be turned over or manipulated by the otters. This method has worked very well in indoor areas where it was not possible to place plantings directly into the enclosure base. "Man-made bamboo stands / overhanging bamboo" can be easily made from cut bamboo. Bamboo that has 1 cm (0.4") to 1.5 cm (0.6") diameter stalks at their base only and the aforementioned stalk size for live growing bamboo, both with heights of 2 m to 3 m (6.56 ft to 9.84 ft) are good for use. Somewhat larger or smaller stalk sizes and varying heights can also be used for variety when the bamboo is cut for use.

Providing turf/vegetation on natural outdoor land areas with soft loose soil will help maintain land dryness and prevent soil and hill/bank erosion, although **otters must not be prevented from digging into the soil or grooming on it (which involves digging/scratching up surface substrates and vegetation) or digging the vegetation/turf away throughout the enclosure**. (These are very important strong natural behaviors that otters must be allowed to carry out. See Section 3 below for why.) When the recommended soil type, quality, and depth and land and water area designs and locations are provided, problems should not occur with the land area remaining dry enough or eroding when the animals dig/scratch away large areas of vegetation/turf and dig and groom throughout the entire enclosure.

When otters are housed solely outdoors vegetation such as deciduous trees, bushes, bamboo stands etc. should be offered in enclosures to provide supplementary shelter from the elements (see Section 9 for more information). Natural furnishings, e.g. such as those just listed, should also be offered outdoors whether or not indoor enclosures are provided, for similar and other reasons. Turf and vegetation can be allowed to freely grow or be planted. Both long and short grass/turf, weeds, ferns, and tall vegetation can be offered outdoors. Trees, large bushes, or large tree stumps with long extended roots may help prevent natural underground den cave-ins and soil and hill erosion. Dense undergrowth growing freely in some areas and aquatic plants can also be provided. Weighted pots/tubs with live growing bushes, tall grasses, ferns, or small deciduous trees etc. can also be provided indoors. If bamboo as described is unavailable, other flexible lightweight soft branch types with leaves or/and some bushes or deciduous trees with long overhanging branches that are within the otters' reach, might be able to be used at least somewhat for play and manipulation.

Deciduous plants (i.e. trees, shrubs etc.) **should be planted / offered rather than coniferous plants** so that otters are not exposed to sap, pine needles etc. which may irritate the otters' feet or skin or foul the otters' fur. Plants with **thorns or thistles should not be offered** for similar reasons. (Giant otters have been reported to keep away from such plants.) Toxic or poisonous plants or plants that may bear poisonous leaves, flowers, fruits, seeds etc. should not be offered. Pesticides or other dangerous chemicals should not be used in enclosures. Enclosures should not be so shaded from the sun, i.e. by trees, bushes etc., that the shade would inhibit the land area from sufficiently drying (although inappropriate land and water area designs and locations and substrates are usually the reason that land and floors do not remain dry enough, so these conditions must be corrected in all cases). Giant otters should also be provided with areas where they can lay in the direct sunlight, as they enjoy sunning themselves.

It is highly recommended to offer deep leaf piles (esp. indoor where it remains dry) as they are another of the otters' favorite areas to dig, groom, play, and rest in. (See Section 4 above for more information on leaf piles and what qualities they should possess.) Leaf litter (i.e. fallen leaves), scattered branches, sticks, tree bark etc. can be left on the ground or offered for manipulation and investigation.

Section 7
Water Area Designs and Furnishings

Observations of wild giant otter swimming behaviors in Suriname:

> *"The depth of dives varied from a few cm to approximately 3m in large rivers…[They swam and fished in both shallow water and]…in the relatively deep water of 3-6m. The feeding behavior sequence begins with active aquatic locomotion when a fishing area has been reached, usually associated with shallow areas of 50cm to 2m in depth. The otters search the bottom and dive under floating vegetation, surfacing among the mats for a quick gasp, pushing the head out of the water only long enough to open the mouth wide to breathe, submerging almost immediately. Underwater chases are very rapid and, in the shallows create turmoil as several otters splash through the water in pursuit until the fish is seized….A fish in deeper water will elicit a single dive whereas in shallow water it may entail several dives and lunges. Perhaps this is due to the reduced mobility of the fish in the shallow water glutted with vegetation whereas in deeper, more open water, the fish can escape more easily or the otter abandons the chase more quickly." (Duplaix 1980)*
>
> Wild *Pteronura* very frequently and commonly use shallow water to play, fish, and wade in (Staib 2002).

It is necessary that a swim area is provided. **The recommended land to water area ratio required for each indoor and outdoor enclosure as well as separable enclosure area will specify the size of the water area** (pool, pond, swim tank etc.) **that is needed in each area**. The water area proportion in the ratio/size will vary according to the total size of the enclosure or separable enclosure area. **Each enclosure or separable enclosure area below 240 m² (2,583.4 ft²) in size requires a different land to water area ratio based on its specific size.**

Enclosures between 240 m² to 600 m² (2,583.4 ft² to) require other land to water ratios, as do enclosures above 600 m². See Chapter 2 Section 1B for land to water ratios. **The land to water ratios must provide at least the minimum size (proportion) land area required within every** indoor and outdoor enclosure and separable enclosure area, whether the enclosure is for temporary or permanent use. (E.g. this applies to quarantine and temporary holding areas, small heated indoor spaces etc..) This is among the must crucial requirements necessary for the husbandry of giant otters. When the land to water ratio provides smaller land proportions than recommended physical, mental, and behavioral health problems can develop (see Section 3 above). **Some indoor enclosures that are attached to outdoor enclosures may not need water areas or full-size water areas.** ***See Chapter 2 Section 9 for when indoor enclosure water areas (e.g. pools/swim tanks) are necessary and for water temperature recommendations.*** **Unless noted otherwise, the recommendations in this section apply to every location where a giant otter has access to a water area.** *Note: within this manual the term "separable enclosure area" will be implied when the terms "enclosure", "indoor enclosure", and "outdoor enclosure" are used. This term although will be used at times when greater clarification is needed.*

A naturally enriched and complexly designed water area environment can be created with the following designs and furniture. A habitat such as this is needed to offer variety and more challenging stimulating places to swim both in deep and shallow water, wade, play, exercise, dive, investigate, manipulate objects, rest, eat, chase live fish, and play chase with other otters. It as well provides a safe and more easily useable environment for cubs, old otters, parents carrying cubs and all other otters.

It is necessary to design outdoor and indoor enclosure pools with varying water level depths that offer adequate space for the aforementioned activities listed in the paragraph above. See the exceptions in Section 9 below. (E.g. some indoor enclosures that are attached to outdoor enclosures only require swim tanks rather than a full size pool.) **Shallow water along the pool perimeter is used very frequently** for wading/swimming, playing, eating, and exiting the pool. **These areas are needed** and they are esp. helpful when young cubs are learning swimming and old animals, cubs, and parents carrying cubs are exiting pools. **Deep areas are used very frequently** for swimming, diving, play, exploration etc. and they should be provided as well.

The provision of shallow areas is "mandatory" (Wünnemann 1995). For example, areas approx. 12 cm (5") deep and additional shallow areas that are 20 cm (8") deep, which gently slope to deeper water, should be provided. Areas that are approx. 35 cm - 40 cm (14" - 16") and 65 cm [26"] deep are also well used. **Plentiful shallow areas should be provided.** I.e. the entirety of at least one of the largest/longest sides of the pool or more sides of the pool should have shallow areas. **Pools should gently slope to deeper water so a variety of depths are provided.** This will also help provide safety when the pools are emptied. **The deep area in pools should be a minimum of 100 cm** (3.28 ft) **in depth.** For example, when the deepest part of the pool is only approx. 75 cm (30") deep, otters have been observed to swim awkwardly because the water was not deep enough to accommodate the full-extent of their most basic natural swimming movements. I.e. it did not allow simple normal swim patterns and this is not including dives or other deep water activities (Sykes-Gatz & Gatz, pers. obs.). **The provision of pools with depths of at least 150 cm** (4.92 ft) **and deeper, e.g. up to 200 cm** [6.56 ft]**, is however highly recommended** so otters can carry out a wider range of swimming and diving behaviors**. Plentiful deep areas should be offered.**

Artificial/man-made pools that are not heated can be emptied when air temperatures make the water too cold for the otters to use. After pools are emptied for cleaning they can take quite a bit of time to refill. **It is important that otters can not jump or fall into the deep areas of empty pools.** If animals can do this they must be kept away from these dangerous areas (i.e. this usually means locking them out of their main enclosure area). **Pools should be designed with these cautions in mind. I.e. deep areas should gently slope to shallow areas or/and they can be placed so that giant otters can not enter the pool from the land at the deep points.** This will also significantly reduce the amount of time that otters will have to be locked out of their enclosures after the pool is cleaned.

Pools must have plentiful areas of gently sloping (smooth non-abrasive) sides/edges so that young cubs learning swimming can easily exit the water (Duplaix-Hall 1972). (These sides/edges should also be made of material and constructed in such a way that prevents or reduces the chance that they become too slippery for the otters.) For example, a cub from any river otter species can drown when pools only have steep borders. Duplaix (citing Harris 1968) reports one such occasion (i.e. a *L. canadensis* cub drowned). **This is also necessary to allow adult otters, esp. old animals, a more natural and easier exit and parents an easier and safer exit when they are carrying their cubs. Ideally, all pool edges** that are bordered by land area **should be gently sloping, although if this can not be done, it is advisable to construct as much of the pool in this way as possible.** If shallow areas do not extend from/connect to deep pool areas to allow for easy exits, a gently sloping pool border could be created during pool construction in various ways. (For example, an approximately one meter wide surface area / shallow exit area can be constructed so that it extends, with a gentle slope upwards, from the top of the vertical pool wall to the land. This sloping 1m pool border can be made so that the water is 30 cm (12") deep at its deepest point [i.e. where it connects to the vertical pool wall]. It can gently and gradually slope upward until only a few centimeters of water depth is present at the edge where it connects to the land area. This pool border can be extended around all the pool areas without shallow exits.) **When swim tanks/tubs are offered they also must provide easy and safe exit areas either in the same manner as above or as follows if no other option is available.** At the least, large rocks/boulders, ramps, logs, or boards around the inside edge must be provided (Duplaix 1972), but they should be constructed with or made of materials that otters can not easily slip on. (See ramp construction in Section 12 and below.)

Pool sides / edges should not be raised much above the water level as this will make exiting the pool difficult for adults alone as well as adults carrying cubs and impossible for cubs. In the wild, "When possible *Pteronura* skirted vertical banks, preferring shallow inclines for entry and exits into the water." (Duplaix 1980).

Pool drains, filters, skimmers, water filtration/cleaning systems, waterfalls, underwater viewing areas, swim tanks/tubs**, and all water areas must be able to accommodate the soft loose natural substrates that may be tracked, pushed, dug etc. into the water from land and floor areas. The simple designs and furnishings described in Section 2C can help prevent substrates from entering water areas and blocking drains or causing other problems.** Although, even with these methods, some substrates will enter the water. Because it is necessary that every indoor and outdoor enclosure land and floor surface is nearly entirely covered with soft loose natural substrates as recommended, **enclosure water areas etc. should be designed or modified with these considerations in mind.** (These methods will also help prevent leaves, sticks, bark, etc. that have fallen from trees, fish remains, natural furnishings

other than substrates, and toys from blocking pool drains or causing other problems.) See Section 16 for water source and treatment methods.

In very small indoor and outdoor enclosures (e.g. quarantine or temporary holding enclosures, etc.), **separable enclosure areas or when temporary swim areas were needed, small tanks or large tubs of water** have been provided for swim areas. **These should be at least 3 m^2** (32.3 ft^2) **to 4 m^2** (43.1 ft^2) **in size and at least 35 cm – 40 cm** (14" – 16") **deep, although the water area size required ultimately depends on the total size of the enclosure area and the land to water ratio necessary for it.** (I.e. it is essential that enough land is provided.) Some indoor enclosures that are attached to outdoor enclosures may not need water areas (see Section 9 below). **A swim tank/tub that is not sunken into the floor or land** (i.e. the sides extend above the base surface level) **should not be much deeper than** 35 cm to 40 cm (14" – 16") **when parents are rearing cubs**. When the tank's top edge is higher from the ground cubs may hurt themselves if they fall over the pool edge and parents will not be able to easily exit or enter the tub esp. when they are carrying cubs. A ramp with a gentle incline, raised slats on the surface for a better grip, non-slippery surface, and an amply wide width should be used for safe and easy exits and entrances, esp. for the cubs. A log stump, large rock or other type of non-slippery stationary step should be placed in the tank/tub for the same purposes. These are very important for safety reasons as young cubs will not be able to exit/enter the tank/tub without these provisions. Tanks/tubs with deeper depths, e.g. 65 cm [26"] deep, should have gently sloping sides and be sunken in the ground for cub safety and for easy exits for all. Swim tanks/tubs have been made of heavy plastic, fiberglass, metal, and concrete with/without tiles. They should have a drain for easy and quick cleaning. These **small water areas** (e.g. tanks, tubs, small pools) **should be emptied and filled with soft sand or mulch** (type as recommended only) **or they should be removed when they are not needed and the vacant space covered over with appropriate substrates**. **This procedure is highly recommended in small enclosures as it will allow for more quality land area and it will also help keep the land/floors drier.** Note: the smaller the amount of land area available, the more difficult it is to keep the land dry, although many other factors will also cause very damp/wet land and floor areas (see Section 5).

Water areas should be located and designed so that they can be accessed/serviced quietly, quickly, as well as easily and if possible while hidden from the otters' view when parents are rearing cubs. This is necessary so that servicing can be done with minimal or no human disturbance (both visual and acoustic) to the otters during cub-rearing. E.g. swim tanks/pools can be designed so that they can be emptied and filled with fresh water or/and be provided with a small gentle constant fln.3(f4urbance cof4urbs)e

water's edge. As well, **in the aforementioned enclosure sizes long water area contour lines/edges should not be used, although varied water area contour lines/shapes are highly recommended.** When enclosures are significantly larger than 240 m² in size and provide the recommended land to water ratios and substrates, water areas should be designed with long and varied contour lines/shapes. This will provide more variety, stimulation, challenges etc. and it will also offer plentiful shallow areas. (See about land to water ratios above.)

A significant amount of water will always be tracked, carried, or splashed onto the land by the otters. Continually very damp or wet surfaces are caused by not enough land area because of inappropriate land to water ratios, substrates depths that are below the recommended minimum depth, or inappropriate substrate types or qualities (esp. hard or artificial surfaces, poor draining/slow drying soil, mulch bark pieces that have broken into small pieces and packed down). Surfaces also remain very damp or wet when there is not enough land area bordering and extending away from the water's edge, more land area is exposed to the water's edge than recommended, inappropriate water area contour lines are used, or nestboxes, dens, or areas for natural underground dens are located too close to the water. Nestboxes (including bedding substrates), dens, and natural underground dens, as well as a significant proportion of the other land/floor areas, can remain very damp or wet when any of the inappropriate enclosure conditions aforementioned exist. Health problems, some very serious, can develop as a result from these conditions (see Section 3 above). **The recommended conditions above and those in Section 1B and Sections 2 & 5 are needed to keep land and floor areas (including dens, nestboxes, and underground dens) dry enough so that they will not cause health problems.** It is essential that the provisions within these sections are offered. These are among the most important requirements necessary for the husbandry of giant otters.

Streams (whether artificial or natural) and natural ponds in outdoor enclosures provide interesting variety and they will be well used. In *addition* to the main pools in large indoor and outdoor enclosures, a small pool of water that is totally separated from or connected to the main pool is also especially well used during play, swimming etc.. Small *additional* pools in indoor enclosures can be around at least 3 m^2 (32.29 ft²) in size and 65 cm (26") deep with gently sloping pool edges. An *additional* small outdoor pool can be approx. 10 m^2 (107.64 ft²), or larger in enclosures above 600 m² (6,458.4 ft²) in size, and 65 cm deep at the deepest point with gently sloping pool sides. In addition small areas, pockets, tanks, or tubs of shallow water that are separated from or connected to larger swim areas, for example 1 m² to 2 m^2 (10.76 ft² to 20.93 ft²) in size and 30 cm (12") to 40 cm (16") deep, are also well liked and frequently used for playing, swimming, and wading in. Note: the aforementioned pools are not meant to serve as the main pools in either indoor or outdoor enclosures. Additional small pools as described are not recommended for use in small enclosures, because land area is already limited. All areas intended for water, regardless of their size and how many there are within an enclosure, must be included when land to water ratios are determined. Water that flows also provides a source of enrichment (see the last paragraph below).

The content of indoor and outdoor pools should be varied so that otters have a more challenging and stimulating place to swim, play, investigate, chase each other and live fish etc.. **A pool that only offers water and no natural furnishings within it, is an unenriched and unstimulating environment. Pools should be enriched with a variety and plentiful amount of natural furnishings. They can be inexpensively and easily enriched with** furniture such as small and medium size logs (with/without bark), large and small tree branches and tall bamboo (i.e. with/without leaves), sticks, tree bark, aquatic vegetation, and rocks (e.g. small river rocks and larger). *Leaves on branches and bamboo and bark can be removed if necessary*

to help prevent water filtration/drain blockage. Natural furnishings that would be more difficult or expensive to provide include boulders, fallen trees, large logs, and large tree stumps with their roots. (See below for more information.) See Section 15 for toys that can be provided in water areas. **Toys for enrichment should only be used as addition to and never as a substitute for the recommended water area furnishings and designs.** *All furniture should be checked for safety to make sure otters can not become trapped within, between, or under the items or become pinned between floating or submerged large objects and the pool-sides.*

A brief description of furniture types follow. Section 4 above provides a full explanation on how the items should be placed/located within the water area so they can be utilized and the qualities that the logs, boulders etc. should possess (e.g. logs from deciduous rather than coniferous trees & boulders with smooth rather than coarse surfaces are needed). That section also describes how giant otters use these items and why they are recommended for use. **Totally and partially submerged logs and branches of varying sizes should be provided.** The more forks that the logs and branches have, the better. **Partially submerged large diameter logs that span from the water/pool to the shoreline's edge are highly recommended as they are well used.** The otters should be able to at least rest/lean against these logs for various activities, although it is preferable that they can lay their entire bodies on them as well. **Partially submerged smooth boulders that the otters can lie/stand on can be provided. Submerged logs, tree stumps or boulders that extend close enough to the surface of the water,** so that the otters can stand on / rest their bodies on these items and keep their head or other body parts above the water can also be offered. **Floating** (i.e. light weight branches and tall bamboo, tree bark, sticks, very large leaves), **semi-submerged, and totally submerged objects** (small smooth round river rocks are especially played with) **that can be manipulated and investigated can be offered**. **The aforementioned furniture is well used.** The location of light and medium weight submerged objects (i.e. logs, large branches, large tall bamboo) can be moved easily and frequently to create variety in swimming patterns.

The zoos surveyed offered their giant otters either artificial pools (e.g. concrete base) or natural pools (i.e. ponds with soil or sand substrate & aquatic vegetation). Natural furniture, deep and shallow water areas, small wading pools, and/or swampy areas were also provided. Streams, natural flow-through water, waterfalls with/without shallow play areas/pockets beneath were used to enhance static water by creating stimulating water currents. Giant otters frequently play with water flow from unreachable hoses or water faucets. *Brasilia Zoo* drapes an unreachable (for the otters) running hose over the side of the containment barrier wall and directs it into the pool to add variety. A few zoos used underwater pool viewing areas in their enclosures (with either total glass fronts or smaller glass viewing areas). Zoo visitors enjoy watching the otters swim and play underwater.

Section 8
Containment Barriers and Service/Keeper Door Designs

This species can climb and they are avid diggers. Giant otters with *healthy behavior* and *the recommended enclosure conditions*, dig both deep and shallow into and groom on (which includes digging and scratching) soft loose natural substrates *throughout the entire expanse of their land area*. As instinctively avid diggers and groomers, these are among their most favored and frequently performed land activities. These behaviors must not be prevented and enclosures

must be able to accommodate these activities. (See Section 3 above for the reasons why.) Captive giant otters have also been observed to climb rather well. Caution must be taken to ensure that these animals can not climb or dig out of their enclosures.

Wünnemann (1995) suggests **an unclimbable barrier at least 180 cm high be used to prevent escape.** Fence, lattice, concrete/stone walls, and glass have all been used to form containment barriers. Some institutions have installed additional thick glass to provide unobstructed and/or underwater viewing areas. **Overhangs or fence roofs, with and/or without electric cattle wire, are used and most often necessary to supplement barriers for safety reasons.** When **electric wire** is used, it **must be placed well above the reach of an otter when it is in the water**. If it is not, this could be dangerous to the otter. Electric wires are most beneficial at the top of containment barriers or on overhangs. Otters may escape during a power failure if electric wire is used alone on climbable containment barriers. For river otters (species non-specified), Foster-Turley (1990) and Duplaix-Hall (1972) recommend **a fence barrier have a complete roof or a 60 cm unclimbable overhang at the top.** Fence mesh size (while still strong) should inhibit climbing. Fence (metal) with **5 cm x 5 cm (2" x 2") mesh is used most often**, but caution should be taken as giant otters could climb this fence. (Fence with 2.5 cm x 2.5 cm (1" x 1") mesh is also used for containment barriers. Fence mesh measuring 2 cm x 2 cm [0.8" x 0.8"] is also used.) A giant otter died after it climbed a 2 m (6.56 ft) high fence and fell to a concrete floor (Trebbau 1972). (Enclosure surfaces not covered with soft loose natural substrates as required can cause various health problems. It is essential that the recommended substrates are offered. See Sections 2-3 above.) Fence/lattice mesh sizes, such as those aforementioned and lattice mesh 5 cm x 20 cm (2" x 8") in size, have been used for containment barriers for one side of a den and for keeper/service doors. When fence/lattice is used for dens, the fence/lattice must be covered over with solid materials during cub-rearing to isolate the dens from human disturbances. (See more below on necessary den containment barriers and areas for husbandry training etc..) Enclosure keeper doors made of solid materials (e.g. metal) have also been used. Foster-Turley (1990) **suggests containment fence and walls be extended at least 0.61 m (24") beneath the earth's surface to prevent river otters (species non-specified) from escaping underground**. Caution: giant otters can easily dig 100 cm (3.28 ft) deep.

Climbable furnishings such as bushes, trees, ramps etc. must be kept well away from containment barriers or removed or made unclimbable if they are near barriers. Rockwork or gunnite containment barriers without uniform flat surfaces (e.g. those with large depressions or that are formed into varied shapes) could also be climbed. Giant otters could also shimmy up between furnishings that are not climbable (i.e. a stand of bamboo with thick diameter stalks etc.) and containment barriers if they are close enough in proximity. Such furnishings therefore must also be dealt with as aforementioned. Wünnemann (1995) reported that a giant otter at *Hagenbeck Tierpark* easily climbed up a bush to a height higher than 2m.

Each enclosure, separable and off-exhibit enclosure area, and den needs its own individual service entrance/keeper door. **Service entrance design and placement must permit easy access for multiple uses** (e.g. large-scale maintenance work, carrying in large logs, pushing in wheelbarrows etc.) **and provide maximum safety. Safety precautions must be considered during enclosure design, as otters can be dangerous and injurious to humans. For example, all enclosures should be designed so that otters can be kept away from keepers and other zoo staff when they need to service enclosures or need to closely view or work with the animals in a protected contact situation. For additional safety, secondary containment areas should be installed at enclosure entrances, esp. those outdoors.**

Section 10B discusses the locations and designs needed for keeper and animal shift doors to offer privacy from human disturbances during cub-rearing. Section 2 discusses designs that can prevent land and floor substrates from blocking keeper and animal shift door movement and how substrates can be kept from pushing through barriers. Section 9 describes locations and designs for animal shift doors necessary to keep enclosures at appropriate temperatures. Section 13 describes containment barrier types that can be used for dens and areas to perform husbandry training. Section 18 describes containment barriers and shift doors that should be used during the introduction of unfamiliar or temporarily separated otters.

Following are examples of containment barriers used in giant otter enclosures:
Hagenbeck Tierpark's (Germany) metal fencing is 2.2 m high (7.22 ft) and buried 70 cm (28") deep, and it has electric cattle wire. This fence has 5 cm x 5 cm [2" x 2"] mesh size. *Chestnut Centre's* galvanized chain link mesh fence (5 cm x 5 cm [2" x 2"] mesh) extends 1.8 m (5.9 ft) above ground and it is buried 50 cm to 61 cm (1.64 ft to 2 ft) in the ground. It is topped with 60 cm (1.97 ft) galvanized steel overhangs. An electric hot wire with 8000 volts is also used on the overhang. A glass-viewing window is included within the exhibit's front fence. A raised wooden public viewing platform overlooks the exhibit. *INPA* (Brazil) has a 2 m (6.56 ft) high fence topped / covered with metal fencing. *Quistococha Zoo* uses 2.4 m (7.87 ft) high concrete walls, topped with a 0.5 m (1.64 ft) wood overhang. *Dortmund Zoo* uses a combination of 2.2 m (7.22 ft) high barriers made of rock walls and glass, with a cattle electric wire at the wall's top (the cattle wire is 6,000 volts).

Section 9
When Indoor Enclosures Are Needed and When They Require Water Areas, Temperature and Heating Recommendations & Outdoor Enclosure Shelter

Note: "**Enclosure***" and "***Exhibit***"** *are used interchangeably. They refer to any/all areas, both indoors and outdoors, in which a captive otter is held or has access to, regardless of whether or not public/visitors can view these areas or the areas are intended for temporary or permanent use. They include such areas as dens, off-exhibit holding and quarantine areas, and areas on-exhibit (i.e. for public viewing) etc..* **"Den"** *refers to an individual man-made room, usually small in size [e.g. 4 m² - 9m²] (43.05 ft² - 96.88 ft²) and constructed with concrete, wood, etc., where an otter has access to. A nestbox can be placed or animals can be briefly held (i.e. for enclosure cleaning, etc.) in a den. Dens are off-exhibit and they do not serve as a nestbox. "***Nestbox***" refers to areas that are only large enough for the otters (including cubs) to sleep. Nestboxes are man-made (i.e. constructed with wood, concrete, artificial rockwork etc.) and they are either placed above or beneath the ground/floor.*

Wünnemann (1995) states "**In temperate zones the giant otter needs both indoor and outdoor enclosures**….They are quite adaptable to colder outdoor temperatures as long as they can choose between the warm indoor and the outdoor enclosures."

In temperate climates, it is necessary that an outdoor enclosure (with or without heated outdoor water) provides access to a heated indoor enclosure. *Indoor enclosures that attach to outdoor enclosures must provide ample quality land area for otters to carry-out the "full range and extent of terrestrial activities" that can not be performed outside because*

temperatures are too low. These activities include digging, grooming, playing, and exercising on land and raising young. The meaning of the *"full range and extent of terrestrial activities*" is very specific; see Section 3B for a description. *In some cases water areas are needed in these indoor enclosures as well* (see below). *It is crucial that these indoor enclosures have the recommended land to water ratios (to provide enough land area if they have water areas), soft loose natural substrate types, qualities, and depths that cover nearly the entire land/floor area (including dens), and deep digging area sizes* (see Sections 1-2 above). (Different enclosure sizes require different land to water ratios.) In addition they must include dens and nestboxes (see Sections 13-14 below) and they need the recommended land and water area locations and designs and locations for the dens and nestboxes (see Section 5 under what is needed to keep these areas dry). They should include the natural furnishings recommended in Section 4 above and the water area design (if water areas are needed) recommended in Section 7 & below (some designs are required for safety). They need the land and water area, nestbox, den, and keeper and animal shift door designs and locations that can offer privacy from human disturbances during cub-rearing (see Section 10 below). See the recommended minimum enclosure size in Section 2 above.

It is essential that all indoor enclosures, whether attached to outdoor enclosures or not, include the basic necessities just listed above and those throughout Chapter 2. These provisions and designs will allow otters to carry out their terrestrial and aquatic (if necessary) activities in appropriate enclosure conditions, allow the land area, nestboxes, and dens to stay dry, and allow privacy from humans disturbances and presence during cub-rearing. When indoor and/or outdoor enclosure land to water ratios offer smaller land proportions than recommended or/and land/floor surfaces are not nearly entirely covered with soft loose natural substrates (including appropriate depths, types, and qualities) or provided with sufficient size deep digging areas as recommended health problems and/or abnormalities will occur. Problems can also occur when the other land and water area designs and locations and den and nestbox locations are not provided as recommended. (See the **problems** that **will occur** in Chapter 2 Section 3). **For example, during cub-rearing in colder temperatures, otter families may need to be held in indoor enclosures, without outdoor access, for as long as 4-5 months.** This fact alone and the problems that can arise from the aforementioned inappropriate conditions (e.g. very damp/wet conditions that can cause cub infection/death and other health problems, behavioral problems that negatively affect cub-rearing success etc.) must be given careful consideration when indoor enclosures are designed and furnished. Providing space that is large enough for the entire family to be able to sufficiently (i.e. to maintain behavioral and physical health) and comfortably carry out all of their terrestrial, and if necessary, aquatic activities during these long periods (or any extended cold periods, whether cub-rearing or not) must also be considered.

Indoor enclosures, that attach to outdoor enclosures with water areas, should offer a swim area, but there is no need to have swim areas indoors when otters can swim comfortably (at comfortable temperatures etc.) in outdoor pools. **An indoor swim area although, must be provided in temperate climates if outdoor water is not heated and temperatures remain too low for otters to swim outdoors** (see below). This area should allow for the full range of aquatic activities to be carried out, i.e. swimming, diving, wading, playing, exercising etc.. **Even if outdoor water is heated, it is likely that otters will need access to indoor swim areas at some time.** These times include when the animals are held inside for extended periods because temperatures become extremely cold, parents are rearing their cubs during colder temperatures, outdoor enclosures need repair, or otters need to be separated during introductions etc.. (See water temperatures below.) **Small swim tanks, large swim tubs, or small water**

areas may be sufficient when otters require temporary swim areas. These **small water areas** (e.g. tanks, tubs etc.) **should be emptied and filled with soft sand or mulch** (type as recommended only) **or they should be removed when they are not needed and the vacant space covered over with appropriate substrates**. **This procedure is highly recommended in small enclosures as it will allow for more quality land area and it will also help keep the land/floors drier. It is crucial that the recommended land to water ratios are provided when water areas are offered in any enclosure area** (i.e. regardless if it is a temporary or very small enclosure area or not, etc.). See the recommended water area (i.e. pools, swim tank/tubs etc.) designs and furnishings in Section 7 above.

In temperate climates, heated indoor enclosures that connect with outdoor enclosures are ideal. This offers a warm and private area for otters to rear cubs and it allows otters to carry-out the full range of terrestrial and aquatic activities that can not be performed outside when temperatures are too low, while still allowing outdoor access all year.

Some examples of indoor enclosures follow:
Dortmund Zoo has a heated 90 m^2 (969 ft²) concrete indoor exhibit connecting to a 350 m^2 (3,767 ft²) outdoor exhibit. Both enclosures provide off-exhibit dens. The indoor exhibit's two pools offer year around swimming areas and the indoor and outdoor pools are both made of concrete. The indoor and outdoor pools are furnished with logs, large branches, tall bamboo, boulders, floating bark and sticks, toys etc.. A sand filter is used for the indoor pool and no filtration is used in the outdoor pool. The indoor pools are located directly adjacent to each other. This exhibit has an approx. 20 m^2 (215.3 ft²) water area (1.1 m and 1.3 m [3.6 ft and 4.27 ft] pool depths) and 70 m^2 (753.5 ft²) land area. The land area is nearly entirely covered with mulch substrate and an approx. 25 m^2 (269 ft²) area of very deep mulch is also provided for deep digging. Large logs and tree stumps with extended roots, many "man-made bamboo stands" and live growing tall bamboo planted in a large tub (the bamboo has the recommended stalk size so otters can play with/manipulate it), a deep leaf pile, tubs of sand, branches, boulders, toys, and 4 nestbox / den areas are also indoors. A semi-transparent roof, with six adjustable openings, allows sunlight and fresh air transfer. The exhibit can be divided into two parts with a pool on each side. The entire indoor exhibit is fronted with glass viewing window containment barriers and the pools have underwater viewing. Otters have access to both indoor and outdoor areas all year, although outdoor access is limited when temperatures become extremely cold (see below). *Chestnut Centre's* 64 m^2 (689 ft²) heated indoor enclosure and additional long den/s with multiple nestboxes, connects to a 767 m^2 (8,256 ft²) natural outdoor exhibit. Otters are given access to both indoor and outdoor enclosures all year. Its heated inside living area is constructed of 100 mm (4") concrete block with a cast concrete floor and insulated corrugated steel roof. It has windows, small visitor viewing windows, a skylight, and a small swim tank. A deep layer of soft loose substrate covers the entire indoor enclosure floor and large diameter logs are provided.

Wünnemann (1995) **recommends** [in temperate climates] **a minimum of 18 °C** (64.4 °F) **air temperature for indoor enclosures [maintained at 18 °C - 20 °C** (64.4 °F – 68 °F) (Hagenbeck & Wünnemann 1992)] **with nest box temperatures staying above 20 °C** (68 °F). **Nestbox temperatures were increased to 22 °C - 23 °C** (71.6 °F – 73.4 °F) **during cub-rearing** at Hagenbeck Tierpark [i.e. the den area, where the nestboxes were located, was heated to this temperature] (Flügger 1997). **Captive giant otters have been observed to have a low heat tolerance** (Carter & Rosas 1997; Sykes-Gatz & Gatz pers. obs.). **Cubs can be very susceptible to overheating or becoming too cold.** Very young cubs especially, do not thermoregulate (maintain/regulate their body temperatures) well (Merck 1986; Read and Meier

1996). **Indoor enclosures should be equipped with fans, cooling, or/and ventilation systems to prevent over-heating and provide fresh air exchange and in temperate climates, a heating system is also needed.**

During warm weather, dens and nestboxes located in outdoor enclosures could become very warm (esp. in climates that are warm all year around) so caution must be taken that temperatures do not become too high for the otters. **Nestboxes should be placed in areas that provide shade for temperature control, esp. in warm climates**. Nestboxes might be able to be placed underground to help keep nestboxes cooler, esp. in warm climates, although this has not been tried and problems may occur. See Section 10B for a discussion on nestboxes and the problems/possibilities of placing them underground. *Caution also must be taken if tunnels are connected to nestboxes, as these tunnels may increase nestbox temperatures and this may help to cause overheating.* Also **nestboxes should not be placed in areas where there are drafts. Animal shift doors should be placed in areas that minimize drafts that may enter enclosures and especially nestboxes and dens containing nestboxes**. **Heavy flexible plastic strips (such as those used in primate exhibits) can be placed over shift door openings to help keep indoor areas warm and minimize draft.** (Shift door frames also should be placed somewhat above ground / floor level to prevent that their movement is blocked by substrates, toys etc.; see Section 2). *See Chapter 2 Sections 2, 5, 10, 11, & 13 for other necessary shift door/gate designs and placement recommendations.* A small area (i.e. just large enough for otters to lay on) with under-floor heating or a heat mat could be useful in outdoor enclosures in temperate climates. *Note: it is not necessary to provide such areas.* E.g. *Hagenbeck Tierpark's* offered a small area with under-floor heating that was covered with sand in the outdoor enclosure. *Dortmund Zoo* offers a heat-mat, covered with sand and just large enough for resting on, in the outdoor enclosure.

Wünnemann (1995) states (swim) **"water temperature seems to be more critical than the air temperature". Scientific research needs to be conducted before specific outdoor water and air temperature exposure recommendations can be established.** See below for general exposure recommendations. The following are only **examples** of what zoos in temperate climates practice and they **are not meant to serve as recommendations**. *Dortmund Zoo* allows otters access to the outside exhibit all year, but empties pool *swim-water* when the air temperature falls below 5 ^{o}C (41 °F). When temperatures become extremely cold, around *minus* 10 ^{o}C (14 °F), then outdoor access is limited to short periods or when colder, totally restricted. *Chestnut Centre* allows their giant otters access to unheated outside pond swim-water and exhibit all year. Their otters swim in the unheated pond water all winter, even for short periods during freezing temperatures. *Duisburg Zoo* (Germany) heats outdoor pool water to 15 ^{o}C (59 °F) in the winter and allows their giant otters outdoor access all year. *Philadelphia Zoo's* (U.S.) indoor dens and building are kept at 20 C^{o}-21 ^{o}C (68 °F - 70 °F) all year. Outdoor pool water is heated to 15 °C - 25 °C (59 - 77 °F) during the winter. Outdoor access is allowed for the entire day at or above *minus* 7 ^{o}C (19.4 °F) (even in snow) and limited outdoor access is given during lower temperatures. Otters are held inside if pool water falls below 10 ^{o}C (50 °F). All zoos above provide continual access to heated indoor housing with pools or swim tanks/tubs during the winter.

Following are some general outdoor water and air temperature exposure recommendations. Giant otters seem to be intelligent enough to avoid air temperatures that are too cold for them. I.e. they will only spend limited amounts of time outdoors when it is at colder temperatures. **In temperate climates, giant otters need access to indoor enclosures that provide the conditions recommended within this manual, when they cannot carry out**

their normal daily terrestrial activities to their full extent because the outdoor temperatures are too low. **It is not necessary to heat outdoor enclosure (swim) water. During colder temperatures and in temperate climates although, sufficient indoor swim areas must be made available so that they can be used instead of the outdoor water areas. Caution should be taken when otters are exposed to swim water when the air temperature falls below 5 ^{o}C (41 °F).** As a precaution, unheated pools (i.e. those made with man-made materials) should be emptied at these temperatures. (It is important that otters can not jump or fall into the deep areas of empty pools. Pools should be designed with these cautions in mind.) Outdoor water areas can be heated when temperatures fall, although otters must always have access to heated indoor enclosures, with the recommended conditions, during these times. **It is not necessary to heat swim water when it is located in indoor housing that is heated to the air temperatures recommended. If pipe water is extremely cold when water areas are being filled, it can be helpful to add warm water to the pool to temper the cold water.**

When air temperatures become extremely cold, around *minus* 10 ^{o}C (14 °F), then the animals' response to outdoor temperatures should be closely monitored and it may likely be necessary to limit their access to exposure to these temperatures to short periods of time. In colder temperatures their outdoor access may likely need to be totally restricted. **If an otter has just been imported from South America or it is a juvenile or sub-adult (i.e. 6 months to 2 years old),** it should be gradually introduced/exposed to colder temperatures (both air and water), at least during its first fall and winter. Otters can then become slowly acclimated to lower temperatures over the cold months of their first fall and winter so that they can be allowed normal access (i.e. compared to other acclimated otters) to the outdoors throughout the following years. **Young individuals (i.e. less than 6 months old) should be kept out of colder temperatures and parents should be prevented from taking them outside during such conditions. Additionally, see the recommendations in the opening paragraphs to this section.**

Shelter from the wind, rain, heat, cold, and direct sun and the recommended land and water area designs and locations (esp. land to water ratios) and substrate types, depths, and qualities (all needed to keep the land area dry enough) **must be provided in all climates.** Offering plentiful natural furnishings is especially important during the rain and rainy seasons, as well as when it is very hot, sunny, or windy etc.. When natural underground dens are not available, nestboxes filled with the bedding substrates recommended, must also be provided. These will help to offer some protection from rain and other adverse climatic elements and offer a small amount of additional/supplementary drying and grooming area, as well as, dry resting area. (The recommended land and floor substrates are the most important and primary areas that otters need to dry and groom themselves.) If nestboxes are not offered then natural underground dens that are dug into hillsides/banks (with the hill designs and substrates recommended) must be provided and they can serve the same purpose. [Note: wild giant otters do not collect materials to use within their dens, they instead depend on the soft natural ground substrates within their underground dens to serve as bedding (Duplaix-Hall 1980).] (See Section 2 for the recommended substrate types, qualities, and depths needed for land and floors as well as bedding materials for nestboxes. See Section 14 for nestbox construction and Sections 10 & 5 and above for locations to provide nestboxes.) When otters are housed solely outdoors hollow logs (large enough for entrance), logs large enough for the otters to lie on, deciduous trees, bushes, bamboo stands etc. should be offered in the enclosures to provide additional shelter from the elements. Logs, esp. those with bark, and hollow logs can provide a small amount of additional drying and grooming areas as well as dry resting areas, as they are elevated from the ground surface and are somewhat absorbent. Hollow logs also offer an enclosed space. Natural furnishings, e.g. such as

those just listed, should also be offered outdoors whether or not indoor enclosures are provided, for similar and other reasons. (See Section 4 for more information on natural furnishings.)

If necessary, at least part of an outdoor enclosure can be covered with a roof or some other material to help keep at least one enclosure area dry when it rains and it can provide shade as well. As well an area (e.g. quite a bit larger than the size of a nestbox) could be constructed with natural materials for otters to go under when it rains. Enclosures should not be so shaded from the sun, i.e. by trees, bushes, buildings, etc., that the shade would inhibit the land area from sufficiently drying (although inappropriate land and water area designs and locations and substrates are primarily the reason that land and floors do not remain dry enough, so these conditions must be corrected in all cases). Giant otters should also be provided with areas where they can lay in the direct sunlight, as they enjoy sunning themselves.

Section 10

Note:
"Cub" *refers to a giant otter that is between approx. one day to six months old.*
"Juvenile" *refers to a giant otter that is approx. between six months to one year old.*
"Sub-adult" *refers to a giant otter that is between approx. one year to two years old.*
*"***Successfully reared cub***"*** *is a cub that lives to one year or older.*
*"***Successfully reared litter***" is where at least one cub in the litter survives to one year old or older.*
"Den" *refers to an individual man-made room, usually small in size [e.g. 4 m² - 9m^2] (43.05 ft² - 96.88 ft²) and constructed with concrete, wood, etc., where an otter has access to. A nestbox can be placed or animals can be briefly held (i.e. for enclosure cleaning, etc.) in a den. Dens are off-exhibit and they do not serve as a nestbox.*
*"***Nestbox***" refers to areas that are only large enough for the otters (including cubs) to sleep. Nestboxes are man-made (i.e. constructed with wood, concrete, artificial rockwork etc.) and they are either placed above or beneath the ground/floor.*
*"***Underground den***" and "***natural underground den***" refer to a den that has been dug by the otters themselves (i.e. dug into natural substrates and underground) and the otters can use this den to sleep/rest and keep cubs in.*

Part A. Parental Behavior & Litter Loss/Stress Caused by Human Disturbances

All zoos world-wide and historically with successful parent reared litters (i.e. where at least one cub in a litter survived to one year or more), **provided parents with privacy and isolation/seclusion from human disturbances (visual and acoustic) and presence (zoo staff and visitors) at parturition and during cub-rearing** (Sykes 1997-99 & 1998/2000, Sykes-Gatz 2001 and unpublished study, 2003). **Either their management methods and/or "enclosure design" alone permitted privacy** and this was and is the most important management factor needed to help parents rear litters successfully. "Enclosure design" means that the enclosures were natural or semi-natural and expansive, at least 600m² (6,458.4 ft²) or more in size, and the otters could dig their own dens underground to keep their cubs in. (Within this section, the general management methods that were used at these institutions during successful cub-rearing, are included. The "enclosure designs" used at these institutions are

described below and in Section 12 below.) **The stress caused by human disturbances and presence has resulted in the loss of a critically significant number of giant otter cubs.** Historically and internationally (from 1968-2002), records show that most of the captive-born giant otter cub deaths reported (where full cub history was known), died because parents, stressed by disturbances, failed to properly care for their cubs. **No institution has ever reared their giant otter cubs successfully unless privacy was offered during cub-rearing. Even parents that had already reared one or more litters successfully with seclusion, did not rear their following litters successfully unless they were offered this method.** (I.e. without this method they ate or neglected their cubs and litter loss resulted because of disturbances to the parents.) See Chapter 1 for more information about these issues.

Observations of wild giant otters in Peru:

> *"Giant otters are highly susceptible to disturbances [esp. during cub-rearing]….The reason for the minimal reproductive success of the Cocha Salvador group and the birth of a litter outside of the normal season can be related to human disturbances." (Translation from Staib 2002). In the wild giant otters are more nervous when they have cubs. They are also nervous when anything unusual occurs in their environment, this includes the presence of humans (Schenck 1996; Schenck et al 2003).*

Baker et al. (1996) reviewed evidence from mammals that psychological stress, particularly for Carnivora, to the parents is often responsible for the parents' failure to rear litters successfully. **After giving birth, captive carnivore parents can be especially vulnerable to disturbances and normal human activity, which did not bother them before parturition. At the time of parturition and during cub-rearing, stress to the parents can be caused by human disturbances (visual and acoustic) and presence (visitors and zoos staff) or any changes to the parents' "social" or "physical environment".**

The following behaviors, caused because **giant otter** parents were stressed by disturbance, have been reported to occur during cub-rearing (Autuori & Deutsch 1977; Hagenbeck & Wünnemann 1992; Gatz, pers. obs. 1996-2002; Flügger 1997 & pers. comm.; Sykes 1998/2002; Sykes-Gatz 2001, unpublished reports 1999-2003 & pers. obs). **Parents physically abused**, i.e. bit, injured, threw, slammed around, nearly drowned, rolled and laid on, suffocated to death by laying on, **or/and ate their cubs**. **They also failed to properly care for and neglected or excessively handled their cubs in other ways.** They **repeatedly carried their cubs** around the enclosure or moved them from one nestbox or place to another within a short time period or performed these actions too many times or even excessively throughout the day. (Note: this indicates that the parents are uncomfortable and they do not feel that their cubs are safe in a particular area, so they move their cubs in attempts to find a safer feeling place. It is also simply just a reaction to stress.) They also excessively moved, pushed, slammed around, handled, and toileted their cubs. **Mothers'** were suspected to have **failed to lactate sufficient amounts of milk** due to stress and they were observed to **press their bodies flat to the ground as a reaction to stress**, **so that the cubs could not nurse** sufficiently during those times. **When** parents became **nervous** in behavior, because of a disturbance, **they did not lie still long enough so that the cubs could nurse or** the **mother left the cubs unattended for too long.** (E.g. the cubs were crying because they were hungry or felt alone and the mother did not return to nurse or pay attention to them frequently enough.) **During these times, the cubs had little or no chance to nurse.** [Very young giant otter cubs, from birth to at least 7 days old when the remaining cub was pulled for handrearing, nursed frequently during each hour of the day (Sykes-Gatz, pers.

obs.. 2002).] **Cubs were taken into the water much too frequently and were treated too roughly there.** Parents pushed and held the cubs underwater too frequently or forced them underwater for too long, so sometimes they nearly drowned the cubs. (The swimming lessons that giant otter parents reportedly give, both in the wild and when captive parents are not stressed, can appear rough, although comparatively, the aforementioned treatment is excessive.) **The greater the amount of stress/disturbance, the more excessive the aforementioned behaviors have become. Parents may also carry out similar behaviors in a significantly less exaggerated manner** (i.e. they may exhibit these behaviors to a minor degree) **as a result of lesser stressors/disturbances**.

To what degree parents are vulnerable to disturbances and normal human activity that did not bother them before parturition, or how parents are effected by stress and to what degree they abuse/neglect their cubs because of it, can vary from non-existent to extreme dependent on many factors. These **factors include** the duration, intensity, frequency, and familiarity of the disturbance, husbandry and management practices, the extent of visual and acoustic isolation available, and the quality, furnishings, design, and size of the indoor and outdoor enclosures. (I.e. see the enclosure conditions and husbandry practices that are necessary to consider in Part B below.) Individual otter personality and history (e.g. physical and behavioral problems), the degree of experience that each parent and if present, older offspring, has with rearing cubs, family social structure (i.e. the age of any older offspring present at the time of the new litter birth, whether the sire is present etc.), and pair compatibility are also factors. All of these factors will affect the success of cub-rearing.

Negative reactions (e.g. parental neglect or cub abuse) to human disturbances (i.e. any actions carried out by humans near and in enclosures etc.) **may not occur immediately after the disturbances have taken place.** E.g. a reaction may take as long as a half hour to occur after the disturbance and the parents could react calmly until that point, without showing stress etc.. The time, type, and degree of both the disturbances and parental behaviors should be closely monitored (either from the recommended hidden viewing areas or on video monitors/tapes) and recorded on an on-going basis to evaluate the actual presence of negative responses.

Normal/routine human activities tolerated before parturition can cause parents significant stress at and after parturition and can result in cub neglect/abuse and litter loss. This includes routine keeper activity performed by familiar keepers, such as daily enclosure cleaning, feeding, observations, or simply the presence of the familiar keeper near or in the enclosure **and the presence of usual visitors or zoo staff**. **After parturition otters can be disturbed by even the most familiar visual and acoustic presence/occurrence**. Insignificant or small unusual events can also cause significant stress. **Examples of** what may very likely cause **extreme stress include** the direct presence of the public and unfamiliar zoo staff (esp. within the nestbox area or directly within the enclosure), “loud/excessive” or “sudden noises”, “unusual activities”, removal of any family/group member (e.g. mates or previous offspring), relocation to a new enclosure, significant physical changes to or within the exhibit etc.. If parents are aware that **even familiar caretakers** have entered the area in which they are, at that moment, keeping their cubs (i.e. nestboxes/dens containing nestboxes, or caretakers peering into/placing their hands in natural underground dens) this may also cause extreme stress. These kinds of stress may likely cause litter loss. When familiar keepers are simply near the area where otters are keeping their cubs, this can cause significant stress. When familiar keepers enter the enclosure within the first week (or sometimes even longer) after parturition, even when keeper activities are greatly minimized, significant stress can result. When otters detect, e.g.

hear, that even familiar keepers are near their enclosure, the parents can become disturbed. If the otters directly see the keeper (whether the keeper is outside or inside the enclosure), even greater stress can result. **Inappropriate enclosure conditions can also cause abnormally elevated or excessive levels of stress during cub-rearing** (see Sections 3B above and 10B & C for more information). I.e. **without appropriate land to water ratios [i.e. enough land area], enclosure land and floor substrates and deep digging area sizes, the parents' ability to successfully rear cubs can be adversely affected or seriously compromised.**

Even when disturbances are minimized as much as possible and video monitoring is used for observations, not all disturbances can be prevented. Some examples from the following two zoos' experiences are discussed below to illustrate this point. (See other examples in Part C below.) (It is important to note that at the following two institutions, the cubs were reared in indoor housing that was blocked off to all humans, except for of the limited, minimized, and restricted husbandry actions taken by one or two primary/familiar caretakers. Nestbox and den areas were also restricted to the primary keepers. These indoor exhibits were/are not expansive in size.)

For example, a light bulb burnt out in the keeper isle of an indoor building that the giant otters were housed in at *Hagenbeck Tierpark* and no other disturbance was reported to occur at that time. This seemingly insignificant event caused massive unrest and stress to the parents rearing their litter (Flügger 1997 & pers. comm.). Video monitoring was used to assess cub-health and parental care.

At *Dortmund Zoo* only the most necessary husbandry actions were performed at parturition and during cub-rearing and by only the two keepers most familiar with the otters. (I.e. except for having to hand feed antibiotics one time per day for 5 days, only quick feeding and on one occasion, on day 6 of the 7 days that cub-rearing took place, feces was quickly removed/dry spot cleaned in one exhibit area far from the nestboxes). Actions were carried out in such a way as to create the absolute minimum of disturbance. All movements were done very quietly and tasks were completed as quickly as possible and, if possible, only when the otters were asleep. Movement and entrance was restricted/forbidden and allowed only in areas remote from the nestboxes (i.e. activity primarily occurred near the area feeding took place, which was called the "feed den"). The exhibit design allows the keeper to access the feed den and exhibit via an entrance isolated from the enclosure. The feed den, in the indoor enclosure, is located as far away from the nestboxes as possible, as is the behind-the-scenes keeper entrance to the indoor building. Infrared video cameras for each of the four nestboxes, another three video cameras positioned on the exhibit, and a baby sound monitor were previously installed in the inside giant otter exhibit. An area for monitoring and recording was also established in the otter house basement, a nearly soundproof room. On the day of parturition, the giant otter house was closed to all persons (i.e. public and zoo staff) except for of the two primary giant otter keepers. Video monitoring was used to assess cub-health and parental care. The otters were video-taped 24 hours per day and taping was monitored "live" for 10-14 hours per day. Much was learned in just 7 days (i.e. nursing times, behaviors etc.). (Some previous litters were quietly watched from a hidden and isolated viewing area outside the exhibit and the otters were also isolated from human disturbances.)

If the parents were awake, the slightest of noises, such as that coming from slowly and carefully opened doors and the *unseen* primary giant otter keeper quietly and quickly putting food in the feed den, resulted in nervous behavior, moderate cub abuse, and abnormal handling on both the parents parts (Sykes-Gatz 2002, pers. obs. & unpublished report). (When the term "abuse" is

used alone below, it also implies "abnormal handling".) Moderate disturbances caused an abnormally increased amount of nervousness, abuse, and handling (compared to the reactions of other giant otters). As well, when the old mother required oral medication for possible infection from an aborted decomposed fetus, the primary giant otter keeper quickly and quietly entered the indoor building to access the feed den. The keeper then handed each parent one fish and immediately left the area in the same way he entered. Extreme cub abuse and excessive handling and nervousness resulted nearly immediately after, and because of, the disturbance. (Note: antibiotics were necessary and they had to be offered hidden in a fish. Each otter had to be handed a fish to ensure that the correct otter received the medication. The medication continued for 5 days and it was administered one time per day.)

Disturbance caused the parents to become very abnormal in their behavior. Observed, with predictable consistency and obvious correlation, were both parents abusing their cubs, abnormally handling them, and/or becoming abnormally nervous as a direct result of even minor human disturbances. Both the mother and father abused their cubs with equal severity and frequency. They also would not lie still long enough so that the cubs could nurse or in rare cases the mother would leave the cubs unattended for an abnormal length of time. During the aforementioned times, the cubs had little or no chance to nurse. All of these factors had negative consequences on the cubs' well-being. When the parents could control familiar events themselves (i.e. they could control their own activities) it was not a disturbance, but events over which they had no control (i.e. human disturbances) caused disturbance and consequential nervousness and cub abuse/neglect.

The greater the disturbance, the longer and/or more severe the abnormal behaviors (i.e. abnormal abuse, handling, and nervousness) became. These behaviors occurred from immediately to 34 minutes (averaging 9 minutes) after the disturbance occurred and they continued either intermittently or continually during a time period of 2 minutes to 71 minutes (averaging 24 minutes) in length. These behaviors ranged from mild to highly excessive/extreme and they occurred 3-6 times/day (averaging 4 times/day) over a 7-day period (until the cubs died or were pulled for handrearing). A large percentage of these periods accounted for, occurred in direct correlation with and as a result of the disturbances created when the primary keeper fed and medicated the otters. (The otters were fed 3 to 4 times per day.) Some of the behaviors that the parents themselves regularly carried out before parturition, seemed to disturb them after parturition. It seemed that these formerly familiar behaviors became "novel" to them after parturition. Mild, to at worst even moderate, abnormal behaviors resulted when these seemingly "novel" behaviors were performed after parturition. After the parents repeated and expanded these behaviors, they became comfortable/familiar with them, they no longer disturbed themselves, and the cubs were treated well. For example, when the mother first left the nestbox after parturition (just after a minor human disturbance occurred about 4 hours after parturition), this caused a significant disturbance and resulted in abuse. Future excursions (without concurrent human disturbances), such as movement/exploration to exhibit areas increasingly more remote from the nestbox containing the cubs, also disturbed the otters and resulted in abuse. The parents although, over time, eventually played, dug, groomed, and exercised and they did not become disturbed or abuse the cubs as a result after these outings. On these outings, the parents could carry out the full extent of their grooming, digging, playing and exercising activities on land and this helped them to relax, reduce their stress, and entertain them.

It is important to note the following points. These parents did not abuse their cubs and treated them normally when disturbances did not occur. Both the mother and the father were quite

nervous in behavior even during normal daily circumstances before the birth of this litter (i.e. when not cub-rearing or exposed to new/unusual situations). In this regard and compared to behaviorally and mentally healthy giant otters, they had abnormal personalities and unhealthy behavior. In addition to the typical abusive reactions that giant otters are reported to carry out in response to human disturbances, this pairs' abnormal behavior and unhealthy mental state was believed to be responsible for causing the excessive abnormal behaviors they exhibited. (They certainly seem to be a compatible pair, so this factor did not have a negative impact on their parenting behaviors.)

This pairs' excessive levels of negative responses to human disturbances (i.e. stress) during cub-rearing and general unhealthy mental state (i.e. during normal circumstances etc.) was believed to be caused because these animals' (the male was 12 years old and the female 10 years old at the time this litter was born.) were housed in inappropriate enclosure conditions (i.e. insufficient land areas and mostly all hard surfaces) for most of their lives. They had 12 out of their 13 litters in these conditions. In addition, the parents were not offered privacy from human disturbances when they had most of their litters. Without privacy, they ate most of their cubs soon after parturition and the remaining cubs were pulled for handrearing soon after their birth. When they were offered privacy for a few of their litters and also lived in inappropriate enclosure conditions they responded similarly with regards to their parental skills (as described above) during cub-rearing, although the cubs lived much longer because privacy was offered. They although were not able to carry out the essential stress-reducing land activities as described above and in Section 3B, because the enclosure conditions did not allow them to do so. They therefore did not have the opportunity to reduce their stress levels (e.g. as they did in the appropriate conditions in the description above or to a further degree if they would have been housed in appropriate conditions for a long term). This was clearly evident as when they were not spending time with their cubs, they were much more nervous and stressed in behavior than they were during the same occasions in this particular study. E.g. this pair would swim pace (a stereotypical behavior) excessively in the water when they spent a normal amount of time away from their cubs and this was when no disturbances occurred. The litter reared and described in detail (during this particular study) was the first litter, of their 13 litters, that the parents reared cubs in appropriate enclosure conditions. This pair had only recently been exposed to appropriate enclosure conditions just before the time of this litter's birth, therefore they were only in the very early stages of recovering from their mental and behavioral (as well as physical) health problems. Additionally, inherited thyroid malfunctions due to severe inbreeding were likely to have prevented the survival of all of the cubs born at this institution. This pair had 13 litters/28 cubs and even the multiple handreared cubs died with the same symptoms as the parent-reared cubs (note: many were eaten soon after birth). It is expected that this breeding pair will never reproduce successfully. It is possible that these parents could have sensed that their offspring were not healthy and not able to survive and their abnormal behaviors during cub-rearing could be at least in part, due to these reasons as well. E.g. parent birds with hatchlings/nestlings will throw unhealthy offspring out of the nest to their death, because it is not worth it to expend the extra energy to rear offspring that will not survive.

It is believed that because of all of the aforementioned problems and because so many litters have been treated the same way, these old parents have become so ingrained in their abnormal behaviors during cub-rearing that they actually performed them with/without appropriate enclosure conditions, as a matter of a learned routine/parenting skills. The firmly ingrained learned parenting skills/routines of these old otters most likely can never be changed/corrected. It is amazing that previous litters survived up to 21/2 and 3 months old in the care of these parents (i.e. this was when privacy was offered). This pair has not had any further litters since

this study and it is believed that they will likely not reproduce again because of their old age. Section 3B above describes how later on, this pair recovered from their mental and behavioral health problems, because they continued to be kept in appropriate enclosure conditions after the completion of the above study.

On the other hand, at *Brasilia Zoo*, where the exhibit and land area (nearly entirely covered with soft loose natural soil) are expansive and many natural underground dens exist, parents were not stressed by usual familiar activity that was somewhat limited. Many litters were reared successfully at this zoo by several pairs of parents. This zoo has two 635m^2 (6,835.14ft²) semi-natural giant otter exhibits located directly adjacent to each other [i.e. only separated by a fence containment barrier] which adds additional privacy from the public on one enclosure side. Each exhibit has a 105 m^2 (1,130.22 ft²) pool and an 85% land to 15% water ratio. The extensive hillsides that surround 2/3 of the exhibit's land area perimeter also provide/provided ample area for the parents to dig many natural underground dens (the top of the hills rise nearly to the visitor level). Additionally, much of the land is located well below the visitor level. The parents' rear/reared their cubs in this enriched stimulating exhibit with underground dens successfully. For example, the parents were not stressed, when the primary giant otter keeper quickly and quietly entered the enclosure (with the otters present in the same enclosure) to dry spot clean the feces and left over fish (Louzada da Silva, pers. comm. 1998; Brasilia Zoo, pers. comm. 2002). The keeper left the enclosure immediately after this quick servicing. As well, parents there also raised their cubs successfully when visitors had normal viewing access to the exhibit, although for some litters a tall wooden barrier was purposely erected to restrict visitor access and viewing. The design of this exhibit alone, i.e. expansive semi-natural exhibit and land area size and natural underground dens, offers parents rearing cubs a great deal of privacy and isolation from human disturbances. (The fact that the exhibit is well below visitor level also contributed to privacy.) It as well offers parents an enriched stimulating environment (with not only appropriate but optimal enclosure conditions) and this too is a very important factor that contributes to the success of cub-rearing.

Part B.
Husbandry Practices and Enclosure Designs/Modifications for Cub-Rearing

The most important management practice needed to promote successful giant otter cub rearing is the isolation of the parents from human disturbances (visual and acoustic) and presence (zoo staff and visitors) during cub rearing. (Duplaix-Hall 1975; Autuori & Deutsch 1977; Hagenbeck & Wünnemann 1992; Wünnemann 1995; Flügger 1997; Sykes 1997-99 & 1998/2002, Sykes-Gatz 2001 & unpublished reports, 2003; "Genealogical Meeting…" 1998; Louzada da Silva, pers. comm.; Corredor, unpublished report, 2003; Dortmund Zoo staff, pers. comm..) **This is the most important management factor responsible for successful parent-rearing of giant otter litters in zoos world-wide and historically** (Sykes 1998/2002). **The success of parents rearing their cubs can also be intricately effected by and interrelated with the quality, design, furnishings, size, and location of indoor and outdoor enclosures, as well as husbandry and management practices**. (See Parts A & C for more information on other factors that can affect success.) Enclosure conditions that can affect cub-rearing success include: the appropriateness of land to water ratios, land and floor substrates, deep digging area sizes, other land and water area designs and locations, enclosure size, and the designs and locations of dens, nestboxes, areas/hillsides for natural underground dens, animal shift doors, and keeper doors. They also include whether natural otter dug underground dens and/or

expansive enclosures are available and the amount of enrichment and privacy designs available within an enclosure. The husbandry practices that can affect cub-rearing success include: how well enclosures and nestbox, den, and natural underground den areas are isolated from human disturbances and presence, how well caretakers limit and minimize their activities and carry them out so that they do not disturb otters, if the otters are familiar and comfortable with their caretakers, and if parental care and cub development, behavior, and health is monitored in a way that does not cause disturbance to the otters.

When cubs are reared to independence, unfamiliar and temporarily separated animals are introduced and then housed together, or otters are maintained to an old age in inappropriate enclosure conditions or/and with inappropriate husbandry practices, this does not validate that the enclosure conditions and/or husbandry practices used were appropriate. (I.e. this does not mean that these circumstances are appropriate because such outcomes have occurred.) **It is essential that inappropriate enclosure conditions and husbandry practices are not repeated or used at any other institution based on the conclusions that such outcomes have occurred.**

It is necessary that enclosures are designed or at least modified and husbandry practices are changed so that they can provide/allow for the following conditions discussed below. When modifications must be made and the construction/provision processes for the alterations may disturb otters with cubs, they must be done before parturition. **Most all modifications must be done before parturition, although some minor changes,** such as locking enclosure building doors so that visitors/staff cannot enter etc.**,** may be able to be done the day of parturition when they can be completed without disturbing the otters. I.e. the otters must not see or hear the alteration being made. Large/significant changes, such as installing extensive blinds, visual barriers etc. around large areas of the enclosure, should be done before parturition. Even if such changes can be done without the otters detecting that the modification is being made, they should be done before parturition, as significant physical changes to/near the exhibit at or after parturition, will likely disturb the otters.

It is necessary that every enclosure is appropriately furnished and designed to keep the otters physically, mentally, and behaviorally healthy, **whether otters are rearing cubs or not**. I.e. **it is essential that within each indoor and outdoor giant otter enclosure the land to water ratio is provided as recommended (i.e. enough land is offered), the recommended soft loose natural substrate types, qualities, and depths cover nearly the entire land and floor area** (including dens)**, and at least the minimum recommended size deep digging area is provided. (Note: each enclosure below 240 m²** (2,583.4 ft²) **in size, requires a different land to water area ratio based on its specific size.** Enclosures between 240 m² to 600 m² (6,458 ft²) require other land to water ratios, as do enclosures above 600 m².) **The other recommended land and water area locations and designs and locations for nestboxes, dens and areas for natural underground dens are also needed**. These include the provision of plentiful land/floor area bordering and extending away from the water's edge, water area contour lines as recommended, no more land area exposed to water edges than recommended, and nestboxes, dens, and areas for underground dens located a sufficient distance away from the water's edge. See Section 3 above for the **health problems that adults and cubs can develop when these provisions are not provided**. E.g. **cub death can occur when** enclosure surfaces remain very damp/wet because of inappropriate substrates, land to water ratios, nestbox/den locations, and/or other land and water area designs. See Chapter 2 Sections 1-2 and 5 (under what is needed to keep areas dry) for the necessary substrates, land and water area designs and locations, and locations for the nestboxes, dens, areas for the natural underground dens. The **other**

recommended natural furnishings, such as large logs, bamboo stands ("man-made" or/and live growing), deep leaf piles etc. should be provided as well (see Section 4 above). Water areas must also be constructed so that they are safe for cubs and parents carrying cubs (see Section 7 above). See Section 9 **for when indoor enclosures and indoor water areas are needed**. See, in Section 1 above, the **enclosure size that should be provided** and Section 15 below for toys that can be offered for additional enrichment. Note: **some indoor enclosures, that connect to outdoor enclosures, do not require water areas, although all of the other enclosure conditions recommended in this manual are necessary for all indoor areas, regardless of their size.**

The aforementioned enclosure conditions are esp. crucial during cub-rearing for other reasons as well. **When indoor and/or outdoor enclosure land to water ratios offer smaller land proportions than recommended or/and land/floor surfaces are not nearly entirely covered with soft loose natural substrates (including appropriate types, qualities, and depths) or provided with sufficient size deep digging areas as recommended, the otters' ability to successfully rear cubs can be adversely affected or seriously compromised.** This not only includes the ability of parents, but also any older siblings that might be present during cub-rearing. (Note: older siblings help to care for their younger siblings.) This is because these inappropriate enclosure conditions **can cause abnormally elevated or excessive levels of stress during cub-rearing.** (See Sections 3B for an explanation and 10A & C.) It is also important to note that when otters must rear cubs in very small areas this may likely cause additional stress. At least the recommended minimum enclosure size (see Section 1 above) should be provided. It is important to remember that **during cub-rearing, in cold temperatures, otter families may need to be held in indoor enclosures, without outdoor access, for as long as 4-5 months.**

It is necessary that enclosures are as enriched as possible during cub-rearing. Note: **the enclosure provisions already discussed are the most important forms of environmental and behavioral enrichment** and as aforementioned, they are also necessary to maintain health and promote cub-rearing success. **If** although, **additional enrichment can be offered** during rearing without disturbing the parents, **this is highly advisable**. For example, toys for additional enrichment that are safe for the young cubs and family members, and that can be placed in enclosures and left without removal or be removed quietly and quickly when necessary should be provided. **Toys for behavioral enrichment should only be used as addition to and never as a substitute for the recommended enclosure designs and furnishings.**

Efforts must be made to minimize stress/disturbance factors as much as possible in order to increase the possibility of cub survival. **Parents must be provided with privacy and isolation from humans disturbances (visual and acoustic) and presence (zoo staff and visitors) at parturition and during cub-rearing.** It is important that husbandry practices and enclosure designs and furnishings **allow for the provision of fresh food, minimized/limited enclosure cleaning, medical/emergency care necessary to ensure the survival of the animals, and monitored cub progress, with no or minimal human disturbance to the otters** during cub-rearing. (See below for the rare cases when nestboxes, dens etc. may need to be entered so that care, essential to ensure the survival of the otters, can be given.) **The recommended management methods within this manual and/or the particular "enclosure design" below are needed to provide privacy**. **"Enclosure design" means that otters could successfully rear their cubs when the enclosures were natural or semi-natural and expansive, at least 600m²** (6,458.4 ft²) **or more in size, and the otters could dig their own dens underground to keep their cubs in. When the particular "enclosure design" aforementioned is provided,**

the husbandry practices recommended during cub-rearing are also necessary to provide privacy. The only husbandry practice that might not be necessary is the isolation of the entire enclosure from visitor viewing. If the enclosure is very expansive, i.e. well above 600m², this may likely not be required. When the enclosure is not very expansive it might need to be isolated from visitor viewing. E.g. the enclosure at Brasilia Zoo is 635m² and it has many natural underground dens, but the exhibit is also sunken well below visitor level and this contributed to additional privacy. Note: keeper activities were significantly minimized as well. For some litters, visitor viewing was also restricted. See Part A above. Section 12 below lists the institutions that used expansive enclosure designs and/or natural underground dens during successful cub-rearing and it includes a brief description of each enclosure. See throughout Chapter 2 for more details on some of the enclosures and cub-rearing experiences.

The provision of expansive[1] **complexly and naturally enriched enclosures with hills that offer otters ample area to dig underground dens is optimal.** [1]*Within this manual "expansive enclosure" means any enclosure that is 600 m² [6,458.4 ft²] or larger.* The larger, more complex, and natural the enclosure, the more benefits gained. (The enclosure also requires the recommended land and water area designs and locations [esp. appropriate land to water ratios that provide enough land], substrates, deep digging area sizes, and hill designs and locations to offer these benefits.) This type of living area **provides optimal enrichment and living conditions for giant otters and it is very important to help aid successful cub-rearing.** This is because **the larger the enclosure, the further parents can get away from human disturbances and presence** during cub-rearing (i.e. the more privacy they have) **and** as well, **natural underground dens provide additional visual and acoustic isolation.** The otters are offered an optimal area where they can carry out, to the fullest extent possible in captivity, the innate terrestrial behaviors that are among the most important activities needed to allow these animals to significantly reduce or prevent the negative responses (i.e. stress, nervousness, boredom etc.) that can occur and cause significant problems (e.g. litter loss) during cub-rearing. **Dens that the otters dig themselves** provide a great amount of isolation in combination with an expansive enclosure or an enclosure that is totally isolated. These den types **are highly recommended and are very important to promote successful cub-rearing** in all enclosures. Wild *Pteronura* use the multiple underground dens that they dig within their vast territory, to rear cubs and sleep in. When given the appropriate conditions, i.e. substrate types and hill designs as recommended, captive *Pteronura* will also dig many underground dens throughout the expanse of the hillsides/banks provided and use them for the same purposes. Underground dens are fairly visually and acoustically isolated, i.e. more so than a wooden nestbox, natural for otters to rear their litters in, and private and safe feeling for the otters. They do not have to be serviced or maintained by keepers because the soft loose substrates in them keep the dens clean, dry, and sanitary when land to water ratios, other land and water area designs and locations, substrates, and hillside locations and designs are provided as recommended. (No bedding materials need to be offered within them.) The fact alone that humans usually do not enter underground dens (esp. in comparison to a nestbox, den containing a nestbox, or artificial underground nestbox), adds to feeling of seclusion and safety from human intrusions and disturbances.

Giant otter enclosures and any buildings housing such enclosures should be designed and located within the zoo so that they can be isolated from all visitors/public and zoo staff during cub-rearing, yet still allow minimal keeper activity in limited areas without creating human disturbance. It is necessary to provide multiple nestboxes, dens containing nestboxes, or natural underground dens where human entrance can be restricted during cub-rearing (see below). **Nestboxes, dens, and areas for underground**

dens (i.e. hillsides) should be located as far away as possible from public/visitor areas, keeper access areas/doors to enclosures and buildings, areas where food will be offered, and from where keepers would need to service enclosures, e.g. to empty pools etc., **and shift/lock out animals. They also should either be located and positioned within enclosures or/and modified** or the area immediately around them modified **so that the otters that are within the dens and nestboxes cannot see keepers performing necessary servicing** (i.e. entering or cleaning enclosures, feeding, etc.).

Nestboxes and dens containing nestboxes should be located and designed so that they can be isolated from all humans during cub-rearing. If they cannot be totally isolated, simple enclosure modification techniques made before parturition **might be possible to help provide some privacy** (see below). **At least 2 nestboxes must be offered when natural underground dens are not available**, although **at least three or more nestboxes, each placed within a separate den, should be provided. Nestboxes should be placed within dens to offer additional privacy**. When natural underground dens are not available, a nestbox, esp. those made of wood, placed in a den will offer the otters more isolation from human disturbances and presence than when it is just placed somewhere within the enclosure area. Multiple nestboxes and dens will offer parent's rearing litters an opportunity to choose which area they feel most comfortable and safer in (Hagenbeck & Wünnemann 1992, Wünnemann 1995, and Flügger 1997). It is important that parents feel that they can move their cubs to a safer feeling den/nestbox, especially after a disturbance has occurred. E.g. Wünnemann (1995) reported giant otter parents at *Hagenbeck Tierpark* used multiple nestboxes when they changed the locations where they kept their cubs during cub-rearing. *Dortmund Zoo* staff reported the same and that the parents would move their cubs to different nestboxes sometimes as many as one or more times during the same day. **At least two dens should be located so that they are a distance apart from each other** so that the otters can feel as if they are moving cubs to a significantly different, more remote, and seemingly safer location. **The additional provision of two interconnecting dens is also recommended** for easier shifting and temporary separation of animals etc.. In climates that are warm all year around, satellite nestboxes or den areas with nestboxes can be connected to and located behind outdoor enclosures, as long as they can be isolated, for additional privacy. Note: multiple dens should be provided within all enclosures for various reasons. **Indoor enclosures, whether they are attached to outdoor enclosures or not, although must provide at least two or more off-exhibit dens in addition to the indoor land area that is necessary for otters to carry out all living activities that are too cold to do outdoors.**

Dens should be constructed with solid non-transparent containment barriers, such as concrete or tile, so that they provide maximum visual and acoustic privacy during cub-rearing. When although, fence/lattice barriers are used they should be covered with wood/plywood boards during cub rearing to offer additional privacy and prevent cubs from crawling through the fence/lattice mesh. Each den needs a keeper access door and they also need an animal shift door accessing the larger enclosure areas and possibly, the adjoining den depending on exhibit and den placement. When the keeper or animal shift doors/gates to the dens are constructed of fence/lattice they also should be covered with plywood/wood or other non-transparent materials or the shift doors could be replaced with a non-transparent shift door. (Note: when fence/lattice is used for one of the containment barrier sides within a den, the den could also be used for an area to perform husbandry training or as an area, in addition to other enclosure areas, to use for the introduction of unfamiliar/temporarily separated animals. See Section 13.) It is optimal when long narrow tunnels, made of wood/plywood, are connected to the nestbox entrance holes as they help increase privacy, keep nestboxes free of draft, help reduce tracked in water, and

keep cubs from crawling out (Duplaix-Hall 1975). Transparent viewing areas should not be created within nestboxes as they could detract from the feeling of safety and privacy. Nestboxes should remain dark or if necessary infrared lighting could be used when video cameras (see below) do not have infrared capabilities. See Chapter 2 Sections 12-14 for information on natural underground dens, dens, and nestboxes for construction methods for privacy etc..

Areas where food will be offered and keepers will need to enter the enclosures for cleaning etc. **should be located and designed so that they can be accessed/serviced quietly, quickly, and easily and if possible while hidden from the otters' view. Water areas should also be designed and located so that they can be accessed and serviced in a similar manner.** E.g. swim tanks and pools can be designed so that they can be emptied and filled with fresh water or/and be provided with a small gentle constant flow of fresh water, without the keeper having to enter the enclosure. **Enclosure, den, and nestbox animal shift doors** that can be controlled easily and quietly and when hidden from the otter's view will minimize disturbance. (Note: nestboxes within dens generally do not need shift doors.) In these cases, small viewing areas of the shift doors are necessary for otter safety during shifts. In addition, shift door control handles that can be placed directly next to the dens etc. can be used when otters are not rearing cubs, for easier shifting**. Dens, nestboxes, areas for natural underground dens, animal shift doors, and enclosures should be designed and located so that when cubs require vaccinations or emergency or medical care, parents can be easily shifted/locked as far away as possible from the den and nestbox area and in an area where they cannot see the cubs being handled**. This is necessary to minimize stress and disturbance during these rare events. See below for methods used to accomplish this. With the recommended land and water area designs and locations (esp. appropriate land to water ratios), substrate types, qualities and depths, and nestbox and den locations, nestboxes, dens, and land areas should remain dry enough so that bedding and other substrates do not need to be replaced/added to during cub-rearing. I.e. no or low maintenance will be required. Note: nestboxes, dens, and natural underground dens must not be entered and parents and cubs must not be disturbed or handled during cub-rearing unless it is necessary to ensure the survival of the otters (see below). *It is important to remember that giant otters can be very dangerous and can seriously harm/injure caretakers at any time, but they can be particularly dangerous and protective when they are rearing cubs. Enclosures should be designed with these considerations in mind.*

Windows and glass doors to buildings housing giant otters can be covered with posters, paper, cardboard, plywood, bamboo fencing etc. so visitors cannot peer inside. **Barriers can also be placed near the front of visitor entrance doors to help prevent the public from trying to attract the otters' attention.** E.g. visitors may bang/knock on the doors to waken the otters etc.. **Public access paths to outdoor enclosures can be blocked** to allow otters privacy outdoors as well as indoors and signs can be placed asking visitors to be as quiet as possible when near these areas. **Enclosures can also be surrounded with non-transparent barriers** such as a tall wooden fence etc. for additional visual privacy.

Wooden nestboxes or nestboxes made of other materials might be successful and provide additional privacy if they are placed underground, esp. in hillsides/banks where the soil caves-in, although this technique has not been reported to be tried. It is unknown if this would be successful in a giant otter enclosure. It is important that the nestbox floors remain dry and soft loose substrates, such as sand or mulch, are provided within the nestbox as recommended. Small drainage holes covering the floor might help to aid water drainage. All boxes must be able to be accessed to monitor and replace bedding substrates when they become wet or very damp, mulch breaks down into small pieces, or substrates become too shallow etc.. (Natural

underground dens do not need to be serviced in this way when the recommended soil types and hillside designs are offered. No bedding materials need to be offered within them.) Nestboxes must be able to remain dry enough, without servicing, for long periods during cub-rearing. (Appropriate enclosure designs and substrates must also be provided to keep the nestboxes dry.) It is unknown if underground nestboxes would be able to possess these qualities. If they do not, it may be difficult or impossible to not disturb parents during cub-rearing when the nestboxes require servicing.

Infra-red video cameras with microphones, placed in each nestbox, den, and enclosure area to monitor the entire enclosure **and viewing monitors (with recorders) located well outside of and isolated from the enclosure area/housing, are highly recommended to monitor cub development, behavior, and health and parental care without disturbance to the otters** (Hagenbeck & Wünnemann 1992, Wünnemann 1995, and Flügger 1997). [*Hagenbeck Tierpark* (Hagenbeck & Wünnemann 1992) was the first zoo to use this method with giant otters and they highly recommend its use, as it allows parents rearing cubs maximum isolation. Since, at least two other zoos, Dortmund and Cali Zoos, have also used this method with great success.] Microphones for monitoring vocalizations are very important, as they present the other half of the "full picture". The vocalizations of cubs and parents will tell as much about what is occurring, as visual pictures will. E.g. otter vocalizations are just as important to determine the health and contentment of the cubs and parents, as are visual pictures. When giant otter cubs are crying more often than usual, this indicates that they are hungry, feeling neglected, being abused, or feeling sick. Also, it is much easier to determine when cubs are actually nursing, because during this activity they make "nursing hums" and display "tail wagging". (See Chapter 3 for information on these behaviors.) If recording systems are not available with microphones, a baby sound monitor can be used, although "half of the picture" will be missing during play back of a video. Section 14 below describes ideas for how to install video cameras in nestboxes.

With a video monitoring system caretakers can determine if emergency intervention is needed e.g. when cubs need to be pulled for handrearing etc.. Determining the location and activity of the parents and cubs by video monitoring can also indicate the optimal times that exist for the keeper to service the enclosure and feed the animals. E.g. when the parents are sleeping, this is the best time to quickly carry out minimal cleaning and when otters are located far from the feeding area or areas that needs to be serviced, servicing can be carried out with less disturbance to the otters. Much can be learned about cub development etc. and parental care with a monitoring system as described. It is crucial that this information is recorded and shared with the scientific community to increase overall knowledge. For example, the frequency and length of nursing activity should be monitored as it can be used for comparisons to other litters, i.e. to detect problems etc.. It also can be used to help better formulate handrearing guidelines. Parental cub abuse and neglect in reaction to disturbances, i.e. any actions carried out by humans near and in enclosures etc., should also be closely monitored and recorded. *Negative reactions to human disturbances may not occur immediately after the disturbances have taken place* (see Part A above). **The time, type, and degree of both the disturbances and parental behaviors should be closely monitored** either from the recommended hidden viewing areas or on video monitors/tapes. This information should **be recorded on an on-going basis to evaluate the actual presence of negative responses. This way appropriate correlation can be made to identify what disturbs the otters and what husbandry practices are necessary/must be changed to prevent such disturbances.** This also can identify enclosure modifications or conditions that may be needed for future litters to provide privacy. See

Chapter 1 for studies that should be conducted and information that should be recorded to help further knowledge.

When video camera monitoring is used, then live/recorded coverage could be offered so visitors can see what is going on with the otters without disturbing them. Visitor areas for viewing, e.g. pre-recorded or live events etc., **should be located well away from the otters' enclosures** to help discourage visitors from staying around the enclosures/buildings. This will offer the visitors an enjoyable and educational experience. If video monitoring is not used, educational signs can be displayed, e.g. at zoo entrance gates etc., to help explain why the otters are not on display. E.g. how critical their situation is in captivity and in the wild and why it is important that the otters not be disturbed can be explained.

When video cameras are not available, otters might be able to be quietly watched from an area outside of the otter enclosure that hides and isolates the observer, as long as the otters are unaware of and undisturbed by the observer's presence. For example, a small hidden viewing area, such as a small hole in a solid containment barrier wall, may be able to be successfully used in indoor buildings or outdoor enclosures to view otters in their enclosures. Such viewing areas should only be just large enough for the observer to look through (i.e. the width/length of the observer's eye/s), they should be covered over with a piece of cloth etc. when not in use, and they should never be placed near dens or nestboxes where otters will likely detect human presence. Blinds, e.g. a hunting blind, with small hidden viewing holes, may be able to be used for outdoor enclosures. If a recording system is not available at all, baby monitors, located near dens with nestboxes and the receiving monitor located well outside of and isolated from the enclosure, could be used for sound monitoring.

No substantial changes should be made to the parents' physical (i.e. relocation to a new enclosure, significant physical changes to or within the exhibit etc.) **or social** (i.e. removal of any family/group member) **environment when the mother is close to parturition or when parents are cub-rearing. Both the mother and father should be allowed to rear their offspring together. Optimally, cubs should be fully weaned before isolation/privacy is gradually reduced.** Note: decisions on when to gradually reduce isolation must be made dependent on individual parental behavior and cub progress. E.g. some parents may feel comfortable with less isolation when their cubs are weaning, although others may not. How parents will react, is dependent on the many factors aforementioned. Isolation should always be gradually reduced, rather than suddenly eliminated.

Just before parturition and during cub-rearing, enclosures (i.e. every area where otters have access to) **should be isolated from keepers, other zoo staff, and visitors, yet still allow minimal keeper activity** (i.e. feeding, very limited or no cleaning) **in limited areas without creating disturbance. Buildings, in which the otters may be housed, should also be closed off to all persons, except for of minimal access by the primary keeper.** (See above for how buildings and entire enclosures can be isolated.) **The nestboxes and den areas that contain nestboxes should be closed off to *all* keepers, even the primary keepers, staff, and visitors. These areas should be able to be completely isolated from all humans. When they cannot be totally isolated, keepers should not get near these areas and simple enclosure modification techniques** (see above) **should be used to help provide some privacy**. **Even when these areas can be totally isolated, keepers should stay away from the general area that they are located as much as possible. Keepers should stay as far away as possible from natural underground dens and not enter them (unless necessary for the survival of**

the otters) as well. Nestboxes, dens, and underground dens must not be entered and cubs must not be disturbed/handled unless it is necessary to ensure the survival of the otters (see below).

Because the situation of giant otters in captivity is so critical, unnecessary risks should not be taken. E.g. if parents were locked away from the den and nestbox area and their nestboxes were opened to provide necessary medical care to the cubs, and the parents did not react negatively, this does not mean that similar procedures should/can be repeated for non-essential actions, just based on the parents' reaction in the aforementioned situation. If such chances were taken, there could be a possibility that the parents would begin to react negatively if such procedures were repeated too often. If parents were to suddenly eat or severely injure the cub as a result of the disturbance, there is not much that could be done to prevent such a reaction. As well, negative behavioral patterns could develop if the parents' tolerance level to such disturbances was exceeded. These risks should not be taken, esp. in light of the current situation.

Hagenbeck & Wünnemann (1992), Wünnemann (1995) and Flügger (1997) emphasize that caretakers that otters are not familiar with could create a significant source of disturbance. **Only primary otter keepers/caretakers, most familiar with the otters, should care for otters during cub-rearing and all other humans, visual and acoustic disturbances should be prohibited near the entire exhibit/enclosure. The number of keepers caring for the giant otters during cub-rearing should be kept to a minimum**, i.e. no more than two keepers if possible. Keepers should keep detailed records of developments and problems and relay this information to the other caretakers involved.

Otter keepers should develop a good report with the giant otters in their care. For example, training is a great tool to improve the keeper - animal relationship, which is especially important in the case of giant otters (Gatz 1997). In a zoo environment, some minimal disturbances are unavoidable during cub-rearing and it is essential that the otters are very familiar with and comfortable with the caretaker during this period to lessen the disturbance/stress.

Only the most essential husbandry actions should be carried out when parents are rearing their cubs and they should be minimized/limited as much as possible. These actions should be done as quietly and quickly as possible and otters should not see the keepers performing their work. During the first week or longer, depending on parental tolerance, keepers should not clean or enter the enclosure. (The enclosure will likely develop a strong smell from the defecation-urination build up, although even spot cleaning during the first week can cause great disturbance. This method has been successfully used in both indoor and outdoor giant otter enclosures either in South America or outside of South America without the development of health or other problems. E.g. at least one institution in South America did not enter the outdoor enclosure, which was not an expansive or natural enclosure, for cleaning for a three month period during cub-rearing to allow maximum privacy. No problems resulted during the multiple times this practice was used and 100% of the cubs were successfully reared.) **Keepers should place the otters' food in areas where the otters cannot see the keeper and in areas that the keeper can quietly, quickly, and easily access, without disturbance to the otters. Minimal exhibit cleaning, e.g. dry spot cleaning of feces and fish remains, should be carried out in the same way. It is ideal to service enclosures when the parents are asleep. Left-over fish should be minimized/eliminated by feeding only what otters eat readily.** (E.g. if at the end of the day a significant amount of fish remains are left over, less should be fed the next day.) **This is necessary to avoid health problems** (see Section 2 for health problems that could result and cleaning methods). It is important that husbandry

practices and enclosure designs allow for the provision of fresh food and enclosures without left-over/spoiled fish, unsanitary water, and overly accumulated fecal remains, with no or minimal human disturbance. See above for additional enrichment items, i.e. toys, that can be offered during cub-rearing. See above for ways to monitor cub progress etc..

Cleaning by hosing and scrubbing enclosures can cause disturbance and this should be avoided when possible. When enclosures are furnished with soft loose natural substrates as recommended, dry spot cleaning is sanitary and much easier and quicker to accomplish than the aforementioned method. This cleaning method will significantly minimize disturbance to the parents. Water areas, e.g. pools, swim tanks etc., can be drained and refilled with clean water, but it is advisable to avoid scrubbing the pools clean if possible. Water areas can be emptied and filled with fresh water or/and be provided with a small gentle constant flow of fresh water, without the keeper having to enter the enclosure.

It is crucial to remember that even when primary/familiar keepers are carrying out limited/minimized activities to service the otters during cub-rearing or keepers are near or in the enclosure, the presence of the caretaker alone and/or the activities performed (whether detected, seen, or just heard by the otters) can cause significant disturbance and stress to the otters. See Part A above for an explanation and examples.

Before parturition, **nestbox bedding materials** such as straw, hay, and leaves should be removed during cub-rearing to maintain nestbox dryness without human intervention in the nestbox area. Woodwool should not be used during cub-rearing as cubs may become entangled in it and also for the same reasons as above. The recommended types and qualities of mulch or soft sand, at least 10 cm to 20 cm (4" to 8") in depth, should be placed in nestboxes as a replacement for the aforementioned materials. This will help keep the nestboxes dry with no or low maintenance from keepers and provide soft surfaces for the cubs (see Section 2 above). **Although,** when enclosure land to water ratios, other land and water area designs or locations, land or floor substrate types, qualities, or depths, or den and nestbox locations are not provided as recommended, nestboxes/bedding substrates and land areas can remain very damp/wet. (See Section 3 above for the serious health problems that can develop in these situations). Note: no bedding materials are needed within natural underground dens other than the soil floor naturally present. It should be determined before litter birth how any live plants within the otters' indoor enclosure can be watered without disturbance, e.g. by automatic watering systems etc..

Shifting and locking the otters into various enclosure parts should be limited as much as possible. Rather than locking otters into their nestboxes or dens, it is much less disturbing and frustrating/stressful to the otters, when they are locked/held onto opposing enclosure sides. This can be accomplished best**,** i.e. with less disturbance, when the animals are sleeping. If the necessary action must be done at a time when the otters are not sleeping, the otters may be able to be lured over to a particular enclosure side and distracted by feeding. The keeper should feed in such a way so that he/she is not detected by the otters. Otters should never be chased away from their cubs, nestboxes, dens, natural underground dens or particular enclosure areas unless it is an emergency. This could be extremely stressful and disturbing to the otters.

Cubs and parents must not be disturbed and nestboxes, dens containing nestboxes, and underground dens must not be entered/disturbed unless the action is considered essential to ensure the survival of the cubs or other group members. These actions include those necessary during emergencies, crucial medical care, vaccinations (e.g. at 8, 12, and 16 weeks old) and pulling cubs for handrearing. **For example, cubs should not be weighed, measured,**

examined, or sexed in order just to gather this data, as this may result in litter loss. Such information can and has been gathered from cubs that are handreared. Although, if cubs require vaccination or other medical attention or emergency care, the parents should be locked away from the cubs so they are not able to see the procedure. This can be done by feeding the parents in an enclosure location as remote from the cubs as possible, to distract the otters and lure them away from the cubs. (The primary caretaker should feed the otters in the best possible way to avoid being detected.) The parents can then be locked away from/out of the area with the cubs and only the most necessary staff should enter the enclosure so that they are not seen by the otters, perform the procedure as quickly and quietly as possible, and exit in the same manner. Cubs should be handled with gloves so the parents do not smell that humans have touched the cubs. Great caution and care should be taken during the entire procedure, as the parents may very likely become easily frustrated, nervous, and stressed once they realize they have been locked away from their offspring.

To what degree parents are vulnerable to disturbances and normal human activity that did not bother them before parturition or how parents are effected by stress and to what degree they abuse and neglect their cubs because of it, can vary from non-existent to extreme dependent on many factors. (See Section 10 Part A & C and above.) It is therefore important that husbandry procedures should be adjusted to fit the individual needs of each parent.

> *"As in other otter species, Pteronura's hearing is acute (pers. obs.). An adult pair sleeping on shore heard an Amerindian canoe being quietly paddled upstream long before I did and, before it came into view, dived into the water…. Pteronura is extremely inquisitive and very aware of its surroundings – a single noise out of place in the constant background sounds of insects and birds will cause it to lift its neck and try to locate the sound. This alert posture is seen very often and in the water is replaced by periscoping, i.e. bobbing up and down while treading water" (Duplaix 1990).*

In the wild, specific attention is now being given to help isolate the areas, that giant otters use during the cub-rearing season, from human disturbances (i.e. tourist activities) (Schenck, pers. comm. 1998; Groenendijk and Hajek pers. comm. 2002). This is because wild giant otters may react negatively towards human disturbances during these periods and this may affect the success of the litter.

Part C. Family/Social Structure Management & How Family/Social Structure Management Affects Breeding and Cub-Rearing Success

"There is a high degree of pair bonding and group cohesiveness in *Pteronura*. Family members travel and fish together, seldom straying out of sight or calling distance from one another. Allogrooming takes place frequently and mated pairs sleep in contact with one another...Indeed, most of the activities carried out during the day are done by individuals in close proximity to one another. " (Duplaix 1980). This is also true for giant otters in captivity. Animals that are kept together become frustrated, anxious and stressed when they are separated/locked away from each other by their caretakers for even as little as a one minute time period. They prefer to keep very near to each other constantly, although they do normally occasionally carry out some activities separately without problem. In the wild, a mated pair normally bonds for life and all family members, including offspring (usually 1 to 2 years old) from the parents previous litters,

care for the cubs (Schenck & Schenck 1994). Both parents, in addition to the older siblings, play a significant role in the care of the cubs (Duplaix-Hall 1980; Schenck & Staib 1994). (In the wild, these animals usually have one litter per year.) Captive giant otters will also bond for life and both parents care for the cubs together; see below for older siblings helping to care for their younger siblings in captivity.

Giant otters are social animals and in captivity they should be housed as a single mated pair with/without offspring, having only one breeding pair. *Currently there are a significant number of otters being housed singly or in single sex pairs and this number has a critically negative effect on the small captive population.* (See Chapter 1 Section 1 for more information.)

Single sex groups, usually males and usually 2 individuals and rarely 3 in a group, have been kept together successfully, but they must be reared together or introduced with proper introduction practices (see Section 18 below). Adult females have been reported to live together, although only a few cases were reported and no other information is known at this time. (See the exception below.) *It is not advisable to introduce adult females.* For example, the following occurred at two institutions, even when females were kept in adjacent enclosures that were separated with fences that allowed visual-olfactory-acoustic contact for a considerable time before a physical full-contact introduction was attempted. At the time of the full-contact introduction, one female was attacked by the other and she died from the serious injuries that were inflicted upon her (Brasilia Zoo staff, pers. comm.). Note: one female at the time of the introduction had offspring with her; this is the female that died. At the other institution, "In two occasions the female defended her territory [by fighting] against another female, which we tried to introduce,..." (Trebbau, 1972). See another case of failed introduction between temporarily separated adult females below. (During introductions/re-introductions and more commonly, females are reported to have injured or killed males and even other females, but also males have injured other males. Females seem to be the more dominant animal during introductions, and afterwards once animals are paired, and they seem to initiate fights more often. Females and males fought against their own sex, females fought males, young otters fought against other unfamiliar young otters, and adults fought against unfamiliar young animals. All otters that are unfamiliar with each other or that have been kept together and temporarily separated must be introduced with proper introduction methods.) In one case an adult male killed a juvenile male (Kranz pers. comm.) and it is assumed that these animals were familiar with each other. Trebbau (1972) noted that "...in captivity it is necessary to separate the mature males, as they tend to fight". Although overall, reports have shown that adult males have lived together successfully and it is not unusual that adult males are kept together. E.g. at Philadelphia Zoo (Sykes-Gatz, pers. comm.) adult males lived together as compatible partners, though often at feeding times they had small brief quarrels and growling, and sometimes even small fights. They although did not inflict injury upon one another. These behaviors were similar to and no less severe than those that captive male and female pairs have carried out; see below.

"Problems [occurred] with the combination of two young males with one older female. Several occasions [occurred] with aggression and fights with the female being and imposing her dominance." (Vera da Silva, pers. comm. 1998). There have been several situations where mixed sex groups with adult animals, e.g. 2 males and a female, 3 females and a male, have lived together and it is assumed they co-existed without significant problems, although no specific reports or other information about these animals were available.

Removal of any family/member of a giant otter group during cub rearing or close to parturition will likely cause litter loss. It is crucially important to closely monitor a female

in a breeding pair to determine, as early during gestation as possible, if she is pregnant. I.e. dates when mating occurred should be recorded, teats and abdomen should be checked for increase in size, ultrasound training can be performed etc. **This is necessary so that if family/group members (i.e. 6 month old cubs) need to be removed from the breeding pair, separation can be done in the early stages of pregnancy.** For example, Flügger (1997) reports, when staff removed a 6 month old juvenile from parents who were rearing their successive litter, this action disturbed and stressed the parents so severely, that it resulted in the loss of the newest litter two days after the 6 month old was removed. The cubs (5 in total) in this litter died at 4 days old.

It is not recommended to separate parents during pregnancy or cub-rearing (Louzada da Silva, pers. comm. 1998; "Genealogical Meeting…" 1998; Flügger, pers. comm. 2001; Sykes-Gatz 2001; Gatz pers. comm. 2003). As stated earlier, in captivity, both parents are responsible for taking care of the cubs and it is very unnatural for parents to be separated during cub-rearing or at any other time. **Separation will cause great stress to the parents and this can cause the significant chance that litter loss will occur**. That is because when captive giant otter mothers are stressed (as well as fathers) they can eat, neglect, or abuse their litters. Note: litter loss will most likely occur if parents are separated after parturition, but even if they are separated before parturition there is a significant chance that litter loss will occur. It may be possible that mothers could abort their pregnancy because of stress caused by separation. **Only the following zoos have reported to separate parents (these zoos separated the parents before parturition). A significant number (i.e. 57%) of the litters from these parents died in the sole care of the mother during rearing. I.e. 4 of the 7 litters born where parents were separated, died within the first two days after parturition in the mother's care.** *Hagenbeck Tierpark*, *Sao Paulo Zoo,* and *Dortmund Zoo* were the only three institutions that reported such occurrences. Following are their experiences.

Hagenbeck Tierpark (Hagenbeck & Wünnemann 1992) reports that parents were separated two weeks prior to parturition and the male was moved to quarantine. This "recently formed pair" (i.e. the parents) was separated because they "did not live together in complete harmony". The pair was separated for two litters. From these litters, one cub was successfully reared by the mother in a litter of 4 live born cubs and 2 cubs were reared successfully in a litter of 3 live born cubs. **Flügger (1997) and Wünnemann (1995) at Hagenbeck considered it wise and natural to keep the parents together during cub-rearing; therefore** throughout the following 7 litters (after which the female died), the pair was not separated. Three of the seven litters born were successful and four were unsuccessful, although 2 of the 4 unsuccessful litter deaths (see above and below), occurred because of severe disturbances (i.e. caused by older offspring or the removal of older offspring during rearing) (Flügger 1997). The male "proved to be a good father".

The parents at Sao Paulo were separated 30 days after mating and the female was moved to another enclosure (Autuori & Deutsch 1977). Three litters were born when the otters were separated. The first two litters died or were eaten by the mother, both within 2 days after their birth. One cub in the last litter was successfully reared by the mother; although no births were reported after this.

At Dortmund, parents were separated approx. over one month before parturition and the male was moved to an enclosure that was located far away from the female, although at this time and after litter birth the female was being visually introduced to an unfamiliar male (Sykes-Gatz pers. obs. 2000). The father was also separated from the mother a few days before parturition and he

was moved to another enclosure (Gatz pers. comm. 1996). The two litters born after these separations occurred were both eaten by the mother within 2 days after parturition. Litter loss resulted because the mother was under a great deal of stress (i.e. she was nervous, frustrated, and exhibited excessive stereotypical behaviors etc.) from the massive change and disturbance caused by the separation.

Separating the parents is not recommended for more reasons than only the significant chance that it will result in litter loss. Because mated pairs bond for life, breaking this bond can cause both individuals significant stress whether they are cub-rearing or not (Sykes-Gatz and Gatz, pers. obs.). Also, if parents are separated and introduced to other partners multiple times, this may have a significantly negative effect on the otters' behavior. In addition, re-introducing any giant otters that have been separated, can be in some cases, especially difficult, dangerous/injurious to the otters and sometimes impossible. For example, giant otters that were housed together, temporarily separated, then re-introduced had serious fights during their re-introductions (see below). These fights led to injuries. The female also tried to kill her former mate during the re-introduction process and in the other case, the re-introduction attempt was aborted because it was unsuccessful due to the aggression that occurred during the introduction (Sykes-Gatz and Gatz pers. obs. 2001; Brasilia Zoo, pers. comm. 2002). See Section 18 as well as Section 3B for more introduction information.

A very compatible pair that was kept together for 7 years and that had many litters together was separated for eight months and housed far away from each other during the separation (Dortmund Zoo, Sykes-Gatz unpublished report & pers. obs. & Gatz pers. obs.). Just after the separation, the female was introduced to a new male, although this pair proved to be incompatible. The introduction took 5 weeks to accomplish and it was very difficult to introduce the animals, because the female's ability to adjust to this new situation was seriously compromised because of inappropriate enclosure conditions. It was very difficult as the female was extremely stressed, nervous, and acting in a neurotic manner (e.g. she performed extreme stereotypical swim pacing behaviors). This resulted because of being separated from her previous mate and being housed in an enclosure that did not offer the conditions necessary to reduce stress and other negative responses during all (including new/unusual) situations. (She was also housed in such enclosures for most of her life and it seems this was responsible for her general unhealthy mental state during normal circumstances. Note: her mate also suffered similar problems. See Chapter 2 Section 3 and below.) Even with four weeks of visual introduction and one week of full-contact introductions (the length of the full-contact periods were gradually increased over the week), the female was very aggressive and extremely domineering. She initiated serious fights and even tried to kill the male during the introduction period. Although the pair became compatible enough after the introduction to live together without the female inflicting injury to her new partner, the female remained so domineering over the male that eventually he was not able to eat enough food to maintain a healthy weight. This pair had to be separated after 8 months of being paired. The female again became extremely stressed, nervous, and neurotic because of the same conditions as mentioned above. Just after this separation, she was re-introduced to her original partner. It took approx. 2 months (with visual introduction for 40 days and then physical full-contact introduction for 18 days) to fully reintroduce them. For the same reasons as above, the controlled and closely monitored introduction was long, very difficult, and both of the otters were extremely stressed and nervous, and they fought many times. (The female was very dominant and was the aggressor; she initiated the fights and even tried to kill the male.) After 2 months the pair was finally fully introduced, and gradually, after a few months (during which both animals were exceedingly

nervous and stressed and the female was excessively domineering), they developed into a very compatible pair again.

Although a compatible pair bond was formed again, the female seemed to have developed some on-going social behavioral problems, and she (as well as her mate) also was, for at least a few months after her re-introduction, exceedingly nervous in behavior and easily stressed. (Note: these levels of nervousness and stress were greatly increased above the levels that she and her mate displayed before separation. Both the female and male were quite nervous in behavior even during normal daily circumstances before the separations and this seemed to be caused by the inappropriate enclosure conditions that they were housed in for most of their lives.) Gradually, over the few months after the re-introduction, their exceedingly abnormal behaviors subsided to the levels they displayed before the separation and the female's excessively dominant behaviors reduced. This is assumed to occur just because of the passing of time. About a year later, the female and males' generally abnormal and unhealthy behaviors/mental health, i.e. esp. the elevated nervousness, greatly improved after they were offered appropriate enclosure conditions and these conditions seem to be the cause for the improvement in their behavior. This improvement gradually developed after the changes in enclosure conditions were made. They remained within the same enclosures and only the conditions of the enclosures were changed. Even when they were relocated to other appropriate enclosures within the zoo, they carried out behavior that a healthy otter would carry out under such circumstances.) The female became although, until at least the completion of this report, abnormally domineering over her original partner after her re-introduction to him. This may have been because she adopted/learned to act this way because of her previous experience and also because the extreme stress from the separations and inappropriate enclosure conditions were responsible for the development of this abnormal behavior. This report was completed a few years after the separations occurred.

Also, at another zoo (Brasilia Zoo, pers. comm. 2002), a 2 year old female was housed with her siblings and parents for two years and then she was separated from them for only a day or two with visual-acoustic-olfactory access. This female was attacked and injured by her mother and sisters upon her re-introduction to them. The re-introduction attempt was aborted. Under normal circumstances, giant otters do not like to be separated for even a minute or so from the other otter, as this situation makes them frustrated and anxious (Sykes-Gatz and Gatz, pers. obs.).

In all cases, breaking partners or other group members apart for any reason should be avoided as much as possible. If individuals are separated from their partners or other group members too often (e.g. to be repaired with other mates), this could cause a significantly negative effect on the otters' behavior, possibly over the long-term. E.g. this may cause very difficult introductions to unfamiliar or temporarily separated animals, the failure to successfully readjust to and get along with new animals/previous partners, social behavioral problems, the failure to rear cubs successfully or treat cubs properly, and/or general mental/behavioral health problems. More research should be conducted on these issues as only very limited information is available on the affects of multiple separations and re-introductions on individuals. It is most important although that the enclosure conditions that the otters were kept in before (i.e. for their lifetime) and after separations and re-introductions occur are also studied and evaluated to determine their affect on such situations. The enclosure conditions that are necessary to evaluate are those described in Chapter 2 Section 3B.

Inbreeding, physical, behavioral, and pair compatibility problems should be considered for repeated breeding or rearing failure, providing appropriate husbandry and management is used during cub-rearing and at all other times. Hagenbeck and Wünnemann (1992) suggest that giant otters "show individual preferences when accepting a mate"; hence, repairing mates should be considered when pairs show clear signs of extensive pair incompatibility. Although **a pair should not be determined incompatible just on the observations of brief temporary quarrels, growling, etc.** seen between group members during the normal day. For example, it is quite common that captive giant otters, even truly compatible pairs, will growl at each other and sometimes even briefly fight (not inflicting injury), when they are eating fish. They will often try to keep some distance apart when they are eating. One individual may beg or show the other that he/she wants the other's fish and one or the other may growl or make defensive/offensive bodily movements in addition. [These behaviors are also seen among wild *Pteronura* family group members. At least among adults "each otter catches its own prey and consumes it immediately…and there is no food sharing" (Duplaix 1980).] Many other negative, aggressive, or domineering behaviors must be displayed and on a continuing basis to determine if the pair is incompatible. Note: the individual "personality type" (i.e. very dominant, submissive, patient, nervous etc.) of each otter can affect pairing success, therefore this should be considered when selecting possible mates and partners as well.

It as well should not be assumed because of certain behaviors, that the presence of fathers during cub-rearing will have a negative impact on the success of cub-rearing. For example, it seems to be normal, both in captivity and in the wild (Staib 2002), that fathers will often take cubs out of the den/nestbox and the mothers will immediately take action to return the cubs to the den/nestbox. When this behavior is not abnormally frequent or excessive, it should not be determined as harmful. Parents at *Dortmund Zoo* (Sykes-Gatz pers. obs.), *Hagenbeck Tierpark* (Flügger pers. comm.) and *Cali Zoo* (Corredor pers. comm.) have all been observed to carry out these behaviors. In at least the first days after birth, mothers have also been seen to be a little protective over their cubs when the father tries to become involved with the cubs. This as well should not be seen as abnormal behavior. Soon afterwards, the father will become equally involved (and his involvement well accepted by his mate) in the care of the cubs. Providing multiple nestboxes or having multiple underground dens gives fathers a place to go and mother's a little free space during these times. As well, it is crucial that enclosures are properly designed and furnished to help occupy the father's and mother's attentions on something else rather than only the cubs.

It may also be possible that when siblings from the same litter are reared and reach sexual maturity together, they will not breed if they are housed together as a potential breeding pair. This situation and failure to reproduce is known to have occurred in three cases, at three different zoos (Louzada da Silva, pers. comm. provided information about the pairs' family history at Brasilia and Sorrocaba Zoos; Wünnemann 1991). For example, at *Hagenbeck Tierpark*, a female was kept with her brother, who she grew up with, until she was at least 3 years old. This pair had rare and failed mating attempts and no pregnancies resulted. Wünnemann noted that this male was not well experienced at mating [maybe he did not penetrate the female]. This pair was then separated, the female was paired with a new partner and she had a litter. A litter was born at *Cuiaba Zoo* in 1994 and a pair from this litter was transferred to *Sorrocaba Zoo* and no litters were born from this pair during their lifetime, although they were kept together their entire lives (which was at least 6 years or more). (More detailed information regarding this pair is not known, so other explanations for breeding failure may also have been possible.) At *Brasilia Zoo*, a brother and sister that were reared together were eventually separated, but they were kept in visual-acoustic-olfactory contact with one

another during their separation. This male successfully bred with other females when he was separated from his sister. When this male although was put back together with his female sibling they never bred. During the long periods that this brother and sister were kept together, no litters were born. It is interesting to note that the sister, during separation bred and bore litters (that did not live) with another male. **It may also be possible, that if unrelated giant otters are reared together or introduced well before they reach sexual maturity, and they reach sexual maturity together, they will not breed. It is therefore not advisable to keep otters in the aforementioned situations.**

It is advisable to remove cubs from the parents, when the cubs reach 6 months old. (Captive cubs are normally fully weaned at an age of six months.) **Although, because of limited available data and limited experiences** (Corredor, pers. comm. 2003, Brasilia Zoo, pers. comm. 2002, Flügger 1997**) a specific guideline cannot yet be made.** Many factors can affect how successfully juvenile and sub-adult siblings (and adult siblings) are able to co-exist with and help care for their younger siblings, this therefore affects cub-rearing success. The success of the few institutions (Corredor, pers. comm. 2003, Brasilia Zoo, pers. comm. 2002, Flügger 1997) which have experienced this situation has shown that more cubs have died in such situations than survived. The experiences at each institution are reported below.

Flügger (1997) **found it necessary to remove offspring from the parents when the offspring reached six months old.** This is because at *Hagenbecks Tierpark*, three one-year-old offspring from the previous litter played too roughly with the new cubs and parents were not able to defend the young cubs from the exhausting play-ways of the older cubs. The younger cubs died at 17, 23, and 27 days old. In another litter, three 6.5 month-old cubs, from the previous litter, competed with the new cubs for the mother's milk. The younger cubs died at 3, 9, and 60 days old at which time the remaining 3 cubs were handreared (of which one died at 3 months old after 4 ½ weeks of handrearing). (Note: the three cubs were emaciated at the time that they were pulled for handrearing.) In both cases, it was presumed that the mother failed to lactate sufficient amounts of milk because of the stress. Litter losses resulted in these cases, because of the stress this type of disturbance caused the parents, the competition for the milk supply and the affects of the exhausting play-ways on the cubs. The older siblings created the stresses/disturbances. It is assumed that these otters were housed only or primarily in an indoor enclosure during the period in which the successive litters were reared (esp. as these litters were reared during the cold months in Germany). Note: an outdoor enclosure of 255 m² [2, 744.8 ft²] was also available when it was warm enough for the animals to have outdoor access.

At Cali Zoo, in at least two successive litters, of which 3 cubs were born in one litter and 1 cub was born in the following litter, 2 cubs survived, one from each litter, when juveniles and/or subadults were also present (Corredor, pers. comm.). This is a 50% success rate for these particular two litters. Although it is important to note that two of these cubs died of a bacterial infection caused by the wet/very damp conditions within the dens. Updated records showed that two following litters, reared by the same parents and in a group with a similar social structure as aforementioned, failed to survive.

It is interesting to note that no births were reported to occur at one institution for a 2 year period, during which the breeding pair was housed with their offspring, until the offspring reached 2 years old (Brasilia Zoo, pers. comm. 2002). Concerns/reports were that some of the births were suspected to have been undetected (i.e. cubs were eaten and no remains were found) at this institution in the past and this suggested that more litters may have been born than were recorded (Louzada da Silva, pers. comm.). I.e. the cubs were born and raised in natural

underground dens in this expansive exhibit and they were sometimes not known about until the parents moved the cubs (i.e. when cubs were more than one month old) from the underground den. It could be possible that cubs were born from this breeding pair during the two years the pair raised their offspring, but they were not detected. If litters were born, they might have had similar problems as those experienced at Hagenbeck Tierpark, because of the competition the older siblings might have created. (See the alternative theory in the following paragraph.)

The cubs that were born (5 cubs in total) **when their siblings turned 2 years old, were reared by the entire family in a healthy natural manner, until the young cubs turned 4 months old** (at which time the 2 year old siblings were removed from the enclosure) (Brasilia Zoo, pers. comm., 2002). The three female older siblings helped to care for their younger siblings, as they would do in the wild. It could be possible that because the older siblings reached a mature age, they presented no competition for the mother's milk and they were old enough to more carefully handle possible younger siblings, because of their own experiences of being cared for. In the event that litters were not detected during those two years simply because litters were not born, it might be possible that the older siblings could have successfully cared for hypothetical younger siblings. They might hypothetically have been successful because of the expansive enclosure that offers a simulating and challenging environment. This might have been enough to occupy their attentions so that they would not excessively play with or overly focus on their hypothetical younger siblings as play toys for lack of better enrichment.

> *"In Manu National Park, Peru, in 2001 a giant otter family gave birth to two litters spaced approx. six months apart. One cub of the first litter survived and remained with the family during the successful rearing of the second litter." (Groenendijk pers. comm. 2003)*

Many factors can affect how successfully juvenile and sub-adult siblings (and mature siblings) are able to co-exist with and help care for their younger siblings, this therefore affects cub-rearing success. These factors include the quality, size, design, and furnishings of the indoor and outdoor enclosures (see Parts A-B above for an explanation of these factors). They also include individual otter personality and history (e.g. physical and behavioral problems), the degree of experience that parents and offspring had with rearing cubs, family social structure, and the age of the older siblings at the time of the new litter birth. The amount of visual and acoustic privacy/isolation available, the duration, intensity, frequency, and familiarity of disturbances, and husbandry and management practices are also factors as well as the other issues discussed within this section. In an ideal situation, it would be advantageous for cubs to remain with their family group until they are two years old. Helping to replicate the natural social structure found in the wild would provide the maturing cubs and parents with a more natural, enriched, and stimulating environment. If new litters were born, this would allow otters from previous litters to gain experience helping to rear cubs, which would be highly beneficial towards their own parenting skills later on in life. When cubs reached sexually maturity (i.e. at 2 years old), they then could be mated with non-related individuals to form a breeding pair. Although, **because the situation of giant otters in captivity is so critical, cub-rearing success has been so poor, there are very limited experiences with these matters, and many zoos do not have ideal situations, little chance should be taken for experimentation.**

Section 11
Additional Enclosures and Separable Enclosure Areas

It is recommended to have an additional enclosure that can be used as a temporary holding area, esp. if it can be used to safely introduce unfamiliar or temporarily separated otters or house offspring that can no longer live with their parents. Although, in the rare case that paired individuals (i.e. bonded partners/mates) might need to be separated, it is also recommended to have an available enclosure that is not located near and that is remote from the permanent otter enclosure. These enclosures should be out of visual and acoustic distance of the newly separated animals to help reduce the significant stress and frustration that will likely occur on both otters' parts, because of the separation. (I.e. when otters can see and hear each other during the separation, this will greatly frustrate and stress them, because they cannot be in physical contact with their partner.) Giant otters vocalize very loudly and they can be heard over quite a distance. The recommendations within this manual apply to these (and all) enclosures and separable enclosure areas that will be used to house giant otters. See Section 3 for how the necessary enclosure conditions can greatly reduce the stress that animals can experience when they are in new/unusual situations. Without these conditions the otter's ability to successfully adjust to the new/unusual situation can be adversely affected or seriously compromised.

Introduction (also called howdy) gates and fences, that can separate indoor and/or outdoor enclosures, are recommended so that introductions of unfamiliar or temporarily separated otters can be carried out easily, safely, and in appropriate conditions. It is necessary to conduct visual-acoustic-olfactory introductions before potentially dangerous initial full physical contact introductions take place. (Below when the term "visual introduction" is used it implies a full "visual-acoustic-olfactory introduction".) It is not uncommon that unfamiliar otters injure or sometimes even kill each other during introductions. The larger the area that visual introduction can take place, the better. For example, a visual introduction gate 5 m (16.41 ft) long worked very well to introduce unfamiliar otters, where as much smaller areas, such as only twice the size of a shift door or a little larger produced much poorer results during visual introductions (Sykes-Gatz & Gatz pers. obs.). Otters must also have sufficient area where they can hide or stay out of the other's view when they feel it necessary and they should be given at least a reasonable size living area during the introduction period. **Enclosures, with no additional separable living areas other than dens, should design methods that allow temporary division of at least some enclosure space because e.g. small areas, such as dens, do not have enough space to allow for appropriate visual introductions.** This not only allows for safer and more effective visual introductions, it also offers temporary additional living space if otters need to be separated. *See Sections 13 & 18 for more information on enclosure designs needed for introductions and Section 8 for how well otters can dig and climb.*

Section 12
Natural Underground Dens, Hills/Banks, Varied Terrain, Flat Land, Steep Banks/Hills, Ramps & Stairs

Observations of wild giant otter territories and underground dens in Suriname:

"The size of the home range can only be roughly estimated…[it] is roughly 12 km long and 12 km wide…Normally a pair of otters and their offspring of the past two years will clear and mark sites dotted along a 2 to 3 km section of the creek, even though they may wander over these borders at regular intervals…At least a portion if not all the territory is patrolled each day…They excavated or renovated five new dens when they settled in this new portion of their home range, using eight different dens in two months….

…. It was possible to measure the tunnels and den chambers of 3 dens. The tunnel measuring 30 cm to 3.6 m in length leads up to the oval chamber which measures 1.2 m to 1.8 m in diameter and is 43 cm - 74 cm high. No bedding material was found inside, only a bare sandy floor worn smooth…A small air hole 10-20 cm in diameter may be present if the overhanging tangle of roots in the roof does not offer sufficient ventilation. While the chamber floor is level, the tunnels leading to it may turn upwards or sideways at an angle of 35°-45°….The average size of the 30 den entrances which could be measured were 52.5 cm wide and 37.4 cm high.

…The den consists of a tunnel leading to a single chamber which has been excavated into the riverbank….The diameter of the tunnel opening is consistent with the approximate diameter of an adult otter in a crawling position, approximately 30-40 cm in diameter. Tunnel openings may partially cave in in looser sandy soils until they are quite wide, up to 1.50 m.

Upper Coesewijne river	*39.77 cm (width)*	*32.23 cm (height)*
(5 dens, 13 holes)	*range = 18-80 cm*	*range = 18-60 cm*
Kabo creek		
(Tibiti river)	*47.88 cm (width)*	*32.13 cm (height)*
(8 dens, 8 holes)	*range = 30-100 cm*	*range = 20-42 cm*
Kaboeri creek		
(Jan-Sept 1977)	*57.14 cm (width)*	*39.86 cm (height)*
(8 dens, 14 holes)	*range = 32-150 cm*	*range = 27-55 cm"*

The large variation between maximum and minimum sizes represent the difference between new den entrances (minimal size) and older dens (maximum size)... While sandy soils cave in more often they are still used and the dens [den] is repaired until it is abandoned." (Duplaix 1980).

"High forest usually meant high banks with relatively little undergrowth and the otters preferred lower lying areas...The key factors in habitat choice are…low sloping banks with good cover…" (Duplaix 1980).

Within this manual "**underground den" and "natural underground den**" **refer to** a den that has been dug by the otters themselves (i.e. dug into natural substrates and underground) and the otters can use this den to sleep/rest and keep cubs in.

Sections 1, 2, and 5 describe the land and water area designs and locations (esp. land to water ratios), **land substrates, as well as hill/bank locations for natural underground dens, that are needed to keep the hills/banks and underground dens dry. Also discussed are the soil substrate qualities and types and hill/bank designs that are needed to construct areas for natural underground dens to be dug. Section 10B describes the hill/bank locations and husbandry practices needed to isolate underground dens from human disturbances during cub-rearing. The aforementioned provisions are among the most important requirements necessary for the husbandry of giant otters and without them serious health problems and problems during cub-rearing can occur.** See Sections 3 and 10 for the problems that can develop.

The provision of hillsides/banks within outdoor enclosures, with the designs and substrates recommended, would encourage and enable giant otters to carry out their natural behavior of digging underground dens to sleep and rear their cubs in. These natural underground dens, that help isolate parents rearing cubs from human disturbances and presence, **are very important to aid successful cub-rearing in captivity** (Duplaix-Hall 1975; Louzada da Silva, pers. comm. 1998, Genealogical Meeting…in Brazil" 1998, Sykes 1998/2002; Sykes-Gatz 2001). (Section 10 describes how these dens provide privacy.) Hillsides/banks also help keep land areas dry (by providing water drainage areas) and add variety to an enclosure. They as well provide an optimal source for physical and behavioral stimulation/enrichment. For these reasons, **this provision is highly recommended.** The inclusion of other types of varying terrain can provide some variety.

Wild *Pteronura* use the multiple underground dens that they dig within their vast territory, to rear cubs and sleep in. **When given the appropriate conditions** (i.e. substrate types and qualities and hill designs as recommended), **captive *Pteronura* can also dig many deep underground dens throughout the expanse of the hillsides/banks provided (e.g. extensive hillsides) and use them for the same purposes**. E.g. captive *Pteronura* have dug many underground dens throughout a 500 m^2 [5,382 ft^2] land area composed of hills that have the recommended designs and substrate furnishings (see below). **The expanse of the hillside/bank area provided should be as large as possible to accommodate this behavior.** (See Section 2 for information on the minimum size area of hills/banks that are needed when hills are used for deep digging and/or underground den building areas, as well as information on optimal sizes.)

It is important although that plentiful level land area is offered, with the recommended substrates, for otters to use when hills are provided. E.g. level land can be located at the top of the hills, along the water's edge, or/and elsewhere within outdoor enclosures and some areas can also be furnished with deep soft sand for variety in digging substrate. Otters in the wild will form multiple campsites on level ground throughout their territory (Duplaix 1980). ("...sites are usually above the high tide and high water level...The elevation is 50 cm to 2.5 m above the slack water line..." Low sloping banks are preferred.) Campsites are large level land areas where terrestrial/living activities, such as eating, marking, drying, grooming, playing and resting are carried out. These sites can also be located next to/over top of their underground dens, but they are not always located in the same area as their dens. A number of sites can be visited and used several times within a few days (Duplaix 1980). "...the average size [site] on three different rivers was remarkably similar : Upper Coesewijne river 8.12 m x 6.81m [26.64 ft x

22.34 ft] (11 sites) ; Kabo creek (Tibiti river) 12.25 m x 6.96 [40.19 ft x 22.84 ft] (16 sites), and Kaboeri creek 8.94 m x 5.99 [29.33 ft x 19.65 ft] (50 sites)." Sites although have been recorded to be as long as 28 m (91.87 ft) in length and as wide as 14.7 m (48.23 ft) in width. Generally sites (as well as latrines) are enlarged with each subsequent visit.

The provision of stable support structures, e.g. very large logs or boulders, wooden constructions etc., for otters to dig under may help prevent natural underground dens from caving in. **Additionally, trees, large bushes, or large tree stumps with long extended roots may help prevent cave-ins and soil/hill erosion so they are highly recommended. Dens should be checked for stability (i.e. cave-ins).** One institution, *Belem Zoo* in Brazil, reported that the dens that giant otters dug caved in. The otters were although able to successfully dig a den under a concrete nestbox, that was already within the enclosure, as it acted as a support structure for the natural den. A cub was reared successfully in this natural den. It is interesting to note that the parents rearing cubs preferred to rear their cub in the natural dens, rather than in the (artificial) concrete nestbox already available.

Multiple successful litters were reared in otter-dug underground dens at three of the six zoos world-wide and historically with successfully reared litters. Two of these successful zoos had expansive semi-natural or natural exhibits (i.e. enclosures at least 600m² (6,458.4 ft²) or more in size) as well, which is also very important to aid successful cub-rearing. This is because the size of the enclosure alone provided a great deal of privacy and the optimal enclosure conditions offered many other benefits as well. Note: one of the pairs to give birth at one of the aforementioned institutions with otter-dug underground dens, Museu Paraense Emilio Goeldi (Belem, Brazil), was loaned to a private facility called Criatorio Crocodilo Safari (Belem, Brazil). Because this same pair gave birth to at least one or more successful litters at both of the two aforementioned institutions, these two institutions are associated, and no other breeding pairs were known to be held at these institutions, these two institutions are counted, except where noted (see below), as one institution for all data within this manual. The facilities are also referred to as "Belem". If these two institutions were not counted as one, then in total (historically and world-wide) three institutions had expansive semi-natural or natural enclosures. As well, it is assumed that four had natural underground dens (three institutions where known to have underground dens), where cubs were reared successfully. The total number of institutions to successfully rear cubs would then also have to be increased to seven. See the international and historical cub-rearing statistics in Tables 2-3.

At *Brasilia Zoo* (Brazil) their semi-natural 635 m^2 (6,835 ft²) outdoor exhibit, with an 85% land to 15% water ratio, vegetation (i.e. grass etc.), and land areas nearly entirely covered with soft loose natural soil (i.e. Non-ferric Red Latosol*)*, offers plentiful hillsides where the otters dug/dig many underground dens throughout. All of their many successful litters (from several pairs of parents) were reared in these underground dens and the otters slept/sleep in the dens nightly. (No nestboxes or indoor enclosures needed to be provided.) With a high frequency throughout the day the animals groom, dry, rub, roll, scratch, and dig on/into the surface of the soil and they dig deep into the soft soil on the hillsides. The expanse of the enclosure and land area, the natural underground dens, the large expanse of hillsides provided to accommodate the dens, and the optimal enclosure conditions were very important to aid successful cub-rearing. Two thirds of the giant enclosure land area perimeter is surrounded by hills (i.e. one continuous large hill) with approx. a 40-45^o angle and they are extended at least 2 m (6.56 ft) high or more. The base of the hills are located behind and near the water's edge/shoreline and at the top of the hills is an expansive level flat land area. A large stand of bamboo formerly grew in part of the large open

level area within the enclosure. (See Sections 2 and 10 for more information on this institution's cub-rearing experiences and enclosure design, soil type etc..)

Multiple successful giant otter litters were reared in otter-dug underground dens in *Cuiabá Zoo's* (Brazil) very expansive natural outdoor exhibit (Louzada da Silva, pers. comm. 1998). The 4,282 m^2 (46,091 ft^2) exhibit also allowed parents rearing cubs to get away from human disturbances as well as many other benefits.

At the *Museu Paraense Emilio Goeldi* (Belem, Brazil) giant otter parents chose to dig their own underground den to raise their cub in, rather than the (artificial) nestbox already provided ("Genealogical Meeting…" 1998). The entire exhibit was closed off to zoo staff and visitors and only the zoo veterinarian monitored and serviced (with very limited/restricted activities) the otters during cub-rearing. The cub was successfully reared in the natural underground den. This exhibit was not expansive in size.

At the *Criatorio Crocodilo Safari* (Belem, Brazil) the pair successfully reared a giant otter litter in a very expansive natural enclosure 14 hectares (34.6 acres) in size. It is assumed that the pair within this enclosure reared their litter in natural underground dens that were likely present within the enclosure. The pair gave birth to one litter total when they were held at this institution.

Although wild giant otters can and do climb very steep banks that have soft substrates, it is not advisable to provide steep banks or steep hills in captivity. E.g. erosion problems could likely occur and otters could have difficulty climbing these (esp. young cubs, old animals, or parents carrying cubs) etc.. As well it should not be assumed that because giant otters can climb steep banks in the wild, that they can comfortably climb steep inclines made of hard surfaces, such as concrete, wood etc.. In the wild giant otters use the soft texture of the soil to dig their feet/nails into to help them get a good grip on the surface and this helps enable them to climb steep banks more easily. **Whether steep or not, ramps and stairs** (with hard surfaces) **do not offer this quality. They can be difficult for otters to climb, cubs or old animals may not be able to get up and down them at all, parents can have a difficult time carrying cubs up and down them, and animals could be injured if they fall or jump off the surfaces. They can also be slippery (esp. when they are very damp or wet). Ramps and stairs are not advisable for use on any land area.** (Even when ramps have rungs/slats or concrete has gentle step like indentations they can be difficult and dangerous to climb.) **Stairs or any structure/surface that otters must climb every day in a significant manner to access or utilize it should not be included within enclosures** as there may be a possibility that they could cause walking difficulties/abnormalities involving the otters' hind legs and lower back (Wünnemann, pers. comm. 2003). (Note: climbing artificial stairs or the other surfaces/structures as aforementioned are not the same as other forms of climbing. Captive giant otters often climb onto and lay on the top of their nestboxes and large diameter logs, tree stumps etc. This behavior is natural (they climb and lay on large fallen trees in the wild), they enjoy it, and it is not harmful to their health.) See Chapter 2 Section 3 for similar health problems caused by hard surfaces. If ramps have to be used because no other option is possible, they should be made of non-slippery material and have wooden slats/rungs to aid grip. They should also be enclosed on all sides like a tunnel (if they are over land areas) and be made with as gentle slope as possible.

Section 13
Den Construction

"Den" *refers to an individual man-made room, usually small in size [e.g. 4 m² - 9m²] (43.05 ft² - 96.88 ft²) and constructed with concrete, wood, etc., where an otter has access to. A nestbox can be placed or animals can be briefly held (i.e. for enclosure cleaning, etc.) in a den. Dens are off-exhibit and they do not serve as a nestbox. Note: the term "underground den" should not be confused with the term "den". Within this manual an "underground den" is that which is dug by an otter.*

Sections 1, 2, and 5 describe the den locations and land and water area designs and locations (esp. land to water ratios) **as well as land substrates that are needed to keep the dens dry. Also discussed are the substrates that are necessary within the dens**. **Section 10B describes the den locations and husbandry practices needed to isolate dens from human disturbances during cub-rearing. The aforementioned provisions are among the most important requirements necessary for the husbandry of giant otters and without them serious health problems and problems during cub-rearing can occur.** (See Sections 3 and 10 for the problems that can develop.) Section 10B also discusses locations and designs needed for keeper and animal shift doors to dens to offer privacy from human disturbances. Section 2C also discusses designs that can prevent land and floor substrates from blocking keeper and animal shift door movement. Section 9 describes locations and designs for animal shift doors to dens necessary to keep dens at appropriate temperatures and the temperatures that are needed within dens.

Enclosures should have at least 2 to 4 dens where otters can be briefly held or separated (i.e. for enclosure cleaning, etc.) **or/and nestboxes can be placed** (for otters to sleep and keep cubs in). **It is important that enclosures have dens in all situations**, i.e. even when otters require no indoor housing for cold temperatures and natural underground dens can be used for cub-rearing. This is because when it is necessary to temporarily contain or separate otters from each other or specific enclosure areas, it can be done easily and without harm or significant stress to otters and zoo staff. Hence, with dens, husbandry and management procedures such as enclosure maintenance, repair, daily cleaning and servicing, medical care, and unfamiliar/temporarily separated otter introductions can be accomplished more easily and safely than without dens. (*Note: giant otters can be very dangerous and enclosures should be designed with this in mind. Also, giant otters will become stressed when they are separated from their group members, although separation by shifting is significantly less stressful and much more safe than separation by netting, anesthetizing, etc..)* When natural underground dens are not available, a nestbox (esp. those made of wood) placed in a den will offer the otters more isolation from human disturbances and presence during cub-rearing than if it is just placed somewhere within the enclosure area. **Nestboxes therefore should be placed within dens** to offer additional privacy**.** Providing multiple dens, *each with nestboxes*, offers parent's rearing litters an opportunity to choose which area they feel most comfortable and safer in. It is important that parents feel that they can move their cubs to a safer feeling den/nestbox, especially after a disturbance has occurred. (Note: natural underground dens [i.e. dens that the otters dig themselves] provide a great amount of isolation in combination with an expansive enclosure or an enclosure that is totally isolated. These den types are highly recommended and important to promote successful cub-rearing.) **Indoor enclosures, whether they are attached to outdoor enclosures or not, must provide at least two or more off-exhibit dens in addition to the indoor land area that is necessary for otters to carry out all living activities that are too cold to do outdoors.** (See Chapter 2 Section 1 Part C for the recommended minimum size

for indoor enclosures that attach to outdoor enclosures and Section 9 for more information on such enclosures.)

Individual den size ranges from 4.5 m^2 to 9.5 m^2 (48.4 ft² to 102.3 ft²) **and animal shift doors measure 41 cm** (16") **wide x 41 cm – 59 cm** (16" - 23") **high.** Each den needs a keeper access door and they also need an animal shift door accessing the larger enclosure areas and possibly, the adjoining den depending on exhibit and den placement. **Dens should be constructed with solid non-transparent containment barriers, such as concrete or tile,** so they provide maximum visual and acoustic privacy during cub-rearing. **If although, fence/lattice barriers are used they should be covered with wood/plywood boards during cub rearing** to offer additional privacy and prevent cubs from crawling through the fence/lattice mesh. Strong fence/lattice barriers need mesh size that prevents entrapment of body parts (toes, feet, and head). **Fence/lattice mesh size** that is 5 cm x 5 cm (2" x 2") or 5 cm x 20 cm (2" x 8") have been used for a containment barrier for one side of the den. Fence mesh size of 2.5 cm x 2.5 cm (1" x 1") has also been used. When small fence mesh is used, it is advisable to place feed gates within the fence barrier. For example, a feed gate could be 26 cm x 15 cm (10" x 6") in size and have three evenly spaced bars over the opening to prevent otters from putting their heads through the feed gate. When fence/lattice is used for one of the containment barrier sides within a den, the den could also be used for an area to perform husbandry training or as an area, in addition to other enclosure areas, to use for the introduction of unfamiliar/temporarily separated animals. (See below.) A small border/edge (e.g. made of wood boards) can be placed/fixed along the outside bottom edge of containment barriers that are not solid (i.e. fence, lattice etc.) to prevent loose floor/land substrates from pushing through containment barriers. This could also help prevent cubs from crawling between barrier mesh. Keeper access doors/gates and animal shift doors/gates to the dens should be designed so that substrates (or even toys etc.) will not block the door or gates' path/movement/tracks. The animal shift and keeper door/gate frames should be positioned (raised) somewhat above, e.g. approx. 10 cm [4"], the surface height of the intended substrates to help prevent this from occurring. If the keeper doors or shift gates are not already designed (e.g. raised) to help prevent substrates from blocking them, simple modifications can be made for the same purpose (see Section 2C). If the keeper or shift doors/gates to the dens are constructed of fence/lattice they also should be covered with plywood/wood or other non-transparent materials or the shift doors could be replaced with a non-transparent shift door. **It is highly recommended to install infrared video cameras with microphones in dens** (as well as nestboxes and all enclosure areas) to monitor cub progress etc. without disturbance to the parents during cub-rearing (see Section 10B).

Introduction gates and fences (also called "howdy gates" or "howdy fences"), **that can separate indoor and/or outdoor enclosure areas, should be used for** visual-acoustic-olfactory **introduction of unfamiliar and temporarily separated otters.** (See Section 8 for introduction fence designs.) **The larger the area that the introduction can take place, the better.** When dens are the only areas where visual introduction can take place, they should be as large in size as possible, have fences/lattice and animal shift doors that are well located (to connect dens/tunnels to make the den area larger, etc.), and fence/lattice containment barriers with the recommended mesh size necessary for introductions. The fence/lattice should be used as a containment barrier for at least one side of the den that connects with a larger enclosure area or another den. **Larger divisible enclosure areas although should be provided in addition to dens** to promote visual introduction success because small areas, such as **dens, do not have enough space to allow for appropriate visual introductions**. Otters should be given at least a reasonable size living area during the introduction period and they must have sufficient area where they can hide or stay out of the other's view when they feel it necessary. Otters

should not be introduced with physical full-contact within a den area alone, as this area is too small and confined for a full-contact introduction to take place. Animal shift doors that are constructed of solid materials, but that can be replaced/interchanged with a shift door made of lattice/fence with the recommended mesh size necessary for introductions, can be a helpful addition during visual introductions, although larger introduction fences are needed as well. For example, an introduction fence 5 m (16.41 ft) long worked very well to introduce unfamiliar otters, where as much smaller areas, such as only twice the size of an animal shift door or a little larger, produced much poorer results during visual introductions. See Section 18 for information on enclosure design (fence mesh size etc.) and husbandry practices needed during introductions.

It is helpful to have areas available where husbandry training can take place. Sometimes the only place that this can occur is in the den area. When this is so, at least one den should have a fence front (i.e. used as a containment barrier for one side of the den), with fence mesh large enough to permit the passage of human hands, training targets, fish, ultrasound heads etc. **Fence mesh, with 5 cm x 20 cm (2" x 8") fence mesh size works well for husbandry training**, although caution must be taken as otters can climb this fence. (To avoid various health problems, den and all enclosure land and floors must be covered with soft loose natural substrates. In the rare case that an otter may fall, such substrates will soften the surface.) The largest den/s available should be used for training. When only very small dens are available it is difficult to train two animals together or even one in this small space. It could be possible that when two trainers are available at the same time, each otter in a pair could be trained in two individual dens that are separated so that they do not distract each other during training. (It is although challenging to encourage otters to feel comfortable with such a separation period.) **When possible larger enclosure areas should be used for husbandry training as well.** See Chapter 3 for training information and Chapter 1 for why husbandry training is important.

Additional den furnishings, other than a nestbox with bedding substrates and the necessary soft loose natural substrates covering the den floor (see Section 2), **can include** the following. A deep leaf pile, woodwool (remove woodwool during cub-rearing), a log for lying on, a box/tub of sand for substrate variety if only mulch is offered within the den, and cut tall bamboo (with the stalk size recommended) placed in fence mesh, the floor substrates, or in a hollow log so they overhang the otters can be included (see Section 4). These additional den furnishings will be helpful to add enrichment esp. during cub-rearing, when otters will stay close to their nestboxes/dens when the cubs are very young and when unfamiliar or temporarily separated otters are introduced to each other.

Dens are an ideal location to offer toys for additional enrichment when toys have to be kept away from the water or they cannot be presented on-exhibit in the visitor viewing area. See Section 15 below for a list of toys that can be offered. For example the following toys have been offered within dens. Items included cardboard boxes, cardboard tubes and PVC pipe tubes (30 cm to 31 cm [12" to 12.2"] in diameter) for lying and playing in, and a large plastic bread tray (turned upside down for lying on) with/without astroturf carpet secured on the top of the bread tray. Also woodwool and long strips of paper roll towels with light items, such as small cardboard boxes etc. hanging from the paper towels have been offered. These items are reported to be very well liked by the otters. For safety, woodwool, plastic bread trays and other items with holes that could entrap cubs and any item that could be dangerous to cubs (e.g. those that could roll on them etc.) should be removed before cubs are born and they should not be offered during cub-rearing. **Toys for behavioral enrichment should only be used as addition**

to and never as a substitute for the recommended enclosure designs and furnishings which are the most important forms of behavioral and environmental enrichment.

Section 14
Nestbox Construction and Temporary Transport Crates

*"**Nestbox**" refers to areas that are only large enough for the otters (including cubs) to sleep. Nestboxes are man-made (i.e. constructed with wood, concrete, artificial rockwork etc.) and they are either placed above or beneath the ground/floor.*

Sections 1, 2, and 5 describe the nestbox locations and land and water area designs and locations (esp. land to water ratios) **as well as land substrates that are needed to keep nestboxes dry. Section 10B describes the nestbox locations and husbandry practices needed to isolate nestboxes from human disturbances during cub-rearing. The aforementioned provisions are among the most important requirements necessary for the husbandry of giant otters and without them serious health problems and problems during cub-rearing can occur.** (See Sections 3 and 10 for the problems that can develop.) Section 2 also describes the bedding substrates that should be used within nestboxes. Section 9 describes the nestbox locations and den designs that are necessary to keep nestboxes at appropriate temperatures and the temperatures that are needed within nestboxes.

Giant otters need at least two dry draft-free nestboxes within each enclosure (Foster-Turley 1990; Duplaix-Hall 1972), **although at least three or more nestboxes should be provided.** It is emphasized that multiple nestboxes should be offered to give parent's rearing litters an opportunity to choose which area they feel most comfortable and safer in (Hagenbeck & Wünnemann 1992, Wünnemann 1995, and Flügger 1997). It is important that parents feel that they can move their cubs to a safer feeling area, especially after a disturbance has occurred. See Sections 10 and 12 for the importance of natural underground dens (i.e. those that giant otters dig themselves). Natural underground dens provide a great amount of isolation in combination with an expansive enclosure or an enclosure that is totally isolated. These den types are highly recommended and important to promote successful cub-rearing.

Nestboxes need enough space for parents and cubs to sleep, nurse, move, and turn around comfortably in, while offering a private safe feeling place. Nestboxes are usually made of plywood/wood. **The nestbox should measure approximately 1m wide x 1m long x .75m high** (3.28 ft wide x 3.28 ft long x 2.46 ft high) **and be made of wood/plywood. A nestbox entrance hole should be placed at one end of the nestbox and it should be approx. 30 cm wide x 40 cm high** (12" wide x 16" high). **The entrance hole should be placed about 10 cm to 15 cm** (4" to 6") **above the nestbox floor to help prevent cubs from crawling out** (i.e. to create a lip) **and bedding materials from being dug/pushed out.** Giant otter nestboxes range in size from approximately 1 - 1.2 m long x 1 m wide x .75 m+ high (3.3 - 4 ft long x 3.3 ft wide x 2.5 ft high). Multiple small holes that small enough to prevent cubs or their body parts from getting caught/stuck in the holes can be drilled into the nestbox floor to help aid water drainage/drying. **Nestboxes should have at least one openable top or side to more easily change/add bedding substrates and access cubs during emergencies or medical care.** Cubs will stay in the nestbox more easily with an opening in the top, rather than the side. An approx. 60 cm long x 60 cm wide (24" long x 24" wide) non-transparent opening hatch (i.e. a wooden

door) could instead be made in the nestbox for servicing etc. This would be useful to help keep cubs and bedding substrates in the nestbox if the nestbox door must be opened. **Nestboxes and dens containing nestboxes should not be entered or approached during cub-rearing except for when it is necessary to ensure the survival of the otters,** i.e. for emergency or medical care or for vaccinations (see Section 10 above). **Transparent viewing areas should not be created within nestboxes as they could detract from the feeling of safety and privacy**. **Nestboxes should remain dark or** if necessary infra-red lighting could be used when video cameras (see below) do not have infrared capabilities.

Shift doors should not be attached to nestboxes, although a removable shift door can be made to attach to the nestbox when the nestbox will be used for transporting animals for short distances (see below). E.g. otters should be locked in dens or separable enclosure areas, and not nestboxes, when enclosures are serviced etc.. A nestbox is too small and confined and in very warm temperatures, too hot, for otters to be locked in them on a daily or regular basis. Also, if parents have cubs, they should not be locked in their nestboxes together as the parents could harm their cubs in their attempts to get out or when they are under stress. See the paragraph below for tunnels that can be fitted with shift doors and attached to nestboxes.

It is optimal when long narrow tunnels, made of wood/plywood, are connected to the nestbox entrance holes as they help increase privacy, keep nestboxes free of draft, help reduce tracked in water, and keep cubs from crawling out (Duplaix-Hall 1975). The tunnel should be detachable so the nestbox can be moved/carried around more easily and the nestbox can be turned into a temporary transport crate if needed. The tunnel should be at least 40 cm (16") wide and 40 cm to 60 cm (16" to 24") high. The tunnel length should be at least 1 m (3.28 ft) long and it can range to 1.60 m (5.25 ft) long depending on den size. The tunnel entrance-way should be placed at the tunnel's side, not the tunnel's end, at the farthest end from the nestbox for extra privacy. I.e. the otters will have to turn a corner to get into the tunnel. The tunnel entrance-way opening can be 40 cm high x 40 cm wide (16" high x 16" wide). If the tunnel is long enough, it also can be made into an L shape for extra privacy. It is optimal when a shift door can be placed at the tunnel end of at least one nestbox so cubs, esp. older cubs, can be locked inside if necessary (i.e. for medical care / emergencies). The shift door frame should be elevated, e.g. 10 cm (4"), above the tunnel floor to help prevent substrates from blocking the shift door track. The shift door should be made of non-transparent materials so otters can not see through the door. A non-transparent opening hatch, i.e. a wooden door, with a secondary fence/lattice covered hatch located behind the opening hatch can be created in the tunnel. These hatches can be used for viewing the tunnel with safety and for accessing the tunnel. This way cubs can be removed from the tunnel if they are not directly in the nestbox and tunnel substrates etc. can be serviced/monitored more easily. **Tunnel floors should be lined with the recommended mulch or sand types, qualities, and depths to help keep the nestboxes and tunnel dry.** Note: during warm weather, dens and nestboxes located in outdoor enclosures could become very warm (esp. in climates that are warm all year around). *Caution must be taken if tunnels are connected to nestboxes as they may increase nestbox temperatures and nestboxes may become too warm for the otters. Other situations could also cause nestboxes to become too warm as well.*

If tunnels are not used, a "tunnel-like entrance" could be installed within nestboxes, although a full tunnel is much more effective and the following technique has not yet been reported to be used during cub-rearing. The following design creates a "tunnel like entrance" within the nestbox itself. (This nestbox was used as a sleeping box for 2.0 otters at *Philadelphia Zoo*). The nestbox measures 99 cm wide x 122 cm long x 76 cm high (3.25 ft wide x 4 ft long x 2.5 ft

high). It has an openable top, entrance shift door, and floor drainage holes. The entrance hole is located on the box sidewall measuring 122 cm (4 ft) long. A plywood wall (tunnel wall), at the entrance hole's inner side, extends from the nestbox's ceiling to floor and continues part way (48 cm [19"]) to the box's back wall. Ample room is left so adult otters can easily walk around the corner created.

Detachable tunnels/tunnel sections that access/connect to the nestbox or carry away nestboxes, designed to securely lock an otter within, are optimal for easier, safer, and less stressful otter relocations. When these are used as transport crates, they should only be used when the otter is transported over a short distance e.g. within the same zoo to another enclosure. **These should not be used for longer transports**. **Even during short moves,** tunnels or nestboxes that are made of solid materials (i.e. wood) and that are used for a temporary transport crate, **must allow adequate ventilation during the move**. For example, the shift doors on tunnels and nestboxes should be made of strong metal lattice to allow ventilation. A temporary transport crate can also be created from a removable section of tunnel that accesses two separate enclosures etc. For example, a 40 cm wide x 40 cm high (16" wide x 16" high) metal lattice tunnel that accesses two areas can be sectioned with a guillotine metal sliding shift door at each end, to create a 130 cm (4.27 ft) long area. This section should be designed so it can be easily detached from the entire tunnel to form a temporary transport crate. The shift door frame should be elevated, e.g. 10 cm (4"), above the tunnel floor to help prevent that substrates block the shift door track. **The tunnel floor should be covered with mulch or sand for daily use** (see Section 2 above for substrate qualities, depths etc.). If the floor of the tunnel is **made with metal materials (e.g. metal lattice, solid metal) this is esp. crucial** during the winter if the animals have wet paws when they are traveling through the tunnel. (Wooden boards can be placed/fixed along the outside bottom edge of the tunnel to help prevent substrates from being pushed out of the tunnel.)

It is highly recommended to place an infrared video camera with a microphone in each *dark* nestbox (and den and enclosure area as well). In this way cub development, health, and behavior and parental care can be monitored without human disturbance to the otters. See Section 10B. **Video cameras (with microphones) should be placed on the top of each nestbox with a protective covering surrounding the video cameras and wires leading to it.** (Giant otters often like to climb onto the top of their nestboxes and temporarily lie there.) E.g. a wooden box housing can be placed around the camera and video wires can be run through metal/plastic PVC tubes/pipes. Waterproof camera housing protection is also very helpful. The camera lens can be placed through a hole made into the nestbox top. The outside edge of a camera lens within the nestbox can be surrounded by a piece of fence that extends below the bottom of the camera lens to prevent that otters will dig into or play with the lens (e.g. footprints could obstruct the view etc.).

Section 15

Toys & Methods for Additional Behavioral Enrichment

Toys for Additional Behavioral Enrichment

*****Soft loose natural substrates, deep digging areas, land to water area ratios (i.e. enough land area), and other natural furnishings** (i.e. "man-made/live bamboo stands", leaf piles, logs) **provided as recommended are the most important forms of environmental and behavioral enrichment. These will provide a healthy stimulating and challenging environment in which the development of stress, boredom, stereotypical behaviors, frustration etc. can be avoided. Toys for behavioral enrichment and/or enrichment methods should only be used as addition to and never as a substitute for, the aforementioned provisions.** The above-mentioned furnishings and enclosure designs are discussed throughout Chapter 2 and the reasons for providing them are discussed in Section 3. **These provisions (e.g. digging areas, cut bamboo stalks, leaf piles etc.) are not discussed within this section.** See why enrichment is necessary in Chapter 2 Section 3B.

Giant otters regularly manipulate objects that are on land and in the water, as well as those that overhang them but that are within their reach. These objects most especially include items that are light in weight and that are easy for the otters to move around/manipulate. Note: these animals will manipulate items when they are lying down, standing, and standing on their hind legs. **Toys for additional behavioral enrichment should include items that vary in size and that can be manipulated, pulled on/down, tossed around, torn apart, dug into, entered, moved/pushed around, and investigated**. Giant otters carry out such activities with great energy and when they do so, it occupies their attention in a healthy way, **therefore at least some toys should be provided for additional enrichment on a daily basis. Note: often these otters will have favorite toys that they will use every day and that they will rarely ever become bored with. These items therefore should be provided everyday.** For example, toys such as sturdy cardboard boxes that are used for vegetables/fruits (see the box size below), cardboard tubes that are large enough for entrance, and woodwool are reported to be used daily by giant otters. Other lesser used toys should be offered occasionally to keep the otter interested in them. *Note: soft loose natural substrates that cover nearly the entire enclosure land and floor area, including deep digging areas, (see Section 2) and "man-made/live bamboo stands" that have the recommended diameter stalk size (see Section 4) are among the most frequently manipulated items (including artificial and natural items) within a giant otter's enclosure.*

Toys, that do not look natural/do not fit into the enclosure scenery, e.g. those constructed from man-made materials, **can be offered in dens (or even nestboxes) or other off-exhibit areas**, i.e. areas visitors do not have access to, **when necessary**. Toys that can be destroyed quickly in the water, e.g. paper/cardboard products, should also be offered far enough away from swim areas or in dens (or nestboxes) to avoid that they are taken into the water. When possible **these practices should be carried out so that toys can be offered.**

When otters are introduced to new toys, changes or new/unusual items within their environment, they may take a few days or even weeks of exposure to the item/s or changes before they show interest in it. Although once the items/changes are adjusted to, they can become occasionally or frequently used and favored. The less change that an otter has

been exposed to within its environment, the longer it may take for the otter to show interest in the object or change and become comfortable with it. An otters' environment should not remain stagnant or fear of change, boredom, and other abnormal stress causing behaviors can result. If its environment is stagnant, changes should be introduced slowly unless they include making changes to provide the recommended enclosure furnishings or designs. Note: the recommended enclosure furnishings and designs are the most important conditions that must be provided to avoid that abnormal behavioral and mental health problems develop and to resolve health problems that may already exist. Making changes to offer these conditions should be done as quickly as possible, i.e. these changes should not be made slowly. New/unusual changes should not be made at parturition and during cub-rearing and all necessary changes should be made before this time.

Most of the following items are inexpensive, easy to find, present, and maintain and are especially liked by the otters. The institutions surveyed reported that these items were well used and liked by their giant otters. *The condition and size of all toys, esp. tubes, tires etc., should be checked to prevent possible body entrapment and/or entanglement.* For example, an approx. 3 month old cub suffocated in a plastic cup (Flügger 1997). *Entrapment or entanglement could cause severe and potentially dangerous stress. This situation is also esp. dangerous in and near pools or if more than one otter tried to enter the tube/tire etc. at the same time in the water. As well, the condition of the items should be checked so that ingestion of toy and toy parts is not possible. Using a rope, or other similar items to tie objects up with or to simply play with in itself, should be avoided to prevent strangulation and entanglement. For safety, woodwool, plastic bread trays and other items with holes that could entrap cubs and any item that could be dangerous to cubs, e.g. those that could roll on them etc., should be removed before cubs are born and they should not be offered during cub-rearing.*

Giant otters enjoy tossing around large items (as well as medium and small sized items), such as those that are approx. two-thirds of their body size. These toys should not only be light in weight because this is what otters like, but also because this is what can be safely used both in pools and on land. Pteronura are very strong and can lift up very heavy objects that are overtop of them, with the back of their neck, shoulders, and back (Sykes-Gatz pers. obs.). For example, during a husbandry training session an adult male giant otter lifted, with the back of his shoulders, one end of a large and very heavy beam scale which he forced his head, neck, shoulders, and part of his back under. The beam scale was made of two long heavy metal beams (used for weighing very large animals) that were connected by a sizable wooden platform that was located low to the ground.

Playing with **cardboard boxes, esp. those large enough to lay on,** is a special favorite. **Sturdy cardboard boxes (e.g. boxes used for vegetables/fruits), approx. 60 cm (24") long, 40 cm (16") wide and 15 cm (6") high, are especially liked.** Otters will normally toss around, tear/rip apart into many pieces, dig into, and rest on these cardboard boxes. (New boxes often need to be offered daily to replace destroyed/wet boxes.) Various sizes can be offered. In many countries, cardboard boxes are available for free at grocery stores etc. or zoos themselves will often have boxes available from deliveries. Boxes can be offered in dens or places far away from swim areas to avoid that they are taken into the water. Giant otters also especially like **thick-sided large cardboard tubes** (used for carpets or concrete construction forms, 30 cm in diameter x 122 cm+ long [1 ft in diameter x 4 ft long]) to play and sleep/rest in. (Large PVC pipes can be used too, although they are not as favored as cardboard tubes.) (Keep tubes away from the water to prevent underwater entrapment.) Otters never before exposed to cardboard boxes or other new toys may take a few weeks of exposure to the item/s before they use it.

Although once items such as cardboard boxes etc. are used, they can become a very well used and favored item. No problems have ever been reported to be caused when paper or cardboard products have been offered to giant otters.

Woodwool, i.e. excelsior used for packing fragile items, can be placed in nestboxes to double as a bedding and play material. It is very frequently used by the otters as a play material. It dries quickly and can be re-used for as long as e.g. two to seven days. Unsoiled woodwool can dry after it is placed in the full sun for only a few hours. Woodwool should be kept away from feeding areas, so fish does not become entangled/coated with the woodwool, and it should not be used during cub-rearing. Otters will not use the woodwool when it becomes very damp/wet. Giant otters also frequently manipulate with their paws and push around, **smooth small round rocks, esp. river rocks, that fit easily into their paws, so SEVERAL of these can be offered** on land and in the water. **Only several should be offered. Piles of/land areas with rocks must not be placed anywhere within enclosures** (see Sections 2-3 for why). **Paper bags, paper egg cartons, overhanging long paper towels from a roll** that are tied and hung from a fence etc. with/without toys attached, and **telephone books** (in their entirety or in sections) are also torn apart quickly and well played with. Light toys, branches or cardboard boxes can be tied to the paper towel ends for otters to play with/reach for. **Tires** that contain no **steel wire and that are small in size or large enough for entrance** and **heavy-duty indestructible plastic tubs, containers and lids**, all small for handling or large for entrance, are often played with in the pool and on land. For example, heavy plastic trash containers and their lids are well liked, although the containers' handles must be removed for safety. Additionally, small heavy-duty plastic gasoline tanks/carriers are also well used. These must have their handles and caps removed and they must have never been used for gasoline or other dangerous/toxic substances.

Large plastic (bread) trays and plastic milk crates with their lattice bottoms turned upwards (for resting on) and water running from an unreachable hose are also well used. **Indestructible balls, buoys, small rafts** (wooden/log), **whole coconuts with the stringy fiber removed for safety**, a lightweight floating wood disc (i.e. slice) cut from a log, brown paper (large sheets/crumbled), waterfalls, vine hoops, pine cones, and feathers can be offered. Ice blocks/cubes, keeper blown soap bubbles, hard-boiled eggs, whole carrots, apples, pumpkin, watermelon, greens, catnip, crickets, large mealworms, bamboo poles (with branches stripped off), and tape recordings of animal sounds have been used. Perfume, cologne, and scented oils have been placed on various toys, but the otters did not seem to be interested in them.

Observations of wild giant otters in Peru

> *On one occasion, it was observed how the otters used a tin can that was thrown away by tourists as a play toy*." (Translation from Staib 2002). [Of course, tin cans should not be provided in captivity as they are too dangerous.]

Methods for Additional Behavioral Enrichment

Enrichment methods, discussed below, are also important. Survey respondents reported the following. Some toys should be changed regularly and offered on a varied rotating basis (dependent on interest in the object). Other items that are especially well used everyday should be given on a daily basis. E.g. many otters do not get bored with cardboard boxes and tubes, woodwool, etc. when they are given daily. *When otter parents are not rearing cubs or close to*

parturition, or individuals are not under stress or unusual circumstances, the predictability of the environment should also be reduced. The location of some enclosure furnishings can be changed daily to stimulate new interest, reduce predictability, and create new walking or swimming patterns. I.e. light logs, rocks, branches etc. can be moved to new locations within the pool and on land. Exhibits can be refurnished or pre-existing furniture can be relocated on a larger scale once or twice a year. *Methods that significantly change the otter's environment or cause disturbances (i.e. changing furniture location, etc.) when parents are rearing cubs, close to parturition, or otters are under stress or unusual circumstances, must not be used*. Toys can be presented in different manners to offer variety. They can be stacked on or within each other, hung, hid, scattered, placed in the pool or on land etc.. Giant otters enjoy pulling down overhanging items. E.g. cut bamboo branches (see Section 4 for the necessary bamboo type and stalk diameter size that otters need, to use the bamboo successfully) and toys hung on long paper towels are used very frequently. Fish can be hand fed, thrown onto the enclosure land area or into the pool for the otters to chase and it can be fed whole or in small pieces or fed live. Offering live fish is particularly enriching for giant otters (see Section 19 below for more information on fish types, quality, etc.).

Husbandry training, via operant conditioning, is also a stimulating and positively challenging form of behavioral enrichment and it is highly recommended for many reasons. See Chapter 3.

Section 16
Water Source and Treatment

It is necessary to offer clean swim and drinking water (free of spoiled fish and harmful bacteria etc.). Note: giant otters only defecate and urinate on land and not in the water. Tap or natural/spring water (flow-through included), with/without filtration and re-circulation, is used for giant otter swim water. Only one zoo, *Philadelphia Zoo*, is known to add chemicals (chlorine) to giant otter pool water. Complete pool water changes with pool cleaning are usually done at most zoos holding giant otters. (Many zoos do not filtrate their water.) This type of pool maintenance is usually performed one time per week or less frequently. When sand filtration is used, pool water changes and cleaning are reported to usually be carried out around once every 3 months. Although it is important to note that with sand filtration and when it becomes very sunny with very warm/hot temperatures for long extended periods, it was reported that it was necessary to carry out pool water changes and cleaning more often. Natural ponds with flow through water are also provided for giant otters. Specific information on chemical additives is available by request. Please contact the author and compiler of this manual for more information.

Pool drains, filters, skimmers, water filtration/cleaning systems, waterfalls, underwater viewing areas, swim tanks/tubs**, and all water areas must be able to accommodate the soft loose natural substrates that may be tracked, pushed, dug etc. into the water from land and floor areas. The simple designs and furnishings described in Section 2C above can help prevent substrates from entering water areas and blocking drains** or causing other problems. Although, even with these methods, some substrates will enter the water. Because it is necessary that every indoor and outdoor enclosure land and floor surface is nearly entirely covered with soft loose natural substrates as recommended, **enclosure water areas etc. should**

be designed or modified with these considerations in mind. These methods will also help prevent leaves, sticks, bark, etc. that have fallen from trees, fish remains, natural furnishings other than substrates, and toys from blocking pool drains or causing other problems.

Water quality and, if used, chemical additives and their levels, must be monitored closely. Excessive chemicals or poor water quality could cause sickness or/and poor fur coat condition. Poor fur coat condition can also cause sickness that could lead to death. (Note: problems with water quality and excessive chemicals and health problems resulting from them, have not been reported to occur among captive giant otters. See below for occurrences of leptospirosis.) If the state of the water is causing these health problems, immediate action must be taken to improve the condition of the water and provide any necessary medical care. The entire situation must be carefully evaluated, although, to make sure that other reasons are not responsible for causing poor fur coat condition. It is important to note that land to water ratios that do not provide enough land area or substrates that are of inappropriate types, qualities, or depths can cause land/floor surfaces to remain very damp/wet and this can also cause poor fur coat condition and health problems, such as infections and death. These inappropriate land conditions have commonly been the reason why poor coat condition and their related illnesses have occurred (Duplaix Hall 1975). In such cases, the enclosure land conditions must be corrected to resolve and prevent such problems from reoccurring and of course, medical care must be provided when necessary; see Section 3 above.

Fish should be fed in amounts that otters can finish, so that excess uneaten fish is not left in enclosures during the day and overnight. Uneaten fish can attract rats and rats could transmit leptospirosis to the otters. A couple giant otters have contracted leptospirosis and this is suspected to have occurred because large amounts of uneaten fish were left daily in enclosures overnight/during the day. When fish remains exist, they should be removed from all water and land areas daily. Otters will eat their fish in pools or take their fish into the water, as well as eat fish on land. Caution must be taken, as illness may also occur if otters (esp. cubs) eat spoiled fish remains or are exposed to harmful bacteria ridden swim water (other than exposure to leptospirosis, neither of these events have been reported to occur). **Note: it is not uncommon that otters will pick up small pieces of left over fish within their pools and land area and eat them; this although has not been reported to cause problems. It is nearly impossible, even with filtration systems, to remove all small fish pieces from the water.**

Water areas should be located and designed so that they can be accessed/serviced quietly, quickly, and easily and if possible while hidden from the otters' view, while parents are rearing cubs. This is necessary so that servicing can be done with minimal or no human disturbance (both visual and acoustic) to the otters during cub-rearing. E.g. swim tanks/pools can be designed so that they can be emptied and filled with fresh water or/and be provided with a small gentle constant flow of fresh water, without the keeper having to enter the enclosure. See Section 10B above for more information on enclosure designs and privacy needed during cub-rearing.

Section 17
Record Keeping

Record keeping is not only necessary to provide continued adequate care to individual giant otters, it is also necessary that all institutions worldwide keep and openly share these records to advance husbandry and management practices, research, and strategies. Chapter 1 provides a complete overview of which records should be kept and why it is crucial that they are maintained. Chapter 5 describes in detail the general daily maintenance records that should be kept during handrearing, although a complete overview of all of the records that should be maintained during handrearing are discussed in Chapter 1. Chapter 2 Section 10 describes in detail some of the records that are necessary to keep during cub-rearing and Chapter 1 discusses a complete overview and more detailed aspects on many of these issues. The following is only an overview of which records should be maintained on all of these topics.

Census records that should be kept for every individual that is born and acquired include individual identification and sex, identification of the dam and sire or location born in the wild, birth, acquisition, death, and transfer dates and corresponding locations, and reasons for death. Also needed are complete records on every cub and litter that a parent sired or gave birth to and any suspected pregnancies and births and reasons for the death of each cub/litter. Dietary, medical, physical (i.e. body weight, length, and temperature, blood chemistry etc.) and behavioral information on each individual held should also be maintained. E.g. individual behavioral assessments / reports (i.e. identifying dominant and submissive animals, animals with poor parenting skills, etc.) can help to identify individuals that could be most successfully paired/partnered together and individuals who would make good parents. Cub development both in parent and handreared cubs, parental behavior and reactions to human disturbances, trained husbandry behaviors and husbandry and management practices (esp. during parent and hand-rearing, introductions etc.) should also be recorded. Excess body weight gain or loss and daily amounts and food types eaten should be monitored and recorded.

It is also important to record the beginning and ending dates at which estrus / mating behaviors and false pregnancies occurred, as well as when unseen litter births are suspected. (Estrus/mating usually occurs once every 3 months, post-partum and after litter loss and records on such occurrences are needed to help determine if the female is pregnant. False pregnancy reports are not uncommon.) **The females' physical appearance** during the suspected/actual pregnancy, **behaviors indicative of birth and pair compatibility should also be noted.** If delayed implantation has occurred or is suspected, details should be recorded.

The following records should be taken and maintained only on cubs that are handreared and this applies to both wild orphaned cubs and captive born cubs. **Parents rearing cubs must not be disturbed to gather these records**. Daily records should be kept on cub weights, formulas/diets (i.e. dilution, ingredients, preparation), feeding regimens/schedules, beginning and ending weaning dates, amounts eaten, willingness to eat, elimination, handrearing methods and tools, health, problems, medications, behavioral and physical developmental progress etc.. Measurement of cub body length should also be recorded and they should be taken at least one time per week. Body length-weight-age growth curves and behavioral and physical development records are needed for comparison studies in the wild and in captivity. Many other handrearing records are also needed to increase overall knowledge.

Section 18
Introducing Unfamiliar & Temporarily Separated Otters

Giant otters that are unfamiliar with each other and those that have been temporarily separated (i.e. animals that were previously housed together) **must be introduced/reintroduced to each other in a gradual, cautious and closely monitored manner**. **It is necessary that visual-acoustic-olfactory introductions are conducted before potentially dangerous physical full-contact introductions are attempted.** *(When the term "visual introduction" is used within this manual it actually implies a "visual-acoustic-olfactory introduction".)* **These animals must also be provided with appropriate enclosure conditions during such introductions. Reports of significant injury and death during improperly conducted giant otter introductions have not been uncommon.**

It is necessary that every enclosure is appropriately furnished and designed to keep otters physically, mentally, and behaviorally healthy. This includes enclosures that are used to temporarily hold otters during introductions (e.g. separable enclosure areas), quarantine areas etc.. **I.e. it is essential that within each indoor and outdoor giant otter enclosure the land to water ratio is provided as recommended (i.e. enough land is offered), the recommended soft loose natural substrate types, qualities, and depths cover nearly the entire land and floor area** (including dens)**, and at least the minimum recommended size deep digging area is provided.** (Note: each enclosure below 240 m² (2,583.4 ft²) in size requires a different land to water area ratio based on its specific size.) **The other recommended natural furnishings, such as large logs, bamboo stands ("man-made" or/and live growing), deep leaf piles etc. should be provided** (see Section 4 above). **The aforementioned enclosure conditions are esp. crucial when otters are exposed to new/unusual situations, such as when they are being introduced to other animals or have just been moved to a new institution or enclosure** etc.. **When indoor and/or outdoor enclosure land to water ratios offer smaller land proportions than recommended or/and land/floor surfaces are not nearly entirely covered with soft loose natural substrates (including appropriate types, qualities, and depths) or provided with sufficient size deep digging areas as recommended,** the following can occur. **The otters' ability to successfully adjust to the new situations, i.e. to other animals, new enclosures etc., during introductions can be adversely affected or seriously compromised.** This is because the aforementioned inappropriate enclosure conditions can cause abnormally elevated or excessive levels of stress and other negative responses (boredom, nervousness, fear, frustration etc.) during such circumstances. See Section 3B above for how enclosure quality can affect introduction success.

During introductions, **the aforementioned essential enclosure requirements are necessary to promote successful adjustment to the new/unusual situations** (i.e. by significantly reducing or counteracting stress and other negative responses that can easily/usually occur during such situations), **provide adequate enrichment and maintain health.** Such conditions, in addition to the other recommended natural furnishings, also provide enough land area and safe furnishings to allow an otter to get away from the other animal, stay out of the other's view, and rest alone in semi-private places when it needs to take a break from the other otter or the intensity of the situation. (Note: nestboxes must be closed during full-contact introductions to avoid that otters do not trap each other within the box. If fights occur within the nestbox they might be impossible to break up and otters may not be able to get away from each other.) **It is necessary that enclosures are as enriched as possible during introductions and all new/unusual situations.** Note: **the recommended enclosure furnishings and designs described in the paragraph above are the most important forms of environmental and**

behavioral enrichment. If although, additional enrichment can be offered, this should be provided. For example, it is highly advisable to provide toys for additional behavioral enrichment. ***Toys for behavioral enrichment should only be used as addition to and never as a substitute for the recommended enclosure furnishings and designs.*** See Section 15 for toys for additional enrichment.

[Note: during introductions of unfamiliar and temporarily separated otters, animals need to take frequent breaks from the intensity and tension, as well as possibly fear, of the new situation by having stimulating enclosures to focus their activities and attentions on. They also need to refocus their attention on something else other than solely each other. It is important to remember that in addition to the otters having to adjust to each other, they also have to adjust to a new enclosure, husbandry practices, keepers, etc. when they are moved from other locations and this can cause additional stress. Also when otters are held in very small temporary holding enclosures, such as in quarantine or separable enclosure areas during visual introductions, this may likely cause additional stress. It is especially important that they have adequately furnished and sufficient land area to focus on to relieve their stress etc. and focus on something else other than the other otter. They also need sufficient land area to get away from each other and rest alone. Focusing solely on each other and/or abnormally elevated or excessive negative responses can cause introduction difficulties. It can result in serious fights and injuries; see below. The recommended land to water ratios (i.e. enough land area), substrates, and deep digging areas are the most important enclosure conditions and otters being able to carry out digging, grooming, exercising and playing on land to their "*full extent*" are among the most important behaviors, that giant otters require to reduce stress and other negative responses during new/unusual and all other situations. (See Section 3B above for what the "full extent" of these activities means. This meaning is very specific and it is often misinterpreted because of general misconceptions about how giant otters should behave.) The other natural furnishings as recommended and a plentiful amount of them, in addition to the aforementioned essential enclosure conditions, helps further to reduce stress, boredom etc. in all situations.]

Giant otters are social animals and in captivity they should be housed as a single mated pair with/without offspring, having only one breeding pair. Single sex groups, usually males and usually 2 individuals and rarely 3 in a group, have been kept together successfully, but they must be reared together or introduced slowly with proper introduction practices. Adult females have been reported to live together, although only a few cases were reported and no other information is known at this time. **It is not advisable to introduce adult females.** In a few known cases, when female otters that had previously been housed with each other or that previously lived adjacent to and in visual-acoustic-olfactory contact of one another were introduced or re-introduced with physical full-contact introductions serious fights, injuries, or death resulted. (See below for more general information about females and Section 10C for a description of failed introductions between animals and information on social structures.) **Currently there are a significant number of otters being housed singly or in single sex pairs and this number has a critically negative effect on the small captive population.** See Chapter 1 Section 1 for more information.

Single sex groups, mixed sex groups and single individuals have caused injury or death to individuals, including adults, juveniles and young otters, introduced to them or already previously housed with them. During introductions/re-introductions and more commonly females are reported to have injured or killed males and even other females, but also males have injured other males. Females seem to be the more dominant animal during introductions (and afterwards once animals are paired) and they seem to initiate fights more often. Even otters that

have been housed together and then temporarily separated, i.e. from 1 day to 8 months, have had very serious fights upon reintroduction and in at least one case the re-introduction attempt was aborted. (See Section 10C for these experiences). E.g. injuries and/or deaths were reported by several zoos/institutions when unfamiliar giant otters were introduced or temporarily separated giant otters were re-introduced. Aggression and fighting occurred between these otters upon introduction. (Many were introduced without proper introduction techniques, e.g. no visual introduction was conducted before the animals were put together in physical full-contact. See Chapter 1 Section 3 for more details.) Females and males fought against their own sex, females fought males, young otters fought against other unfamiliar young otters, and adults fought against unfamiliar young animals. (On at least two occasions, the otters that were already housed/living together, were separated and then re-introduced. On a few occasions the otters that were previously living adjacent to and in visual-acoustic-olfactory contact of one another, were introduced physically. In other cases the otters had previously been unfamiliar with each other.) (Trebbau 1972; Brasilia Zoo, pers. comm., Lazzarini, pers. comm.; Karanambo Ranch, pers. comm. via Karl Kranz; Georgetown Zoo, pers. comm. via Karl Kranz; Vera da Silva, pers. comm.; Pimentel, pers. comm. 1999; Flügger 1997; Duisburg Zoo, pers. comm.; Dortmund Zoo, Sykes-Gatz unpublished reports & pers. obs. & Gatz, pers. obs.) See Section 10C for more information on introduction experiences.

Tension, stress, nervousness, dominant behavior, and fights may occur between individuals during the introduction period, even when introductions are appropriately conducted and enclosures are appropriately furnished and designed. Some otters have been introduced without problem and in at least one case, they have been unable to be paired successfully, and in a couple cases the female nearly killed the male, all during proper introduction techniques. It seems giant otters show individual preferences when accepting a mate (Hagenbeck & Wünnemann 1992; Lazzarini pers. comm.). The individual "personality type" (i.e. very dominant, submissive, patient, nervous etc.) of each otter can affect pairing success, therefore this should be considered when selecting possible mates and partners as well. It should be noted, that in some cases, introductions may not be able to be successfully accomplished or partners may not be able to be permanently paired.

Introduction gates and fences, also called "howdy gates" and "howdy fences", **that can separate indoor and/or outdoor enclosure areas, should be used for visual introductions.** (See Section 8 for introduction fence designs.) **The larger the area that the introduction can take place, the better.** For example, an introduction fence 5 m (16.41 ft) long worked very well to introduce unfamiliar otters, where as much smaller areas, such as only twice the size of an animal shift door or a little larger, produced much poorer results during visual introductions (Sykes-Gatz unpublished reports & pers. obs. & Gatz pers. obs., Dortmund Zoo). [Note: **when dens are the only areas where visual introduction can take place**, they should be as large in size as possible, have fences/lattice and animal shift doors that are well located (to connect dens/tunnels to make the den area larger etc.), and fence/lattice containment barriers with the recommended mesh size necessary for introductions. The fence/lattice should be used as a containment barrier for at least one side of the den that connects with a larger enclosure area or another den. **Larger divisible enclosure areas although should be provided in addition to dens to promote visual introduction success because small areas, such as dens, do not have enough space to allow for appropriate visual introductions**. Also, though the otters should be rotated and exposed to each separable area within the enclosure during the visual introduction, so that both are familiar with all enclosure areas, both otters will at some time be confined in the small area of the dens, which could become stressful and frustrating. These animals should be given at least a reasonable size living area during the introduction period and

they must have sufficient area where they can hide or stay out of the other's view when they feel it is necessary. Otters should not be introduced with physical full-contact within a den area alone, as this area is too small and confined for a full-contact introduction to take place.] Animal shift doors that are constructed of solid materials, but that can be replaced/interchanged with a shift door made of lattice/fence with the recommended mesh size necessary for introductions, can be a helpful addition during visual introductions, although larger introduction fences are needed as well.

Introduction fences/gates and shift doors, with strong but small fence/lattice mesh size to prevent fence-fight injuries (even 2 cm x 2 cm [1"x 1"] resulted in injuries), should be used for visual introductions. **It seems 2 cm x 2 cm [1" x 1"] mesh has produced the best and safest results, while still offering a strong structure.** The otters should be able to closely see, hear and smell each other, but not be able to put their feet, mouth etc. through the mesh. In some cases, even when otters have only been able to put their toes through the fence, toe and foot pad and webbing injuries have resulted from being bitten. Caution: otters are very strong and could push through loose fencing that is not sunken in the ground deep enough or climb over fencing that is not high enough. (See containment barriers in Section 8). *If fence/lattice with the inappropriate size mesh is already in place, fence with the recommended size mesh above, can be used to cover it over, simply by securely attaching the new fence to the existing fence/lattice*.

Otters should be introduced with physical full-contact introductions in areas that have ample open space and at least two exit/entrance areas to prevent entrapment. These areas should be where staff has full control over the situation, especially to separate the otters when necessary and/or in emergencies. Tunnels, nestboxes, and small dens (unless they have two open exits) should be closed during full-contact introductions to prevent entrapment. An otter must have sufficient land area and appropriate furnishings that allow it to **successfully adjust to the other otter and the new situation, and stay out of the other's view and rest alone when necessary.** (See above under appropriately designed and furnished enclosures.) **Dens alone should not be used for physical full-contact introductions**; see above. **It has been noted that giant otters, esp. the females, will try to force and hold the other otter, usually the male, underwater for an extended period of time**, i.e. so that the otter being pushed under the water comes to the surface gasping for air. Also females seem to like to initiate fights in the water and they have nearly drowned the otters, i.e. males, they were being introduced to. **Offering shallow water in pools that have** gently sloping sides or low sides so that the otters don't hurt themselves if they fall or jump in **or small swim tanks with shallow water have been helpful to prevent otters from fighting or holding each other under the water for too long. This also allows caretakers more control** as otters are esp. difficult to separate when they are in pools, esp. large pools.

Otters that are to be introduced, must be familiar/familiarized and comfortable with the enclosures they are introduced in, ideally before visual introduction, and most definitely before full-contact introductions. For example, otters housed on opposing sides of a divided enclosure should be shifted so that they are exposed to both enclosure sides. The animals should be given as long as they need to adjust to their new territory, e.g. this could take from one to two weeks long. Their behaviors should be monitored to determine when they have adjusted. Most often, this period of familiarization will have to coincide with their visual introduction period.

Experienced staff, most familiar with the otters, must be available to monitor both the visual and full-contact introductions and control all situations during the physical full-

contact introduction, i.e. to stop serious fights etc.. **The animals must not be left unsupervised or unmonitored during the full-contact introductions.** Information about the introduction's progression as well as the husbandry and management methods used should be recorded during the entire introduction process. I.e. records should be maintained on the otters' behavior, length of the visual introduction period and each particular physical full-contact period, occurrence of injuries, enclosure conditions provided etc..

Visual introductions/familiarization with introduction fences must be used before full contact is allowed (see the paragraph below). Experienced staff must closely observe and monitor the otters' behavior and use good common sense and intuition to judge at what pace the introductions should progress. **The otters' behavior will be the best indicator to determine what time is the safest to begin physical full-contact introductions, how long they should be and when to increase or decrease the full-contact introduction time allotments or stop them. The time otters are allowed to stay together in full-contact should be dependent on the level of tolerance, stress, tension, tiredness and aggressiveness that develops**.

Vocalizations, esp. the type, frequency and intensity of them, movements and position of the body, aggressive and defensive behaviors, tolerance/patience, interest levels in the other otter, submissiveness, dominance etc. should all be closely observed. Otters have nine different vocalization types and many sub-categories exist for each type (Duplaix 1980). It is important that the observers are aware of what the different vocalizations mean. For example, humming which is a positive contact vocalization, is a positive sign. Although, when this sound is changed into a much lower tone, it means that the otters are irritated or upset by something, and will carry out aggressive behaviors if the situation they are faced with continues or increases in intensity. As well, **when otters hum excessively** (i.e. hum for an abnormally long time or/and unusually frequently) this is not necessarily a positive sign and these sounds can mean that the otters are stressed, nervous or anxious (Sykes-Gatz & Gatz pers. obs.). It has been observed that in captivity **giant otters' eyes can appear significantly more watery** when they are under stress as opposed to when they are in typical/usual situations (theory posed by Schenck pers. comm. and observed by Sykes-Gatz & Gatz). Note: sometimes, their eyes become a little watery when they are under normal circumstances. When their eyes are watery they tear clear liquid. (Reaction to environmental factors should be considered as well if this is seen as a medical problem. E.g. it could be a reaction to chlorine or other chemicals in the water etc. If discharge is not clear and water-like, then it could also be a medical problem.) This species in captivity has been observed to **have significant amounts of foamy saliva coming from the mouth** when they are exceedingly anxious, excited, nervous, or stressed (Sykes-Gatz and Gatz, pers obs.).

After *both* otters show *continued* positive reactions during the visual-acoustic-olfactory contacts, full tactile contact should be attempted. It is important that throughout the entire introduction process otters have visual introduction. When otters can not see, smell and hear each other this may likely cause a set-back in the introduction process. Also, some animals may take an immediate interest in the other and some may take a little while before they show interest. Both animals should show continued positive interest in each other before full-contact is offered. If one otter shows a lot of/normal interest in the other and the other does not, problems could occur if a full-contact introduction was initiated. Visual introductions have been carried out for approx. one, two, four, and six weeks long and longer before full-contact introductions were allowed to take place. In several cases, total introduction time (including visual-acoustic-olfactory and full-contact introductions) has taken approx. one, two, five, and eight weeks long to be successfully accomplished.

Caution must be taken as initial (e.g. in the first days or longer) positive reactions during visual and full-contact introductions can be very misleading. For example, *at first or in the early stages during visual introductions the otters may seem very compatible and may behave like they want to be in full contact with the other in a positive way.* Sometimes, the otters may also display that they are stressed because they are separated. (Animals that are separated can become stressed because of the separation alone. If they had previously been housed together the stress would likely be very significant, esp. if they were more recently separated.) If although, they were let together too soon they might fight, injure or try to kill each other. Full contact should not be initiated too soon after visual introductions are started. (Note: in some cases, unnecessarily long visual introductions may cause undue stress and problems, so caution should be taken in this regard as well.) As well, *during the first day/days of full-contact introductions otters may seem compatible for a short time just after the contact session is started (e.g. the first 20 minutes), but then they may begin to seriously fight afterwards*. In these cases, otters should be given limited periods of full contact together (e.g. a 20 minute introduction could be started with, then the next day it could be increased to a one-hour introduction etc.). *When stress seriously or continually escalates, otters become very tired, or one otter tries to get away from the other and the other otter does not let the first alone, the full-contact introduction should be stopped for the day*. **Otters should be separated before serious physical fights develop**. Full-contact should be re-tried the next day or be stopped for a while, to allow more visual introduction before full-contact time to occur. Gradually, depending on the successfulness of the previous introduction, full-contact time-allotments should be slowly increased each following day. **Caretakers should be very cautious not to make the decision of leaving animals together permanently (or even for their first over-night stay together) too soon, as this may lead to serious problems.**

Some otters, after a week or two of visual introduction, have been able to be kept together permanently after their first day of full-contact introduction. It is important to note that sometimes, even in these cases, tension, stress, and minor fights have been observed to occur on the first contact day (e.g. for the first 3 hours) (Sykes-Gatz and Gatz, pers. obs., Dortmund Zoo). **Caretakers should allow some minor fights and tension to be carried out rather than separating the otters upon these developments.** This way the otters will be allowed a full chance to work out any minor problems, differences, or dominance uncertainties they may have, and they can adjust to each other's particular character/personality. If otters are obviously successfully partnered, then unnecessarily separated, this may cause undue stress and problems, so caution should be taken in these regards as well.

Note: when giant otters are separated from their family members or familiar partners (or even separated unfamiliar animals), but are still in visual-olfactory-acoustic contact with the animal/s that they have been separated from, the following can occur. They will likely for a time excessively dig on/into land surfaces immediately adjacent to the containment barriers that allow vision etc. and dig directly on such containment barriers (e.g. fence) in attempts to dig out or through to the otter/s that have been separated. This should not be confused with the behavior of excessively digging throughout the entire enclosure land area to relieve their stress. It is necessary that nearly the entire (including the area next to the containment barriers that might be dug into) or all of the enclosure is covered with soft loose substrates and deep digging areas are provided as recommended, so that otters can not only relieve their stress, but they can also avoid damaging their feet. See Chapter 2 Sections 3A-B.

Section 19
Diet and Feeding

Only good quality, *mostly fresh water, fish low in thiaminase and fat* should be offered as the main diet (Wünnemann 1995). **Most salt-water fish contains too much fat that can cause health problems if it is fed as the main diet. Saltwater fish should only be offered occasionally** (see below). **Offering a *variety* of *highest* quality fish is advisable to maintain good health and a balanced diet, accommodate eating preferences, avoid fixed dependencies on a particular fish type and add enrichment** (Crissey 1998).

The following is excerpted from Wünnemann (1995[b]). "Giant otters are the only real 'fish-eaters' among the otters. All studies in the wild say that the main part of their diet is fish....The broader the spectrum of items, the better. The fish has to be first quality, freshwater fish. Saltwater fish is taken, but contains too much fat. The amount of food they need is enormous; 3 to 4 kg of food per day per animal, at best given at three to five different times. The ingestion is very rapid and the remains of the food can be found after two or three hours at the defaecation point." Also Hagenbeck & Wünnemann (1992) explain, "Marine fish, such as herring (*Clupea harengus)* and mackerel (*Scomber scombrus*) are preferred by the otters but are not given as we consider them too oily to offer a good balanced diet." "Marine products contain high levels of poly- and mono-unsaturated fatty acids." (Reed-Smith 2001).

Six out of 16 institutions surveyed fed live fish for enrichment, freshwater rainbow trout (*Salmo gairdneri)* or *Tilapia.* Caution should be taken as feeding live, freshly caught and/or poor quality fish could cause diseases, malnutrition or/and transmit parasites. Feeding fish in the reproductive state (i.e. when they carried eggs) has caused diarrhea and loss of appetite, so fish eggs should be removed before fish is fed (Lazzarini, pers. comm.; Gatz & Sykes-Gatz pers. comm.)

Giant otters should be fed 3-5 times per day (usually 2 - 3 kg [4.4 - 6.6 lbs.] **fish/day/adult) to accommodate fast metabolisms with rapid digestion, prevent accumulation of uneaten fish left-overs and provide enrichment.** Amounts eaten can vary with air temperature and activity level changes, but **if food is refused for one day this could be a sign of sickness**. Excess weight gain or loss and daily amounts and food types eaten should be monitored and recorded.

Fish should be fed in amounts that otters can finish, so that excess uneaten fish is not left in enclosures during the day and overnight. Uneaten fish can attract rats and rats could transmit leptospirosis to the otters. A couple giant otters have contracted leptospirosis and this is suspected to have occurred because large amounts of uneaten fish were left daily in enclosures overnight/during the day (see Chapter 1 Section 4). When fish remains exist, they should be removed from all water and land areas daily. Otters will eat their fish in the water or take their fish into the water, as well as eat fish on land. Caution must be taken, as illness may also occur if otters (esp. cubs) eat spoiled fish remains or are exposed to harmful bacteria ridden swim water (other than exposure to leptospirosis, neither of these events have been reported to occur). **Note: it is not uncommon that otters will pick up small pieces of left over fish within their pools and land area and eat them; this although has not been reported to cause problems. It is nearly impossible, even with filtration systems, to remove all small fish pieces from the water.** If a significant amount of left-over uneaten fish, that has been sitting in the enclosure for a while, is regularly consumed, vitamin deficiencies may occur.

Nutrient values vary between fish species and even within the same species depending on age, sex and season of capture (Crissey 1998). Merck (1986) states "Many fresh-water and salt-water fishes contain thiaminase, an enzyme that results in thiamine [vitamin B_1] deficiency in animals fed exclusively on a diet of such fish." Lewis (1995) states, with regards to mustelids, "Diets high in polyunsaturated fat or fish may predispose vitamin E deficiency." The process of fish storage (freezing), thawing, and preparation causes fish nutrient loss, particularly vitamins B_1 and E, and especially in fish with a high fat and/or high thiaminase content (Crissey 1998, Merck 1986). **Fish types containing high thiaminase and/or high polyunsaturated fat levels should be avoided, as they can cause malnutrition, sickness and even death (Merck 1986). Vitamin supplements, most especially vitamin B_1 (thiamine), vitamin E, and a multivitamin, must be added when *thawed frozen fish* is the main diet.** Vitamins should be fed separately from the main feedings by at least 2 hours, so proper vitamin utilization can occur, esp. vitamin B_1 (Merck 1986). Vitamins can be offered in the gills or throat of fish low in thiaminase (Merck 1986). (See under "Dietary Related Problems" in Chapter 1 Section 4A for more information on vitamin B1 and E deficiencies and the related health problems/symptoms.) Hagenbeck Tierpark (Hagenbeck & Wünnemann 1992) increases vitamin supplements during pregnancy and lactation and increases calcium during lactation. Lactating and pregnant otters will generally need an increased diet. Lactating giant otters have increased food intake from 2-3 kg/day to 6 kg/day (Hagenbeck & Wünnemann 1992).

Complete dietary guidelines for the giant otter need to be developed. No conclusions have been drawn on the appropriateness or nutritional value of the foods or supplements offered at the 16 zoos that responded to the survey. The examples following are to serve only as an overview and not recommendations. Due to space limitations, only one institution's vitamin regimen and some (mostly) principal diets will be given as examples. All institutions offer fish daily (thawed frozen fish, live fish, and/or freshly caught fish), as the main diet. (Four zoos did not specify fish type fed.)

Chestnut Centre feeds live fresh water rainbow trout (*Salmo gairdneri*) as the principal diet. Duisburg Zoo feeds live fresh water rainbow trout almost daily and every second day freshly killed carp (*Cyprinus carpio*) is fed in addition. Cali Zoo feeds river fish (species not identified) and live *Tilapia*, and Brasilia Zoo feeds *Tilapia* as the main diet. Hagenbeck Tierpark fed thawed frozen redeye (*Rutilus rutilis*) and common bream/brachsen (*Abramis brama*) for the principal diet, and herring (*Clupea harengus*), mackerel (*Scomber scombrus*) and live water rainbow trout for variety. Dortmund Zoo feeds live rainbow trout, thawed frozen felchen (*Coregonus albula*), redeye and common bream/brachsen as the principal fish. Herring and mackerel are fed to administer vitamins and small amounts are fed during husbandry training sessions. Philadelphia Zoo gives one 100 mg vitamin B_1 tablet and one 400 IU vitamin E geltab per otter daily, and in addition 1 tablet of K-dec (multiple vitamin & mineral for adult humans) 3 times/week per adult otter. Thawed frozen freshwater rainbow trout, their main diet, is fed 7 days/week. Fresh water channel catfish (*Ictalurus punctatus*), herring and mackerel are offered occasionally for variety. Madrid Zoo (Spain) fed freshwater trout as the main diet and marine fish to supplement. Emperor Valley Zoo (Trinidad) offers *Tilapia mosambica*, *Chicliasoma bimaculatum, Tarpon atlanticus*, and *Priacanthuus cruonthalus* (etc.) as a principal diet. The Aquatic Mammal Research Center (Brazil) feeds Sardinha, Tucunare, Curimata [? Curimbata (*Prochilodus lineatus)* ?], Jappqui, Pipanha, Pacu, Mapapa, and Capa (Portuguese common names).

Cuiaba Zoo in Brazil (Marcato de Oliveira 1995) feeds *Prochilodus scrofa, Psectrogaster curviventris, Curiamata sp, Sctrizodon sp, Hypostonus sp, Pimelodus sp* and *Hemisorubim platyrhynchos*.

Excerpts from Carter; Rosas; Cooper; & Cordeiro-Duarte (1999) on giant otter diets at *INPA Zoo* (Brazil).

"...We examined feeding rates, food preferences, method of prey consumption and transit time of captive giant otters. Results based on two individuals will necessarily be limited in scope and should be interpreted with caution, but our findings provide insight into potential factors influencing observed diets of giant in the wild.

...Food consumption, food preferences and transit time of digesta were determined in captive giant otters, Pteronura brasiliensis, at the National Institute of Amazon Research (INPA), Manaus, Brazil. Food consumption of an adult female was 0.0997 kg $^{-1}$ day $^{-1}$. Giant otters showed significant and varied preferences for the single Siluriformes (catfish) and various Characiformes species offered. The adult female preferred Anostomidae and Hypophthalmus (catfish), followed by Triportheus. Myleinae (pacu) were the least preferred, and other species of Characiformes offered were intermediate between Triportheus and Myleinae but not different from one another. The subadult male preferred Psectrogaster, Potamorhina and Semaprochilodus, followed by Hypophthalmus and finally Hemiodontidae. Within species, larger fish are chosen significantly more often than smaller fish (78.7% of trials, P=0.002). Species, size and individual otter significantly affected the percentage of times fish offered were consumed completely (P<0.016). Overall, most fish were consumed completely beginning with the anterior end. Characoids were consumed completely more often than siluroids (77.8% vs. 38.6% of trials, P<O.OOOI), but the percentage of times different characoids were consumed completely varied (range 0-100%). Small fish (5-15 cm) are more likely to be consumed completely than medium (15-25 cm) fish (84.9% vs. 80.2% of trials, P<0.02). Transit time of particulate markers averaged 3.13 h [hours]. Captive preferences are compared to diets of wild otters in the region (central Amazonia), and implications of study results for determination of food habits in wild otters using scat analysis are discussed.

...Food consumption, food preferences, and consumption method of fish were determined for and adult female of seven years and a juvenile male of approximately one year at INPA. Locally caught fish were defrosted in running water, identified, weighed and measured before each feeding....One milliliter of a vitamin and mineral supplement (Poliplex®, Bristol-Myers) was given once daily, injected into the mouth of the first fish.

...Daily food consumption of the adult female averaged 2.29kg (range 1.38-3.96kg, SD = 0.55, n = 46). The otter weighed 23kg at the beginning and end of the experiment, indicating a mean consumption rate of 0.0997kg kg $^{-1}$ day $^{-1}$. Daily food consumption of the young male averaged 1.52kg (range 0.91 - 2.15kg, SD = 0.35, n = 22. The male weighed 11.5kg at the beginning of the experiment.

...Consumption rates of wild otters may be higher than captive otters, as wild otters must expend more energy obtaining their food (Nolet & Kruuk, 1994).

...Captive preferences generally agree with diets of wild giant otters. Characiformes are widely consumed by wild otters, along with Perciformes and Siluriformes (Carter & Rosas, 1997). Captive otters readily consumed a variety of characoids and the only siluroid offered. At a species level, however, fish preferred by captive otters are not always consumed in the same proportions by wild otters in the same region (central Amazonia). For example, Anostomidae were preferred in 100% of captive trials, and Schizodon sp. was the most common prey of giant otters in the Curua-Una hydroelectric reservoir (Best, 1984). However, Anostomidae were only present in 16.2% of scats from a tributary of the upper Jauaperi river (Rosas et al., in press). Similarly, siluroids were high1y preferred in captivity, but present in on1y 5.4% of scats (Rosas et al., in press). Serrasalminae were generally not preferred in captivity (25.0% of trials), but were relatively common in scats (18.9%, Rosas et al., in press). Serrasalmidae were also commonly consumed (25% of scats) by otters in the Balbina hydroe1ectric reservoir (Benetton et al., 1990). Captive preferences and wild consumption of Myleinae were similar (3.3% of captive trials, 5.4% of scats, Rosas et al., in press).

...In summary, captive giant otters exhibited significant preferences for different genera and sizes of fish, and preferences varied with individual otter. Differences between captive preferences and observed diets of wild giant otters suggest that prey availability may be more important than preference in determining diet composition of wild otters. Method of consumption of fish by captive otters varied with the species and size of fish. This should be considered when determining diet composition from scats, as hard parts, particularly otoliths, of some species and sizes of prey may not be consumed. Transit time is relatively short in giant otters, but same hard parts may be retained in the digestive system for longer periods of time, introducing potential bias to studies using frequency of occurrence to describe feeding habits of giant otters in the wild."

Excerpts from Carter and Rosas (1997) on giant otter diets.

"...The present authors found that a captive adult consumed 10% (range 6.0-16.0%) of its body weight daily and a subadult consumed 13.4% (range 8.0%-18.9%). These results are similar to studies by Zeller (1960) and Best (1985) which reported daily food consumption by adults and subadults is 7.0-9.6% and 12.9% of their body weight, respectively. Schweizer (1992) reported a higher consumption rate of 25% of the total body weight for one sub-adult."

"...Direct observation and faecal analysis in various regions have revealed that fish constitute the majority of the [wild] Giant Otter's diet...Wild adults consume an estimated 3 kg of fish daily (Duplaix, 1980; Schweizer, 1992)....Most fish consumed by [wild] Giant Otters belong to the suborders Characoidei (characins), Percoidei (perch) and Siluroidei (catfish). Species

are consumed in varying amounts according to their relative abundance and vulnerability to Giant Otter predation....Characoids appear to be the most widely consumed prey of Giant Otters....Siluroids and percoids also make up a substantial portion of the Giant Otter diet."

Section 20
Transport

The following excerpts were taken from Reed-Smith (2001).

"The IATA regulations are subject to constant review, so the current Live Animals Regulations Volume at the time of any animal shipment should be consulted. This information is provided as a guideline only.

...all information contained in this section comes from the International Air Transportation Association (IATA) Live Animals Regulations 26th Edition, effective 1 October 1999.

The height of the container must allow the animal to stand in a natural position with its head extended and the width must permit it to turn around and lie down comfortably. The actual measures will vary with the species involved.

The frame must be made from solid wood or metal parts bolted or screwed together. It must be constructed so that it cannot be damaged from continual biting or scratching at the corners. If the total weight of the container plus the animal exceeds 60 kg (132 lbs.) metal bracing must be added to the frame.

The sides and door must be made of metal or solid wood. The front of the container must be constructed of weld mesh. The mesh must have a diameter that will prevent the animal protruding its nose or paws to the outside. The whole front must be covered by a sliding shutter, which can be raised and lowered to permit feeding and watering. It must have two observation holes of at least 10 cm (4 in.), in the upper part and ventilation holes, with a minimum diameter of 2.5 cm (1 in.), spread over the remainder of the surface in order to give good ventilation but at the same time leave the animal in semi-darkness.

The floor must be slatted, over a leak-proof droppings tray.

The roof must be solid wood or metal with ventilation openings over its surface.

A sliding door must be provided, it can be made from the weld meshed front if required. It must have a secure means of fastening so that it cannot be opened accidentally.

Container Requirements 82 apply to otters:

The main ventilation front must be supplemented by meshed openings along the upper part of the container walls and/or holes with a minimum diameter of 2.5 cm (1 in.) spread over the top third of the sides and the whole of the back and top. These holes must be spaced both horizontally and vertically at intervals of approximately 10 cm (4 in.) center to

center. It is essential that there is some ventilation provided in the lower third of the sides for the removal of waste gases.

The total ventilated area must be at least 20% of the total area of the surface of all four sides. More ventilation and the use of larger meshed openings is permitted but the animal must not be able to protrude its nose or paws to the outside from any opening.

If the mesh is fixed to the interior of the container all sharp edges must be protected.

Spacer bars/Handles must be made to a depth of 2.5 cm (1 in.), must be present on the sides of the container as shown in the illustration. [See IATA Live Animals Regulations.]

Food and water containers must be provided with a means of access from the outside.

Forklift spacers must be provided if the total weight of the container plus the animal exceeds 60 kg (132 lbs.) (IATA Live Animals Regulations 26th Edition, p296)

[Hard plastic pet containers should not be used for giant otters.] Reed-Smith (2001) states: *"When shipping an animal, especially across international borders, check to see what types of requirements/restrictions may be in place. For example, some countries will not accept crates in which straw has been used as a bedding material. All animals should be shipped one to a crate. Lactating mothers should not be shipped."*

A transport box with the following inside measurements has been successfully used to transport an otter from Brazil to Germany. It was constructed as recommended above and its length was 140 cm (55.2"), width 60 cm (23.6"), and height 57 cm (22.5").

Substrates such as straw, leaves, or mulch etc. should be used to line the transport crate. This is necessary to absorb feces and urine and to help keep the otter clean and dry. If natural materials, such as those mentioned above, can not be used, then other materials that can be safely used, such as strips of cardboard if the otter has had regular exposure to cardboard and has never ingested it, etc. might be able to be substituted for the same purpose. Also a transport crate with a floor (i.e. where the otter will stand on) that was constructed with many long slats of wood running horizontally and fixed over top of the drop tray, worked very well to keep a giant otter clean and dry on its journey from South America to Europe. The slats were spaced closely enough together that the otters' feet could not get caught in or go between the slats. In this case no substrates were used to line the transport crate.

Note from the author/compiler: Giant otters do not seem to be able to bite on wood structures that have no exposed edges or corners and there are no known reports that otters have done such. It has not been proven necessary to line the inside of wooden transport crates with fence/lattice when transporting giant otters and this is not advisable. E.g. giant otters have been transported successfuly and without problems from distances as far as South America to Europe when wooden transport boxes were not lined with fence/lattice. Exposure to fence/lattice on the inside of crates could likely cause damage to the otters' delicate sensitive foot pads, webbing and/or skin.

Captive giant otters have been observed to have a low heat tolerance (Carter & Rosas 1997; Sykes-Gatz & Gatz pers. obs.). Great caution must be taken when shipping animals during warm weather and as well when they are shipped in colder temperatures. Temperatures between approximately 60° F to no more than 80° F (15.5° C to 26.6° C) during transport are adequate.

Chapter 3

Husbandry Training: For Better Management & Attaining Valuable Information

By: Volker Gatz and Sheila Sykes-Gatz

1. Introduction

Husbandry training, through operant conditioning, should be carried out to help better manage giant otters in captivity (e.g. for health, transport, rearing of offspring etc.) and increase knowledge. Chapter 1 Section 4 explains why giant otters should be trained, which zoos have carried out this practice and what was trained, as well as why training was carried out at Dortmund Zoo.

A detailed report about the husbandry training program at Dortmund Zoo can be found after the following introduction to operant conditioning training methods. Training started at Dortmund Zoo in 1996 and it is continuing. It has been/is being carried out by one or both of the authors of this Chapter.

2. Training Method Overview

Operant conditioning training requires extensive knowledge about the appropriate methods and very careful planning. This article is just meant as a short overview and help for orientation, not a fixed guideline on how to train giant otters.

It is very important to point out that a positive relationship between animal and trainer has to be established and maintained. It is necessary to lead the otter through a behavior in small gradual steps and a lot of patience is required. Each animal may not respond in the same manner to the same reward; therefore, the trainer must learn which rewards are appropriate for each individual animal.

It is also most important to be consistent when using operant conditioning techniques. Only positive reinforcement is used, never punishment.

If a behavior is done incorrectly, the trainer simply does nothing. The training is paused for a few seconds, this "time out" is also referred to as the "least reinforcing stimulus".

It has to be considered that it may take months or even years to train a specific behavior. Training sessions can vary in length from a few minutes or longer and husbandry procedures via training (e.g. ultrasounds) can last up to a ½ hour or more, depending on the interest of the otter.

3. Training Basics

Target

A target is usually described as an extension of the arm that acts as a focal point. A target directs an animal toward a position or direction. It is important that the animal only focuses/touches the end of the target. The animal should not be rewarded if it touches any other

part of the target. The target we use at Dortmund Zoo is a long stick with a yellow wooden ball on one end, or – for small fence openings – a long stick with yellow duct tape on one end (i.e. the color and shape of the end of the target makes it easy to focus on). We use both targets simultaneously as well as independently. The target can be used to lead an animal through small steps of a behavior.

Bridge

A bridge stimulus, such as blowing a whistle or simply the word "good", is an immediate signal to let the otter know that a behavior is done correctly. The bridge is paired with a reinforcer or reward, which is anything that increases the frequency of the behavior. In the otters' case, it's usually food or a favorite toy - something that the animal enjoys and looks forward to get. The bridge becomes connected with the reward and the animal learns to perform the behavior in order to get this reward. It is important that an animal knows immediately when it has performed correctly. A delay of even a few seconds may cause significant problems. The animal learns that when it hears the bridge it can return to the trainer to receive a reward.

Reward / Reinforcer

The most common reinforcement or reward is food. The giant otters at Dortmund Zoo favor mackerel, but it is not part of their regular diet as it is considered to be too fatty and not good for the health if it is fed as the main diet, too frequently etc.. Otherwise, in small amounts and small pieces, it is a great reinforcer during a training session. We have also found at Dortmund Zoo that mackerel is easy to use because it is firm and does not fall apart easily. In the case of one otter, only vocal and tactile reinforcements such as deep massages are used.

Desensitization

Every new and unfamiliar object or behavior that we expect the animal to perform has the potential to be very scary. Every novel item or behavior must be introduced very carefully. During the training, trainers have to guide the animal in small steps. After several successful repetitions, trainers can move on to the next step. Unfamiliar objects should be introduced slowly and gently so as not to scare the animal and to make the animal feel comfortable around the object. As well, the presence of unfamiliar or excess familiar persons during a training or husbandry procedure can also distract or scare the animal. Once the behavior is trained (or even during late training if tolerated) additional familiar persons and eventually unfamiliar persons can be introduced during training sessions to help desensitize the animals to these factors. For example, during crate training or ultrasound training other zoo staff will need to be present when these procedures are actually carried out, so otters should be given time to adjust to these changes/distractions/potentially frightening events during training. As well, when vets must perform ultrasounds, it is most helpful if they have a chance to develop a positive relationship with the otters before or at least during/after training is carried out.

Training Frame, Dummy Portable Ultrasound & Scale Frame Used at Dortmund Zoo, Beam Scale used at Philadelphia Zoo; Temporary Transport Crates Used at Dortmund & Philadelphia Zoos

A wooden frame with a step was developed at Dortmund Zoo to meet the special requirements of giant otter husbandry training. The frame and its step can be placed low in the fence lattice to enable the otter to stand comfortably right next to the lattice. The otter is trained to station, while it is standing on the step of the frame. Most of the otter's body becomes easily reachable with the frame, enabling us to perform body examinations, ultrasounds, or milk sampling. See more details about the training frame construction under "Giant Otter Training at Dortmund Zoo".

A dummy portable ultrasound was developed at Dortmund Zoo and made from a cardboard box (to represent the monitor), a long thick plastic electric wire, and a small plastic container that is shaped just like the real ultrasound head. The dummy ultrasound head was attached at the end of the wire (with duct tape) and the other end of the wire was attached to the box. This was used to imitate the real ultrasound machine during ultrasound training sessions.

A wooden frame was designed so that a small floor scale for human use could be placed in the frame on the floor and be secured so that it would not move around when an adult giant otter is standing on it. (The wooden frame is attached to the containment barrier lattice to secure the frame and it is detachable so it can be stored away.) We found that a conventional scale (i.e. without an electric readout) is easier to read as the scale stabilizes more easily (with movement) than an electric read out. (The otter's tail must be off the floor during weighing.) A metal beam scale (used to weigh large animals) can also be fitted with a large removable wooden board, so that the otter can stand with all four feet/lay his/her entire body, including the tail, on the wooden board. (The wooden board can be temporarily bolted onto the two metal beams to provide safety to the otter, prevent the otter from pushing/lifting the board off the beams, and so the scale can be assembled and disassembled with ease during transport and storage. The electric wires can be covered with PVC pipes and duct tape for safety and run under/through containment barrier fences.) This way the weight of the otter's tail, which is quite significant, can be easily included to determine the otter's entire body weight. This method for weighing adult giant otters was first designed and used at Philadelphia Zoo (Sykes 1997-99) and Philadelphia continues to use this procedure.

A kennel crate (plastic porta-crate for a large dog) is used at Dortmund Zoo for crate training and temporary transports within the zoo itself (i.e. this type of crate is not safe for other transport uses). For safety, the crate itself is secured, with wires, to the training/den/sleep area containment fence barrier when it is not in active transport. As well, the crate's (metal) shift gate/door that swings open is secured to the containment barrier fence/lattice, with a wire, in the open position. (These precautions are especially important to prevent entrapment in the water etc. Otters may also destroy this light weight crate.) The crate's shift gate is only unfastened from the barrier lattice during training/actual use. The trainer's hand can fit through the 5 cm x 20 cm (2" x 8") lattice barrier to control the movements of the shift door and to latch the shift door shut. (As well a long pole can be passed through the containment barrier lattice to control and temporarily secure the door, if the trainer is unable to pass his/her hand through the lattice.) The trainer can then detach the wires securing the crate to the den lattice, enter the den, then move/transport the crate. At Dortmund, a large metal lattice crate is used for moves no more than an hour or so long and a large wooden nestbox type crate (with appropriate air ventilation etc.) is used for long transports (for international transport). (Securable nestboxes and tunnel sections can also be easily used for quick in-zoo transports.)

A very large plastic dog kennel crate was also specially fitted/designed and used for crate training at Philadelphia Zoo (Sykes 1997-99). The metal crate door (that swung) was replaced by a metal guillotine sliding shift door that could be controlled by a shift cable and handle. The crate was placed in an indoor den, a detachable shift cable was attached to the guillotine door, and the cable led from the crate to the den ceiling, and through the den, to the opposite side of the den fence containment barrier, and out to the keeper hallway (via pulleys). The trainer controlled the shift door via the cable handle from the hallway. The guillotine door must close tightly (i.e. with no gap between the door and crate), so that otters can not lift the door up. After the otters enter the crate and the guillotine door is closed, the trainer can go inside the den

to secure the guillotine door with a bolt and nut, detach the quillotine door cable, and move the crate around for transport. For safety, the crate must be removed and the cable must be secured up and well away from the otters after use. This method is useful when it is too dangerous for trainers to go in with adult otters or too dangerous for them to place their hands near the otters.

See thermometer construction/extension and target construction under "Giant Otter Training at Dortmund Zoo".

Variety

Giant otters, like many other mammals can become easily bored or distracted during the training session. It is therefore very important to vary the reinforcement and the behaviors that the animal is requested to perform. It is also often helpful to introduce novel items (e.g. play toys) and train new behaviors on a regular basis to keep the animals interest.

Basic Training

Training may often seem as a simple and straight forward process, but it can have many pitfalls and problems. The proper application of operant conditioning principles requires a great deal of expertise *(Ramirez 2003)*. Karen Pryor's book "Don't shoot the dog" gives a simple introduction to basic training principles and Ken Ramirez of Chicago's Shedd Aquarium combined her "10 Laws of Shaping" with his own explanations. The following excerpts are quoted from *Ramirez (2003):*

1. **Raise criteria in very small steps** *By using very small steps, you will set your animal up to succeed*
2. **Train one criteria at a time** *This will keep the goals clear and not confuse the animal...*
3. **Vary reinforcement before moving towards the next approximation** *One way to maintain a strong response is to assure that reinforcement is varied. There are many ways of providing variety including varying the magnitude of reinforcement, type of reinforcements or required varied duration or repetition of the behavior being trained...*
4. **Relax old criteria when introducing new criteria** *When an animal is being introduced to something new, it is not unusual for the animal to fail to meet all previously learned criteria. This is acceptable at first and will minimize frustration in your animal*
5. **Plan ahead** *Have a training plan in mind and know the short term and long term goals*
6. **Don't change trainers in mid-stream** *In order to maintain consistency with the animal it is not wise to have different individuals training the same behavior*
7. **If a plan doesn't work, change the plan** *Training is a dynamic process, so don't be afraid to change the plan*
8. **Don't stop a session gratuitously** *It is important to stay focused and not get distracted, don't end a session abruptly or the animal may get confused or frustrated*
9. **Regress when behavior deteriorates** *It is normal for animals to forget or get confused. Taking a few steps back can refresh their memory and get them back on the right track*
10. **End on a positive note** *Training should always be fun. Avoid ending a session when an animal is frustrated; try to end with success".*

4. Behaviors

In the following, a few behaviors, some basic, some more advanced will be explained:

Note: *Training sessions should generally last approx. 5 to 10 minutes. If they are extended beyond this time the otters can easily become bored or frustrated and this will negatively affect the success of training.*

Positive Relationship
First, the trainer must develop a positive relationship with the animal before training is begun. Sometimes it can take a long period of time for otter's to develop this relationship and sense of trust with their trainers. Trainers need to use patience, intuition, common sense, gentleness, an understanding of giant otter behavior (including vocalizations), and plenty of time. Trainers should always spend time associating with the animals, i.e. in "relationship and/or play sessions", in addition to the training/husbandry procedure sessions and any other routine husbandry care/servicing the trainer might carry out (i.e. feeding, cleaning, observations etc.). It is essential that the animal does not just perceive that the trainer is there only to work with or service/care for him/her. If this is the case, trainers may not be able to achieve the husbandry procedure goals that they desire. Instead, the animal must have a truly positive bond with the trainer that extends beyond just training/husbandry/servicing procedures. "Play sessions" should be carried out in a protected contact or no/low contact manner if possible. "Relationship sessions" should be conducted the same way if possible. *Giant otters can be very dangerous and unpredictable, even when the caretaker/trainer has had a long-term positive relationship with the otter.* (See more under Giant Otter Training at Dortmund Zoo.)

Introducing the Bridge
The introduction of the bridge is always one of the first steps in training an animal. To familiarize the otter with a bridge signal, the bridge signal should be used just in the moment before a reinforcer is given. The animal will learn to associate the food/reinforcer with the bridge signal and this is how the animal learns what the bridge signal means.

Target Training
Otters are generally very curious. When a target is placed directly in front of them, it will certainly attract their attention. Most mammals will target with their nose. Because otters like to manipulate and hold objects, they will often touch/hold the target with their paws, as well as make contact with their nose. Both targeting with the nose and paws is acceptable, although otters should not be allowed to pull the target away from the trainer. The animal is bridged and then rewarded as soon as it makes contact with the target (i.e. it must make contact at the appropriate focal point of the target). Reinforcement has to be given fast and in small amounts. Otters usually learn very fast that touching or sniffing the target will result in a food reward and they are ready for the next step. The target is now placed further away from the animal so it has to move towards the target. Again the animal is bridged and rewarded as soon as it touches the target.

Target follow / Stationing
One of the early steps needed to train a stationing behavior is to first teach the animal to follow the target. At first the target is moved a short distance when the animal tries to touch it. It should not be moved too far, so the animal can still maintain the contact, but it should be far enough that the animal has to move a little. This practice can be extended to greater distances until the animal directly follows the target. The animal learns that it will be rewarded whenever

it stays close to the target. This then can be used to station the animal in a specific place where the target is presented.

Scale training
The method of scale training varies with the available type of scale. The ideal scale is one that is long and wide enough to enable the otter to stand on it in a natural way (i.e. with all four feet on the ground). Smaller scales are less reliable, but can be used if nothing else is available. In this case, the otter can be trained to stand on its hind feet and the weight can be taken when the otter's tail is off the ground. (See scale designs above.) The desensitization process is usually short, as the scale is normally not seen as a threat by the animal. The training starts with the animal simply following the target onto the scale. The goal is to station the animal on the scale and to extend the time as long as possible to get an accurate weight reading

Crate training
Crate training is a very useful tool to avoid stress and danger to the animals and caretakers during the transport procedure. The first step is usually to place the transport box inside the exhibit as early before transport as possible. Preferable is a placement at the exit of a regularly frequented shift door or next to an area which can be easily reached by the keeper through a fence or a lattice. Models of transport crates vary (see under Training Basics). Preferable is a stable crate with two shift doors so that the animal can just walk through. Kennel/porta boxes/crates are usually considered not stable enough for giant otters, especially during longer transports, but can be useful for short transports within the same facility. (Nestboxes or tunnel sections etc. can also be used as temporary transport crates.)

If the animal is well target trained, it will follow the target into the crate after a short desensitization process. Otherwise, fish or play material can be placed within the transport crate to attract the otters attention. Once the animal is accustomed to the transport crate, so it moves in and out of it freely, the trainer can start to move the shift door a little (first with the otter outside of the crate then with the otter inside the crate). If the shift door is one that the otter can move safely by itself (e.g. kennel crate), the otter should be allowed or encouraged to move the door on its own. This way it will grow comfortable with the movements of the door and feel in control of the situation. Later on, the shift door can be closed for a brief moment. This needs to be done in a very slow and careful way, so that the animal does not become scared. The times of confinement can be slowly extended until the animal appears comfortable enough for transport.

Ultrasound, Body Examination, Milk Sampling Training: An Overview
Caution: Milk samples must never be drawn when the parents are rearing cubs. This may cause a significant disturbance to the parents and may result in litter loss. Milk samples must be drawn only after litter loss occurs. Mother's will soon stop lactating after litter loss occurs, therefore milk sampling should be conducted in the first day or two after litter loss.

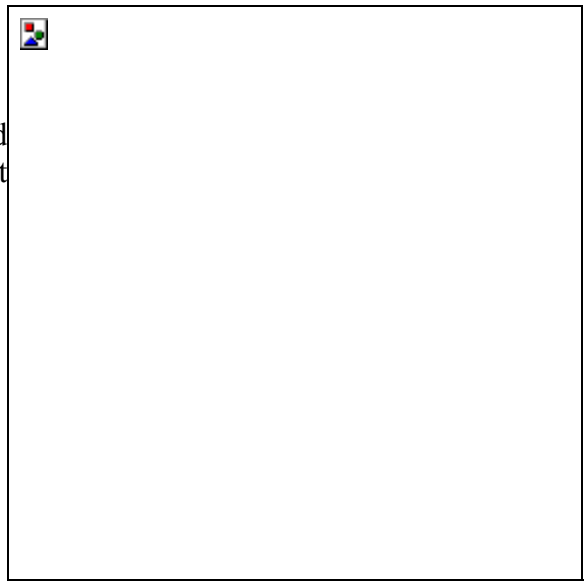
At first, the animal is desensitized to accept the touch of the trainer while it is stationed in the wooden training frame. Non-sensitive areas of the body and those areas that are safe for the trainer should be touched first. Once the otter is comfortable with this, the area around the teats should then be approached. Afterwards, the trainer can try to very gently touch the female's teats. After she becomes comfortable with this, then the teats can be manipulated with the motions needed to extract milk. **Trainers must be very careful not to injure or hurt the animal's teats by squeezing too hard, as this could cause significant health problems. The**

individuals who carry out the milking procedure must be properly trained to milk before they engage in this procedure. A veterinarian should always be consulted for advice. Once this is properly trained, the animal might accept the drawing of milk samples after litter loss.

The aforementioned training can be expanded and modified to train the animal to accept the use of an ultrasound probe while it is stationed in the frame. The ultrasound check-up is a very useful tool for many reasons. It can be used to detect pregnancy, determine if false pregnancies are present, monitor gestation, fetus growth and uterine condition, as well as be used for other health examinations and gathering of medical data. Both females and males should/can be trained to allow this procedure. A dummy probe should always be used during the training sessions, as the otters can be very destructive if they manage to bite the probe.

With modifications of the aforementioned training, another type of behavior that can be trained, by using the frame, is the acceptance of the treatment of small wounds and allowing examination of the body (i.e. palpation of the body). Wounds may be treated with medication while the otter is stationed and close body examinations are also possible.

5. Giant Otter Training at Dortmund Zoo



So far, the following tasks have been accomplished during the giant otter training program at Dortmund Zoo:

1. Targeting – including extended targets
2. Target follow
3. Shape and color discrimination
4. Scale training
5. Crate training
6. Ultrasound examination
7. Milk sample collection
8. Body examination (palpation)
9. Medical treatment in protected contact
10. Measuring of body temperature
11. Resting heart rate measuring
12. Respiration rates

From known reports, this is the first time a giant otter has had ultrasound exams while not under anesthesia. On one of the ultrasound sessions during pregnancy, at least 2 and maybe 4 cub fetuses were seen. The ultrasounds were discontinued soon before parturition and they were started again after litter loss. Katja, the breeding female at Dortmund Zoo, had a false pregnancy and it was possible to confirm this by conducting an ultrasound (at least 3 false pregnancies were confirmed via ultrasound by training).

Training is of course also a very helpful tool to improve the keeper - animal relationship, which is important during giant otter cub-rearing, as well as many husbandry procedures. See Chapter 1 Section 4.

False pregnancies are not uncommon in giant otters. Giant otter cubs are also often killed by the parents soon after parturition (i.e. usually because of human disturbances) and it is feared that

these births may go undetected. Ultrasounds are very helpful to help determine if mother's are actually pregnant, to check health and uterine condition, rule out false pregnancies, and to help make preparation to provide isolation to the parents when needed etc. (See Chapter 1 Section 4).

Because of Katja's reproductive problems (see under Dortmund Zoo in Chapter 1 Section 4), we were increasingly worried about her health. It became highly important for us to monitor her further pregnancies (i.e. to determine and/or study pregnancy and uterine condition before birth and after litter loss) with the help of frequent ultrasound examinations.

The only practical way to accomplish this was through husbandry training. Another important goal of the training is the collection of a milk (i.e. lactation) sample. The specific composition of giant otter milk (i.e. percentages / types of fat, protein, lactose, etc.) is either unknown or unreported. It has to be pointed out that samples must be gathered after litter loss only to prevent human disturbances to parents. Unfortunately, the only sample drawn at Dortmund Zoo was lost due to technical reasons. Additional captive females, world-wide, should be trained to allow milk samples to be drawn after litter loss.

Giant otters are very intelligent, playful and curious animals, which like other otters, like to investigate everything very thoroughly. Nevertheless, training can be quite difficult. Giant otters have a low attention span for focusing on objects for any extended period of time. The training situation must be as fun and stimulating as possible to keep the otters attention. At Dortmund, we have found that it is often difficult to station a giant otter for much longer than 15 to 30 seconds, but occasionally 45 seconds and times up to 1½ minutes have been accomplished. Although, with a different training technique, that only has been used on one giant otter that is kept singly at Dortmund, we are able to perform husbandry procedures for up to a half-hour or more (see below).

This species is potentially very dangerous and serious injuries, even causing death in some cases, have been reported when people entered giant otter exhibits. Therefore, all training has to be done through a protective fence or lattice. It is very important for the trainer to pay a lot of attention to the animals as well as to the interaction of the animals with each other. It seems that especially the females are often jealous regarding a trainer's attention towards her mate and also regarding food rewards, resulting in fights during the training. These fights usually only last a couple seconds but the resulting stress and tension make the extended stationing which is needed for ultrasound examinations nearly impossible. Fights can be mostly avoided if both animals are only rewarded with small pieces of food and if the distance between them during training is big enough. In addition, variations in the training program can help to prevent aggressive behavior.

Katja was four and Kuddel was six years old when we first started training them. Both had no experience with being trained before. Initial training included mainly target follows, including climbing up in the exhibit lattice, shape and color discrimination as well as scale training. Katja was also conditioned to accept different types of body examinations by the trainer's hand, while she was climbed up in the lattice. Clearly, a key to training success is the use of small but frequent reinforcers. Mackerel is our giant otters' favorite food. It is not part of their normal diet because of the high fat content but it is very valuable in small amounts as a training reward.

Initially, a whistle was used as bridge while we currently use the verbal bridge "good" instead. The otters can target, with either their paws or nose, or both. It is the otters' natural tendency to

pull the target with their paws, so this is allowed to a certain degree. This is also a good way to keep the otter occupied while it is being desensitized to be touched.

During the initial training in 1996 and 1997, we used to separate Kuddel and Katja, partly because we were hoping that this might increase especially Katja's attention span and eliminate fights. We also had to separate them because of the exhibit setup at this time, which did not offer enough lattice space to train both of them side by side. The pair bond between giant otters is extremely strong and the separation caused a considerable amount of stress and limited the training time significantly. If a training session lasted longer than a few minutes, the otters just continued to scream and refused to participate. Short dominance fights were also not uncommon after the otters were aloud back together. (Note: It was possible to separate two males during training at Philadelphia Zoo, although this was a very difficult process and the otters took months to get used to this situation. Even then the situation had to be handled very carefully to avoid problems (Sykes, pers. comm.)

After we reinitiated the training program for these particular animals in 2001, it was no longer necessary to separate Kuddel and Katja as it was now possible to train them in a bigger room side by side.

It can be somewhat problematic to estimate the right time of day to do a training session with the giant otters, especially if it includes an ultrasound examination. The otters are fed between four and five times per day. Dependent on the animal's individual mood and activities, weather, and temperature, the appetite can vary significantly. For a successful training session, the otters have to be somewhat active and interested. Training is usually not effective, if they are too hungry or too full.

We have found that the best time to do a training session is usually between 1:00 p.m. and 1:30 p.m., just between two regular feedings.

Before an ultrasound examination, the otter needs to be sufficiently wet. Giant otter fur is very dense and although a water soluble, conductive gel is used, the ultrasonic waves can not penetrate through the fur, if the otter is not totally soaking wet.

During the ultrasound training, at least four people are needed. Two trainers, each for one otter and two veterinarians, of whom one would operate the probe while the other operates the ultrasound machine. More people were often present during the sessions but this can also easily distract the otters.

Giant otters have a very low attention span, they become distracted easily, and they can become quite nervous at times. With Katja, it appeared to be too difficult and dangerous to try to train her to lay on her side or back for the ultrasound, especially in her mate's presence. (Although see below for another otter that is trained with this method.) With limited time available for training sessions, an easier solution had to be found.
Katja likes to stand up at the lattice and she likes to climb up in the lattice. When she was just standing up on her hind feet on the ground, her lower abdomen was too far away from the lattice to conduct husbandry procedures. It also seemed that it might be too uncomfortable for her to just climb up in the lattice and remain in the same position for longer then a few seconds. A solution had to be found that would allow her to be in a more comfortable position after she climbed up the lattice. It was also necessary, with her, to develop a way that would protect

those working with her, from being bitten. For example, if she suddenly felt uncomfortable or afraid of a situation during training or husbandry procedures, she might try to bite.

A wooden frame was developed (Gatz 1997) and attached to the containment barrier fence lattice in one of the giant otter dens. (The den used is 4.5 m^2 [48.4 ft^2] in size and the fence lattice mesh size in the den is 5 cm X 20 cm (2" x 8"). The aforementioned mesh size allows hands, thin pole targets and the ultrasound head etc. to pass through the containment barrier. (This is a recommended size for these and other purposes. See Chapter 2.) The wooden frame allows Katja to stand in the frame, on a small wooden step, so that she is close enough to the lattice so that an ultrasound or other examinations can be carried out. Katja is stationed to stand on the small wooden step with both of her hind feet. The frame measures 36 cm wide x 80 cm (14" x 31.5") high. The frame is just long enough so that a cross bar is just below the height of Katja's head. This is supposed to protect and help prevent her from biting (which she never did). The step is just wide enough for her to stand on it with both hind feet. The step is 35 cm long X 11.5 cm wide (14" in x 4.5") and it is attached at the bottom of the frame. With this width, she must keep her body close to the fence and she is unable to make any large movements on this small step. The step is just about 20 cm (8") above ground, so it is easy for her to step up on it, but it is not so low to the ground that she is encouraged to step immediately off of it again.

During the ultrasound examination, it is often helpful to try to keep close eye contact with Katja. This practice can help to extend the time she remains in the correct position.

Training sessions usually only last up to 10 minutes; although, during the actual husbandry procedures, such as during ultrasounds, we have been able to extend the sessions up to 30 minutes or more when necessary. On some occasions, Katja initially did not station very well, but improved significantly later on, sometimes even without much food reinforcement. Ultrasound examinations are usually made once a week, if a pregnancy is suspected or if health problems are a possibility. They are also carried out after litter loss, usually, once per week initially and once every two weeks thereafter. (I.e. uterine size and condition is monitored.) Currently, we are also performing ultrasounds on a regular basis. It is necessary that Katja stations for at least 15 to 20 seconds to get acceptable results during the ultrasound and even this seemingly short stationing time can be difficult to accomplish.

While Katja was trained to accept the ultrasound, Kuddel had to be kept busy somehow so he would not disturb or distract her. One of the ideas was, to train him to distinguish different shapes and colors. A small selection of wooden tools was made that consisted of circles and triangles in red, white, or blue. Kuddel learned to accept the red triangle as his personal symbol and to identify it among the other symbols. This training was initially done in 1996 and 1997. After a break of almost four years, Kuddel still remembered and recognized his red triangle in 2001 when the training was reinitiated.

We use two targets with Katja. One is a long thin wooden pole with yellow duct tape at the end. She is trained to target with her nose on this target. The other target is a long thin wooden pole with a small wooden ball attached to one end. She is trained to use both targets at the same time. We found that because giant otters like to manipulate and hold objects we could use this to help keep her attentions focused on the target and stationing by giving a target for her to hold/handle. This seems to help extend her interest and therefore somewhat helps to extend the time she stations. As well, the target with the wooden ball at one end can not be passed through the fence lattice, but the other target can be. We use the target without the ball, to pass through

the fence, so that we can ask Katja to perform other husbandry behaviors to provide a stimulating variety during a training or husbandry behavior session.

Kerbe, a 16 ½ year old male giant otter, has been trained in a completely different way. Kerbe arrived at Dortmund in July 1999. He was thought to be a possible new partner for Katja, as he was less closely related and the only other available male at that time. Unfortunately, 8 months after he was introduced to Katja, he had to be separated again as Katja was overly domineering, to an unhealthy degree. There was and is no other animal available to pair him with, so he is living alone, but in visual contact with Kuddel and Katja.

As Kerbe is held alone, it is easier to work with him, without the jealousy factor. During a long and careful desensitization process, Kerbe learned to trust his keepers. He always loved to sleep on top of a cardboard box and this box (a new box every day, as he also loves to destroy them!) was placed directly at the lattice of his feeding den. He slowly accepted to be touched through the lattice while he was on the box. After a while, he was already expecting to be touched and by now, he is often eagerly waiting for his frequent massages. He developed a very calm and friendly nature because of all of the attention his trainers gave him. This enabled us to go a step further. Several behaviors were trained by using body massages and/or extended personal interaction as reinforcers. Physical contact and human vocal reinforcement served as the only reward for Kerbe. (Food is never used as a reward for any of the training or husbandry procedure sessions with Kerbe.)

With this and all types of training, it is of utmost importance that the trainers have continued positive interactions, i.e. "relationship/play sessions", with the otters involved, not only just during training, husbandry procedures, and routine husbandry care and servicing, but also on a regular basis in between the aforementioned events. It is essential that the animal does not just perceive that the trainer is there only to work with or service/care for (i.e. feed, clean, observe etc.) him/her. If this is the case, trainers may not be able to achieve the husbandry procedure goals that they desire. Instead, the animal must have a truly positive bond with the trainer that extends beyond just training/husbandry/servicing procedures. Giant otters are intelligent and sensitive enough to realize the difference between a trainer who only wants results from the otter and a trainer who has developed a healthy report with the animal that he/she works. For example, after just a one month vacation, the trainer returned to perform a training procedure on Kerbe after one long "relationship session" was carried out with him. Kerbe refused to perform during training or husbandry procedures, until after a few days, during which a few long "relationship sessions" were carried out. "Play sessions" should be carried out in a protected contact or no/low contact manner if possible. "Relationship sessions" should be conducted the same way if possible. Giant otters can be very dangerous and unpredictable, even when the caretaker/trainer has had a long-term positive relationship with the otter.

With Kerbe, it was possible for the first time to examine the body temperature, resting heart and respiration rates on a giant otter not under anesthesia. As well, nearly his total body, including his feet (toe pads & webbing), legs, tail abdomen, back, chest, neck, under his throat, top of his head and the outside of his ears) can also be examined by hand palpation. Kerbe has also has been trained to receive portable ultrasound exams and initial ultrasound sessions have already begun. Although no ultrasound pictures have been actually taken, because Kerbe's fur was not wet enough during the session. We will continue these sessions although.

No rectal body temperature of healthy giant otters (neither cubs nor adults) that are not under anesthesia or immobilization have been found or been reported. Kerbe was trained to allow

body temperatures to be taken, when the thermometer was placed snugly between and under the skin folds of his armpit while he was lying down in one of his favorite resting spots. Unfortunately, it is not clear if this temperature, 37.28 ^{o}C (98.8 °F), can be compared with rectal temperatures (although see a full discussion in Chapter 1). (We are also now working on training him to receive a rectal temperature exam.) A thermometer, with a plastic body and for oral use, was attached, with duct tape, at the end of a long wooden stick, with dull ends, to extend the reach of the thermometer. New objects like the thermometer, stethoscope, or dummy ultrasound head, were first shown to Kerbe trough the lattice, so he could look at them and sniff them. After his initial interest in these objects had decreased, they were placed next to him while he was massaged. When he was not interested, the objects could be used. We use body massages during the husbandry procedures as reinforcement and this also helps to distract his attention during exams. Husbandry procedures can be carried out on Kerbe for a half-hour or more, as he remains in a very relaxed state with plentiful massages in between the procedures.

We plan to include all of the giant otters at Dortmund Zoo (we have 5 giant otters at present) in the training program and aim to train a variety of husbandry behaviors utilizing operant conditioning techniques. Although we have not reached all of our goals yet, we have learned much about training a unique species and about the nature and fascinating abilities of giant otters. The otters we have trained really seem to enjoy and look forward to their training sessions and husbandry procedure sessions.

6. Acknowledgments

We would like to extend great thanks to the veterinarians at Dortmund Zoo, Dr. Christine Osmann and Nicole Schauerte, for carrying out the actual ultrasounds via giant otter husbandry training and for helping/training us to correctly draw giant otter lactation milk samples (conducted via husbandry training). We have great appreciation for their continued support and research for these procedures and understanding of giant otter ways and patience. Without their interest, efforts, and support invaluable information would not be able to be attained. We would also like to thank Michael Strugholz for his continued support and Natascha Kuhrt for her assistance during some of the training sessions.

Chapter 4

Reproductive Biology, Cub Development & Parental Behavior

Introduction

Chapter 1 Sections 2, 4 and 5 discuss which aspects of reproduction, physical and behavioral cub development, cub health, and parental behavior should be documented and shared by each institution holding giant otters. Also discussed in Chapter 1 are the aspects that need further study. *Only some of these issues are discussed below.* **Chapter 1 and Chapter 2 Section 10 describe how these aspects can be monitored without disturbing parents rearing their litters and the cubs.** The methods that can be used to determine if females are pregnant (i.e. to confirm false/true pregnancies etc.), to monitor the females' reproductive health in old age, and to attain milk (lactation) samples after litter loss for nutritional content analyses are described in Chapter 1 Sections 4-5. Chapter 5 describes in detail the general daily maintenance records that should be kept during handrearing, although a complete overview of all of the records that should be maintained during handrearing are discussed in Chapter 1. Chapter 2 Section 10 describes in detail some of the records that are necessary to keep during cub-rearing and Chapter 1 discusses a complete overview and more detailed aspects on many of these issues. **It is crucial that every holding institution keeps and openly shares all of the aforementioned records.**

Note:
"Cub" *refers to a giant otter that is between approx. one day to six months old.*
"Juvenile" *refers to a giant otter that is approx. between six months to one year old.*
"Sub-adult" *refers to a giant otter that is between approx. one year to two years old.*
*"***Successfully reared cub***"*** *is a cub that lives to one year or older.*
"**Successfully reared litter**" *is where at least one cub in the litter survives to one year old or older.*

Section 1
Mating, Gestation, Cub Development & Parental Behavior in Captivity

Parental Behavior Overview:
Giant otters are highly social and live in family groups. In the wild, mated pairs bond for life and all family members including offspring, usually 1 to 2 years old, from the parents' previous litters help to care for the cubs (Duplaix 1980; Schenck & Schenck 1994). As well, each litter usually consists of from one to four cubs born one time per year. The cubs are dependent upon the other family members for care, socialization, learning life skills etc.. In captivity, parents should be allowed to rear their cubs together as this is normal behavior. Preventing such activities will likely cause significant problems such as litter loss etc. (see Chapter 2 Section 10C). Both parents will take care of the cubs, teach them how to swim etc. and both will carry/move them to different nestboxes occasionally. It should not be assumed that because of certain behaviors, that the presence of fathers during cub-rearing will have a negative impact on the success of cub-rearing. For example, it seems to be normal, both in captivity and in the wild (Staib 2002), that fathers will often take cubs out of the den/nestbox and the mothers will immediately take action to return the cubs to the den/nestbox. When this behavior is not

abnormally frequent or excessive, it should not be determined as harmful. Parents at *Dortmund Zoo* (Sykes-Gatz pers. obs.), *Hagenbeck Tierpark* (Flügger pers. comm.) and *Cali Zoo* (Corredor pers. comm.) have all been observed to carry out these behaviors. In at least the first days after parturition, mothers have also been seen to be a little protective over their cubs when the father tries to become involved with the cubs. This as well should not be seen as abnormal behavior. Soon afterwards, the father will become equally involved (and his involvement well accepted by his mate) in the care of the cubs. As well, under normal and non-stressful situations, it can appear, esp. when giant otter parenting behavior has not been observed before, that both parents can sometimes treat their cubs roughly or even overly roughly. This kind of behavior can be carried out whether parents are in the nestbox, on the land, or in the water. This is especially evident although when parents are teaching cubs to swim (see below). This seems to be normal behavior for giant otters. Although, caution should be taken when parents are actually too rough with their cubs (e.g. their behaviors become excessive or severe). The cause of such problems should be identified and resolved if possible, i.e. without causing disturbance to the otters. Giant otter parents, of course, treat cubs very gently as well.

See Chapter 2 Section 10C for information on family/social structure in captivity and how it can affect breeding and cub-rearing success. E.g. the discussion of whether juveniles and sub-adults should be left with their parents when new litters are born is presented within this section. Chapter 2 Section 10A-B describes the negative affects that human disturbances have on parental behavior and cub-rearing success. Chapter 2 Sections 10A-B and Section 3 describe the negative affects that inappropriate enclosure conditions can have on parental behavior and cub-rearing success.

Estrus, Delayed Implantation & Mating Behaviors:
Estrus can occur once every 3 months and immediately after litter loss (Hagenbeck & Wünnemann 1992). "When the breeding pair was rearing its offspring together, it mated again in the first week after the birth of the cubs [i.e. postpartum estrus]." (Wunnemann1995[b]). "…we were able to repeat the observation that the otter came into estrus for 3-5 days approximately 5-7 days postpartum and later, after the repeated loss of pups, a new litter was born without further mating. (Born: 12-26-9); Estrus 1-1 through 1-6-92; Loss of pups 9-2 through 9-4-92; next birth 4-13-92.) After the loss of the pups no new mating took place….A calculation of the gestation period from the above mentioned example would yield 94-103 days. The interval between loss of the pups and the birth of the new litter was 63 days. It is possible that the otter produced a reserve litter with the postnatal estrus, made available relatively quickly by the loss of the first litter. The supposition is that there is a type of delayed implantation, such as is known to exist in several species when there is a strong temperature difference between summer and winter." (translation of Flügger 1997). [In the wild, giant otters normally only give birth to one litter a year.] The aforementioned events occurred at *Hagenbeck Tierpark*.

As well, at Hagenbeck Tierpark, "…the observed mating periods lasted from 1-8 days. All matings that I saw took place in the water, but there are also two observations of mating on land…When a litter died matings could occur immediately and the shortest time between the birth of two litters was 74 days." (Wünnemann 1995 [b])

At *Sao Paulo Zoo*, "We maintained the couple together, expecting a new mating to occur and this happened on December 27th, 1970. We verified, therefore that 108 days elapsed between the preceding birth and the new fertilization. Copulation is preceded by a courtship that lasts about 30 minutes; the male pursues the female, she dodges, escapes or lets the male catch her,

then both roll over the sand together. The female tries to escape but the male does not let her get away. He forces her to get into the water, sometimes pushing her; after several attempts, the female finally gets in the water, followed by the male. During several minutes the male pursues the female and finally mounts his mate. The female's whole body is under water except for her head. Copulation follows and is of short duration, lasting up to 60 seconds." (Autuori & Deutsch 1977). Thirty days after the copulation the female was separated from the male and the mother reared her litter alone. Note: within this section, all the cub-rearing/parental behaviors observed at Sao Paulo Zoo, were carried out by the mother only. See the serious problems, such as litter loss etc., in Chapter 2 Section 10C that can be caused when the parents are not allowed to rear their cubs together.

At *Dortmund Zoo*, the giant otters play very roughly (both in the water and on land) about a few days before mating begins. (I.e. the frequency and intensity of play behaviors is significantly increased.) They continue this behavior until and throughout the actual mating period. Mating has been observed to be carried out in the water and on land and it can occur over a 5 to 7 day period. Copulation is very obvious (i.e. it is not easily missed) and it can occur several times per day. Estrus can occur once every 3 months, immediately after litter loss, and within the first week or so just after parturition (i.e. post-partum estrus). At least one occurrence of delayed implantation was thought to have occurred (Gatz & Sykes-Gatz pers. comm.).

At *Hagenbeck Tierpark*, "From our observations mating lasts for ten to 30 minutes and pairs mated several times a day for a period of up to seven days." (Hagenbeck & Wünnemann 1992).

At Parque del Este (Venezuela) "One morning about 10:30 …the giant otters were copulating. At 11:00 when I arrived the animals were still active. The male grabs the female by her neck and brings the base of its tail laterally to the correspondent part of the female…The copulation movements are fast and intense only during 5 – 10 seconds, several times during the whole copulation. The animals stay in contact for about 10 minutes. They produce certain grunts during the act. After the separation, the female pursued the male, overtakes him trying to arise interest. After a few minutes, the male shows interest and copulates again for some 5 minutes. After that, they separate and swimming together they play and look for food. Autuori reports that in his case the male pursued the female. At about 2:30 p.m. they started sexual activities again. In another occasion it was reported to me, that the pair continued for 3 days in sexual activities, not taking exact notes on duration, frequency etc. In heat time, we did not notice any other change in behavior. Food was taken regularly." (Trebbau, 1978).

Chapter 2 Section 10C describes which situations may be responsible for breeding failure in captivity. E.g. it may be possible that when siblings from the same litter are reared and reach sexual maturity together, they will not breed if they are housed together as a potential breeding pair. It may also be possible, that if unrelated giant otters are reared together or introduced well before they reach sexual maturity, and they reach sexual maturity together, they will not breed.

Recently it has been reported that a few giant otters that are sexually mature and that have been paired together for nearly a year or more, have mated, but the females did not become pregnant. This has occurred at 3 institutions (*Philadelphia Zoo*, *Dallas World Aquarium* & *Dortmund Zoo*) with 3 different pairs. At least two of these animals have also been reported to display estrus cycles/mating at unusual intervals. For example, mating occurred and then 2 weeks to one month later, matings occurred again. On at least one occasion a false pregnancy was reported with these particular otters. None of these females have ever given birth before they were mated with their current partners. At least two or all of the females have never been paired

with a male (other than growing up with their father) before their current pairings. All of the females are now (at the end of this report) around 3 ½ years old. (None of the males have ever sired litters or been paired with a female partner before their current partner. Two males are 11 ½ years old and one male is 4 ½ years old.) Further research should be carried out and a world-wide survey should be conducted on these matters. It should be determined if there is a trend in these occurrences and what the causes may be.

Gestation, False Pregnancies, Signs of Parturition, Reproductive Capabilities at Late Age, Litter Births and Initial Care:

Gestation usually occurs from 65 to 70 days in captivity (Hagenbeck and Wünnemann 1992; Wünnemann 1995, Trebbau 1978; Autuori & Deutsch 1977). Wünnemann reports that gestation also occurred from 64 to 71 days (Wünnemann 1995[b]). Gestation was reported to occur for 77 days (Gatz, pers. comm.) (This happened twice with one captive female and gestation was counted from the last day of mating seen. See below.)

False pregnancy reports are not uncommon. A significant number of zoos have reported this occurrence. Giant otters can become enlarged in the abdominal area and develop swollen/extended teats during false pregnancies and they, upon this physical condition alone, appear as if they are pregnant. It is very difficult from visual observations alone to tell if the animal is actually pregnant. The swelling usually disappears within a few weeks and no evidence of litter birth is found. (Cubs are not heard, seen, and no remains of cubs are found within the parents' feces or enclosure.) For example, at *Sao Paulo Zoo*, "Signs of pregnancy were visible on 2 females (swelling of the abdomen and enlarging of the mammillae) but in both cases the animals got back to their normal state after a few weeks." (Autuori & Deutsch 1977). Three false pregnancies, in one female, were confirmed by ultrasound via husbandry training at *Dortmund Zoo*. These occurrences should be more thoroughly studied to determine why they are occurring at this frequency and what is causing them to occur. See Chapter 1 Section 4 and Chapter 3 for ultrasounding to detect pregnancy and why pregnancy detection is so important.

"The gestation period is from 65-70 days. One month before parturition the swelling of the teats became visible and about 14 days before parturition we could see the swelling of the vulva. We could see no signs indicative of imminent parturition on the day of birth and indeed Ottilie took food just six hours before the birth of her last two litters. Shortly before the births of the litters in 1988 and 1989, Ottilie had 'adopted' herrings, taking them carefully between her powerful jaws and placing them near her teats. This apparently maternal behavior, however, did not inhibit her from eating the fish some hours later. We saw no sign of the behavior being repeated before the later successful liters….The birth took place in the "early hours of the morning". "The first pup was delivered at 0100 hours, the second was stillborn at 0200 and the last two births followed at 0215 and 0230 hours. The mother extracted the pups with her mouth, licked the young, picked them up in her mouth to shake them gently and placed them on the teats. After this initial care, the pups received no further help from the dam and always had to reach the teats by themselves." (Hagenbeck & Wünnemann 1992).

In addition this female at Hagenbeck Tierpark, gave birth to 10 litters in 4 years and 5 months (i.e. averaging 2 litters per year and in one case 3 litters in nearly almost one year i.e. 11 days short of one year) (Hagenbeck & Wünnemann 1992; Flügger 1997). For example, their female "…once again had cubs [11-1-92], although she was still raising adolescents….On 2-2-94 Ottilie once again gave birth to 5 pups even though she was still raising one youth." Flügger 1997). Their only successful breeding female, at 11 years old, developed pyometra during her

last litter at which time she died during recovery from surgery for pyometra (Flügger 1997). [Flügger reported that the female was 9 years old at the time she had pyometra, although it was later found, after this article was published, that this female was actually 11 years old at this time (Louzada da Silva, pers. comm.).] At the time that this female died, her mate was 7 years old.

A 9 year and 4 month old captive giant otter, at *Dortmund Zoo*, gave birth to a litter after 77 days of gestation. (The gestation period was counted from the last day of mating seen.) This was the longest gestation time recorded for her (Gatz, pers. comm.). (Usually although, her gestation period was no shorter than 70 days.) She exhibited this long gestation period two times total. The other occasion occurred 4 years before this litter. This mother's teats became visibly enlarged 4 weeks before parturition and the vulva was noticeably swollen roughly around a week before parturition (Gatz & Sykes-Gatz pers. comm.). She otherwise showed no signs of imminent parturition (i.e. she ate and acted normally). Only when this female reached a later age, she slowed in activity approx. 2 weeks before parturition.

During the aforementioned female's latest litter (i.e. at 9 years and 4 months old), this mother aborted decomposing fetus parts (possibly only 1 cub) 4-5 hours before the live births occurred (Sykes-Gatz, pers. obs.). The mother then gave birth (around 1 p.m.) to 2 cubs spaced 10 minutes apart. Her mate remained at her side during parturition. With most of her previous litters, the cubs were usually first detected in the morning hours (when keepers arrived to work). The mother placed the cubs on her teats and toileted the cubs frequently throughout the 7 days the cub/cubs were observed (Sykes-Gatz pers. obs.) The first cub died at 5 days old and the second was pulled for handrearing after its 7th day of life. After the remaining cub was pulled and during the next one year and 7 months she missed all of her normal estruses (including the post-partum/after the litter loss and once every 3 months estruses) that she usually would experience. (I.e. in 7 years she gave birth to 13 litters/28 cubs.) In total, she missed 7 estrus cycles during this period and no mating occurred. (She was 11 years old and her mate was almost 14 years old at the time this was reported.) Although, during this time, she exhibited false pregnancies at least twice. Ultrasounds, conducted via husbandry training only, showed no fetuses were present. This method was also used to detect an actual pregnancy and determine the health/physical condition of her uterus. Her reproductive capabilities may be slowing because of her advancing age and she may have more difficulty if she does reproduce again (i.e. in light of the aborted decomposing fetus). It is although expected that she will never breed again because of her late age. A third false pregnancy was confirmed, via ultrasound by husbandry training, after the aforementioned was reported and no mating was seen beforehand. (Ultrasounds for such procedures should only be carried out by husbandry training. Otters should not be anesthetized for ultrasounds unless it is a medical emergency. It is not worth the risk of death that could occur.)

The past two females (within two zoos) showed difficulty/health problems during pregnancy or/and slowing (or possibly permanently ended) estrus cycles/mating periods in their later age. They both also had a large number of litters during their lifetime and gave birth to an average of 2 litters per year. [It is important to note that normally otters in the wild only have one litter per year and the oldest documented life-span was eight years for free-ranging giant otters (Staib & Schenck 1994). The oldest known giant otter in captivity survived to at least 19 years of age, although this is exceptional and this age is only an estimation. This animal was a female.] This indicates that at least some giant otter females, around 10 to 11 years old, may slow/end in reproductive capabilities or/and have difficulties/health problems during gestation/reproduction, because of advancing age or/and a high number of litter births during their lifetime. Although

of course, because information regarding these issues is so limited, specific conclusions can not be drawn. Males have been able to breed successfully at 14 years of age. This occurred with at least two males in two institutions (*Brasilia Zoo* & *Hagenbecks Tierpark*). It is crucial that research be continued on these matters and that zoos record in detail and openly share their reproduction information. (See the earliest age of breeding and reproduction below.)

At *Hagenbeck* "The number of cubs per litter varied from 1 to 6. Most of the litters consisted of 2 - 4 cubs. There were 2 litters with 5 cubs and 1 litter with 6 cubs." (Wünnemann 1995 [b]). At *Brasilia Zoo*, 5 cubs in one litter all survived (i.e. to one year of age or older).

A historical survey on litter births in zoos world-wide revealed that litter size (n=31-where the litter size was known) ranged from 1 to 6 cubs, with a mean of 2.9 and common litter size of 2 cubs (Sykes-Gatz 2001, Sykes-Gatz 1998/2002). See cub rearing success under Chapter 1.

Cub Development in Captivity

Information on physical and behavioral cub development is limited because parents rearing cubs must not be disturbed by humans except for when it is necessary to ensure the survival of the otters (i.e. during emergencies, vaccinations, or necessary medical care). Information on parental care, cub development and behavior has been gathered by monitoring otters with videocameras and microphones or from hidden viewing areas. See Chapter 2 Section 10B for these monitoring methods. Following are the most thoroughly documented and available records of cub development at this time.

Nursing in Very Young Cubs:
At *Dortmund Zoo* very young giant otter cubs, being reared by their parents from birth to at least 7 days old when the last cub was pulled for handrearing, nursed frequently during each hour of the day (Sykes-Gatz, pers. obs. 2002). (The last cub was handreared from 7 days old to 11 days old when it died because of a malfunctioning thyroid gland. This cub although appeared to be at a healthy weight (but it was significantly injured) when it was pulled for handrearing and its hunger seemed to be satisfied when it was with its parents. See Chapter 1 Sections 2 & 4 for more information on malfunctioning thyroids.) It was much easier to determine when cubs were actually nursing with auditory monitoring (in connection with the video monitoring), because they made from the first day of birth, **"nursing hums"** when they were suckling. This hum is a somewhat higher pitched and faster vocalization than the contact hum (described in Duplaix 1980). It is also unlike the contact hum in that it has a twittering quality to it and it was only performed when the cub was actually suckling. It was performed both when the cub was nursing from the mother and the handrearer's bottle. (When replicated by the handrearer, it can encourage cubs to feed.) The cubs also displayed **"tail wagging"** when they nursed (from the first day of birth) from the mother and nursed from the handrearer's bottle. The cubs wagged their tails, rather quickly and repeatedly, from side to side (i.e. horizontally, but not vertically/up and down), when they suckled. The tip of the tail can also be kept raised upwards while wagging. (Note: sometimes when the cub might be anxious to nurse or immediately preparing for nursing it might wag its tail.) This behavior is different from the "tail waving" that is described by Duplaix (1980) in that it is performed during nursing only (except during the situations mentioned above) from the first day of birth and the tail only moves horizontally in direction. The "nursing hums" and "tail wagging" behaviors are not known to have been described before in literature and the descriptions and terms in quotes are originally made by Sykes-Gatz (pers. obs., unpublished reports 1999-2002).

When nestboxes are dimly lit, cubs have fallen asleep on the mother's teat (which was often), or when parents or other siblings are covering the nursing cubs (so they cannot be seen) the aforementioned behaviors are important to help determine when cubs are actually nursing. (Note: parents with cubs must be isolated from all human disturbances during cub-rearing.) When the giant otter cubs were crying more often than usual, this indicated that they were hungry, feeling neglected, being abused, or feeling sick. Developing cubs (at Dortmund Zoo), that were observed until they were at least 2 ½ months old, were also observed to nurse very frequently throughout the day and/or hour depending on age. The behavior of these cubs was monitored when the cubs/parents were visible in their enclosure and it was also monitored by the vocalizations of the cubs and parents when they were in their nestboxes. All was monitored from hidden/isolated viewing areas so that the parents did not detect the observer and they were not disturbed (Sykes-Gatz unpublished report 1999-2002 and pers. obs.).

Immediately after the 7 day old giant otter cub at Dortmund Zoo was removed from its parents for handrearing, it eliminated softly formed dark green stools (Sykes-Gatz, pers. obs. unpublished reports 1999-2002). This stool resulted from mother's milk, although it is important to note that this cub died of an inherited thyroid malfunction at 11 days old, which may have affected its stool color. The cub although did not appear underweight at the time it was pulled, but it was significantly injured from a bite wound that one of the parents inflicted.

At *Hagenbeck Tierpark*, "The female has four mammae. In the first days of life the cubs tend to fall asleep when suckling, keeping the teat in their mouth for hours." (Wünnemann 1995 [b])

(Nursing frequency and length should be monitored and thoroughly documented for cubs during their entire development, but only when the observer does not disturb parents. This is necessary for comparisons to other cubs, both in the wild and in captivity, and for handrearers to help provide feeding schedules more closely related to the cubs natural nursing behavior.)

Eyes First Open:
The cubs' eyes opened at 30 days old at *Sao Paulo Zoo* (Autuori & Deutsch 1977).

At *Hagenbeck Tierpark* the cubs' eyes opened at 6 weeks old (Hagenbeck & Wünnemann 1992).

At *Dortmund Zoo* the cubs' eyes first opened at 30 days old (Gatz & Sykes-Gatz pers. obs.).

Leaving/Entering the Nestbox:
"Giant otters will use a number of nest boxes and like to change several times while rearing their offspring." (Wünnemann 1995). When the female reared her cubs alone, Hagenbeck reports "The female changed nestboxes with her litter several times, carrying the young in her mouth." (Hagenbeck & Wünnemann 1992). *Hagenbeck Tierpark* reports, "At 67 days of age they left the nestbox and were seen entering the water for the first time." (Hagenbeck & Wünnemann 1992).

At *Sao Paulo Zoo*, "The female [mother] leaves the shelter several times a day – 3 to 5—and gets into the water to catch fish and eat them…" [After eating, she also spent time chasing and killing fish that she did not eat].….[At 63 days old] for the first time, the small ariranha was

seen entering the shelter alone, but pushed by its mother towards the entrance.…" (Autuori & Deutsch 1977).

At *Dortmund Zoo*, both the mother and father, together, or only one or the other, would leave the nestbox with the cubs in it, to get fish. Sometimes the father would bring the mother fish as well; i.e. he would take the fish into the nestbox and place it in front of her (Sykes-Gatz & Gatz pers. obs.). The parents, either both or one or the other, would also carry the cubs to different nestboxes occasionally and they were not showing stress during these times. Sometimes they would move the cubs one to three times in a day or not at all during the day. This was observed with young cubs and cubs as old as 2 ½ months old. If the cubs were moved 4 or more times per day this was considered not normal to excessive behavior (dependent on the frequency moved and in what time period) and was caused because parents were stressed by a disturbance (Sykes-Gatz unpublished report & pers. obs.).

Determining Cub Sex:
At *Hagenbeck Tierpark*, the cubs' sex could be determined by week 10 (Hagenbeck & Wünnemann 1992).

When Parents First Take Cubs To The Water:
Giant otter parents expose their cubs to the water, closely monitor and stay next to/near their cubs while they are in the water and they teach their cubs how to swim. The training for swimming can look very rough; i.e. parents will take cubs into the pool, push them underwater and then help bring them back up to the surface again. This is reported in the wild as well as in captivity.

At *Hagenbeck Tierpark*, "The parents may start between the 20th and 60th day to take the cubs to the water. This training looks very rough." (Wünnemann 1995). Hagenbeck Tierpark also reports that the parents, especially the father, took the cubs when they were 3-4 weeks old, out of the den and then took them into the water. "So the cubs learned swimming at an extreme early age." (Wünnemann 1995[b]).

At *Sao Paulo Zoo*, the cubs were taken to the water when they were 13 days old. (The parents were separated after mating, so only the mother reared the cubs.) The cubs were not let go when they were put in the water at this age. "…when the young were 20 days old, the female took them, one by one, into the water where she would let them go, staying by their side. On the first days the small animal is submerged and is incapable of coming to the surface. The female brings it up with one of her front feet, but letting it go soon after. This behavior is repeated several times until the mother holds the young otter by the scruff of its neck and takes it back into the shelter. Soon afterwards, the mother comes out with another small animal – and repeats the procedure as described above. Each young suffers this treatment twice or three times a day. After a few days the little ariranhas are able to come back to the surface without any help from their mother. They then are capable of keeping their heads partly out of water but their whole body remains underwater in a vertical position. The female remains beside the young animal all the time. The mother then pushes the young one underwater, pressing its head down by using her front foot and thus forcing the small otter to go down under the surface. This procedure is repeated identically with both young. The small otters started to swim [at 31 days old] when their bodies maintained a horizontal position. The female swims alongside the young ariranha and forces it to go underwater several times by pushing it down." (Autuori & Deutsch 1977.)

At *Dortmund Zoo*, the father usually takes the cubs to the water when they are around 2 weeks old and the mother usually brings them back to the den (Gatz & Sykes Gatz pers. obs.). The swimming lessons can appear very rough, especially when the parents push the cubs under the water with their feet and let them come back up to the surface again on their own. The parents carry a cub by holding the cub's neck in their mouth. The cub's body is left hanging down when it is being carried.

First Swim Alone:
The cubs were able to swim at one month old and the cubs' were seen swimming alone at 63 days old at *Sao Paulo Zoo* while the mother stayed on dry land (Autuori & Deutsch 1977).

At *Hagenbecks Tierpark*, "At 67 days of age they left the nestbox and were seen entering the water for the first time [i.e. cubs entering the water on their own for the first time]." (Hagenbeck & Wünnemann 1992).

First Eat Fish and Weaning Ages:
At *Hagenbecks Tierpark* (Germany) giant otter cubs, at approximately 8 weeks old, mouthed and played with fish that the mother brought to them; although they only first started swallowing solid fish at 70 days of age (10 weeks old) (Hagenbeck and Wünnemann 1992). Later reports explain that two cubs, that were captive-born and handreared at Hagenbecks, ingested solid food at 3 months old, although it was found that they could not digest the fish properly when they were this age. "The feces contained a lot of undigested fat and protein and the enzyme level of chymotrypsin was much lower than in adult animals" (Wünnemann 1995[b]). Wünnemann 1995 further reports, "At 70 days, the [giant otter] cubs will start to swallow solid food, although they start playing with it a long time before this time. However, they are dependent on their mother for at least four months [i.e. the first 4 months of the cubs' life] and will continue suckling up to the age of seven months". The cubs continued nursing mother's milk when they were around 6 1/2 months old, although only insignificant amounts were obtained and it provided little nutritional value.

At *Sao Paulo Zoo*, the mother offered the cubs a live fish at 74 days old. The cubs played with the fish, but did not try to bite them. Later, the mother left a fish by the water's edge, and the 90 day old cub ate its first small bites of fish. At 107 days old a cub caught a fish on its own and ate it (Autuori & Deutsch 1977).

Interesting Side Note: At *Dortmund Zoo* the mother brought a fish to her 6 day old cub, placed it in front of the blind cub, and then she placed the fish on top of the cub's back. After 2 minutes the mother removed the fish from the cub's back and ate it (Sykes-Gatz, pers. obs.).

See in Chapter 1 Section 5 and Chapter 5 the dates for weaning handreared cubs and the scientific study that needs to be conducted on ages to wean cubs during handrearing.

Reports of Physical Development in Captivity:
See the giant otter cub weight growth curve under Graph 2. See a complete listing of all reported individual cub weights and lengths in Table 6 and individual adult weights and lengths in Table 7. Also see the discussion in Chapter 1 Sections 4-5 and Chapter 5 about cub body weight and length measurements and corresponding age data that are needed for study. Following are some additional details about some of the individuals reported in Tables 6 and 7 and additional information.

At *Hagenbeck Tierpark*, Wünnemann (1995[b]) reports, "The weight of newborn cubs differs between 150 and 265 g. The total length has been measured with 1.1 cubs, which died after 3 days: 33 cm was the total length of both, the tails measuring 10.5 and 11 cm. The canines were already present at this early age!" At 1 day old two males from the same litter weighed 220 g and 265 g (Hagenbeck & Wünnemann 1992). A 5 day old female weighed 200g and two 4 day old females from the same litter weighed 200 g and 250 g. Also at 13 days old a male weighed 320 g and another 13 day old cub from another litter weighed 220 g. [Note: all of the cubs' aforementioned were weighed just after their deaths.] (See additional information on specific and additional cub weights taken at Hagenbeck Tierpark in Table 6.)

At *Sao Paulo Zoo* Autuori & Deutsch (1977) report, "On the 10th of March, 1971, 5 young were born after 65 days of gestation. Two days later the 5 young otters were found dead, without any apparent signs of injuries. They were 3 males and 2 females. These young were weighed and measured soon after death revealing the following data:" Male 213 g, length 33.5 cm; male 193 g, 33.5 cm; male 161 g, length 31.0 cm; female 230 g, length 33.5 cm; female 209 g, length 32.5 cm. "The tail length was about 10 cm. The head measured about 7 cm from the base of the neck." They further report, a male cub born on December 10, 1971 weighed 3 kg 815 g at its death which occurred on May 1, 1972. "The necropsy did not reveal the "causa mortis". It was practically an atrophic animal. We observed earlier a grayish circular spot – about 1.5 cm in diameter – on the smallest animal's tail [i.e. the otter just referred to]. Some days after birth, this specimen showed very little signs of progress, compared with its sister and depended always on its mother's help for feeding until its death.

The following cubs were born at *Dortmund Zoo* (Germany). These cubs were parent-reared and either died (at the age listed below) with the parents or just within a few hours after being pulled for handrearing. Both parents were captive born.
Day 3 (i.e. died on the third day after birth.); male; weight 220g; total length 34.5cm; the tail length was 12cm and the tip of nose to tail base length was 22.5cm.
Day 3; male; weight 190g; total length 33cm; the tail length was 11cm and the tip of nose to tail base length was 22cm.
Day 4; female; weight 180g; total length 29.5cm; the tail length was 10cm and the tip of nose to tail base length was 19.5cm.
Day 4; female; weight 220g; total length 31.5cm; the tail length was 9cm and the tip of nose to tail base length was 22.5cm.

The following record of weight gain comes from a wild born male giant otter handreared *at Emperor Valley Zoo* in Trinidad. 4 months old – 9 pounds [4.09 kg], 5 months – 11 pounds [5 kg] , 9 months – 30 pounds [13.62 kg] , 11 months – 38 pounds [17.25 kg] , 13 months – 40 pounds [18.16 kg], 19 months – 48 pounds [21.79 kg].

A giant otter male, (named Rio) born at *Hagenbeck Tierpark* weighed 9.1 kg [20 lbs.] at 5 months old (Flügger 1997). At 4 years and 3 months old, he weighed 23.5 kg [51.8 lbs.] (Sykes, unpublished report 1997, Philadelphia Zoo). (See additional weights that were taken during his fourth year of life in Table 7.) At 9 years old he weighed 22.5 kg (Brasilia Zoo, pers. comm.).

A 3 year old male giant otter (named Kuddel) weighed 22 kg and had a nose to tail length (i.e. entire body length) that was 1.65 m and a tail length that was 65 cm. The circumference of his chest behind his elbows measured 57 cm, the circumference of his stomach was 65 cm, the circumference of his abdomen was 53 cm, and the length of his lower arm was 14 cm. This

animal was captive-born at Hagenbeck Tierpark and was held at Dortmund Zoo. (Osmann, pers. comm. 1993)

At *Hagenbeck Tierpark*, it is reported that by 6 ½ months of age the captive-born giant otter has grown to 2/3 of the adult size (Hagenbeck & Wünnemann 1992).

Sexual Maturity in Captivity:
Field biologists and institutions that hold giant otters in captivity are in need of accurate information regarding the earliest age of sexual maturity (i.e. mating) for both females and males, in both the wild and in captivity. The earliest age of sexual maturity is not known, only estimated, in the wild, and in captivity the earliest age of sexual maturity is also not clear. As well, field researchers are interested to know the earliest age of siring/bearing litters both in captivity and in the wild. More detailed records needed to be maintained, shared and studied at zoos world-wide to find clear answers to these questions.

Wünnemann (1995[b]; Hagenbeck & Wünnemann 1992) stated that giant otters (both sexes) at *Hagenbeck Tierpark* reached sexual maturity and mated successfully at about 2 years old. This is accurate for their male, as he first mated (and sired a litter from this mating) at about 2 ½ years old. Although the breeding female (Ottilie) that they used to make this determination, was not 2 years old, but rather 4 years old when she gave birth to her first litter. (This was discovered from *Brasilia Zoo* records by Louzada da Silva [pers. comm.]. This fact was unfortunately not discovered until long after Hagenbeck published their articles/studies). Although, because the age of the other females who bred at this facility were only estimated, accurate age of sexual maturity for them is not clearly known. Unfortunately, in this case Wünnemann's (1992) information, that giant otters "reach sexual maturity at an age of about 2 years" at his institution, can not be considered accurate for the females.

At *Dortmund Zoo*, a female first mated at 2 years and 10 months old, became pregnant from this mating and gave birth to her first litter at 3 years old. The sire was her brother, but the mother and the father were from different litters and they were not paired together until after the male had reached sexual maturity. This female's mate was 4.5 to 5 years old when he first mated and sired this litter (Gatz pers. comm.). This pair was housed together 2 years before their first mating. Unfortunately, it is not known if there were previous matings before this date. So, it is not known with 100% accuracy at this zoo when the female reached sexual maturity.

In summary, it can be said that at 2 years and 10 months old females can come into estrus, mate, and bear litters at 3 years old. A male can mate at 2.5 years old and sire a litter at 2 years and 8 months old. Although, because of the limited records, it is not known if this is the earliest age at which giant otters can become sexually mature. These records are the only accurate and complete records that are known at this time.

Section 2
Reports of Cub Development and Parental Behavior in the Wild:

Two emaciated and moribund cubs at approx. 6 weeks of age at the *Paramaribo Zoo* weighed and measured the following (Duplaix 1980). The male weighed 1400 g [49 oz] and measured a total length of 55 cm [21.7"]. The female weighed 1200g [42 oz] and measured a total length of

52.5 cm [20.6"]. It is assumed that these cubs were born in the wild. See the giant otter cub weight growth curve under Graph 2 and more information on weights above.

Munn & Munn (1988) reported that wild giant otter parents in Manu National Park carried 2 week old cubs out of the den and dropped them in the water at the den entrance. "The cubs… eyes were still closed, and they bobbed helplessly." "By the age of 6 weeks the cubs regularly followed their parents out of the den." They played a lot in the shallow water and on the ground outside the den entrance. Parents brought small half killed fish to their approx. 3 month old cubs and the cubs would grab the prey in their mouth and front paws. The cubs at that age also sometimes accompanied the parents on fishing expeditions. Prior to approx. 3 months of age, the cubs had been nourished almost exclusively on milk. By nine months of age the cubs were eating only prey and were about three-quarters grown.

Carter & Rosas 1997 states "…after 10 months they hunt as successfully as their parents and can no longer be distinguished from adults in the wild (Laidler 1984; Brecht-Munn & Munn, 1988). At about 1 year of age otters will mark on their parents campsites (Laidler 1984; Schweizer 1992) in Carter & Rosas.

Observations of wild giant otters in Peru:

"The age of giving birth for the first time is only known from two females: Triangel and Isla. Triangel was five and Isla was three years old. The age of three females was known when they were observed for the first time with a litter. These animals were not under continuous observation so it is possible that they had litters before. Pua was four, Hanni and Punto were five when they were observed to have cubs." (Translation from Staib 2002)

"In Manu National Park, Peru, in 2001 a giant otter family gave birth to two litters spaced approx. six months apart. One cub of the first litter survived and remained with the family during the successful rearing of the second litter." (Groenendijk pers. comm. 2003)

Chapter 5

Handrearing Giant Otters

Introduction

Chapter 1 Section 5 covers what handrearing information needs to be recorded and openly shared with the professional community and what problems are in need of immediate international attention, scientific study and resolution. Also discussed is what should be done with wild born orphan cubs, i.e. who should handrear them, what should be done with them after hand-rearing etc.. It is crucial that each institution/person who handrears captive-born and/or wild-born orphaned cubs participate in the efforts to help increase overall knowledge, advance/better cub management in captivity and help conservation efforts in the wild.

The following information is only meant to serve as general recommendations, not rules. Because every individual otter differs and much is left to learn, handrearing practices should be adjusted to fit the individual needs of every otter. Handrearing is a very difficult full-time and sometimes round the clock job. With many complexities, problems can occur even for those with experience. The information in this chapter is by no means all inclusive and does not cover all of the problems that can occur during handrearing. It is hoped that this manual will encourage further research and problem resolution, as well as stimulate communication and information sharing among all institutions involved. Handrearing information or applicable research that you would like to contribute would be much appreciated. Please see Chapter 1 Section 4 for where to submit your contributions.

Note:
"Cub" *refers to a giant otter that is between approx. one day to six months old.*
"Juvenile" *refers to a giant otter that is approx. between six months to one year old.*
"Sub-adult" *refers to a giant otter that is between approx. one year to two years old.*

Section 1
Cub Assessment, Cub Weights & Record Keeping

The cub's sex, body weight and length, estimated age, and physical and behavioral condition, health, and abilities should be assessed and recorded when a handrearer first receives the cub. This is necessary to determine diet, housing, and care needs. The degree of alertness, energy and hydration, feces, urine, nose, eye, fur coat, and foot and toe pad, skin, and webbing condition, body temperature, sensitive/painful areas of the body and injuries should be checked.

Cub weight, length, general size and developmental progress (eyes open, walking etc.) will help determine cub age. Although, cubs of the same age and sex, as well as litter mates, can have significantly different weights, sizes, and growth rates or/and they can differ in developmental abilities. For example, "Size varies in direct ratio to the amount of feed available to the lactating female and the number of cubs in a liter. If the animal has been abandoned for some time, it will be smaller than a normal cub of similar age." (Smeeton 2001). See the giant otter

cub weight growth curve in Graph 2 and more weight data and cub development information in Chapter 4.

The cub is grossly underweight or emaciated if one can very easily see and/or feel bones (esp. the ribs, vertebrate, hip and tail bones) under the cub's skin, the abdomen is sunken in or slack, sides are sunken in beneath its rib cage, and its body looks shrunken or eyes are sunken in. Cubs must have a normal body temperature and be properly hydrated before they are fed formulas or foods. (See Sections 2 and 3.) If the otter's fur coat is not in a clean, shiny, and waterproof (i.e. water does not penetrate or even dampen the white underfur) condition, this can indicate health problems. These animals can become sick (esp. with pneumonia), unhealthy, and they may refuse to swim or die if the conditions causing this problem are not corrected (Duplaix-Hall 1975). See Chapter 2 Section 3 for problems that can cause poor fur coat condition.

Cubs should be weighed daily and at the same time every day, e.g. before the first feeding of the day and after toileting. Cub weight changes after elimination and feeding and this is esp. noticeable in very small cubs (see Section 4 below). The otter's entire body, including its tail, which is a significant amount of its total body weight, should be weighed. (Sometimes it is easier to weigh cubs after the second feeding as animals usually get very excited when they are waiting for the first feeding of the day.) A healthy normally developing cub that is reared with proper handrearing practices should gain some amount of measurable weight almost every day. If no weight gain or/and especially if weight loss occurs and continues (e.g. for more than 2 consecutive days), either the formula or/and handrearing practices may be inadequate or/and the cub has other medical/physical problems. The problems must be solved as soon as possible to prevent poor health or death.

The following factors should be closely observed and monitored daily. The information gathered should be recorded either at every feeding, daily, or when applicable: Cub weights, the types/brand names, ingredients, dilutions, and preparation of milk formulas and foods, feeding regimens/schedules (frequency and when fed etc.), techniques and apparatuses (nipple/bottle types), amounts eaten, willingness to eat, preferences (e.g. for specific food and feeding apparatus types etc.), beginning and ending weaning dates, feces and urine condition and frequency, physical and behavioral health condition, medications given, and behavioral and physical developmental progress. Cubs can show subtle behavioral signs that may indicate the gradual development of illness or other problems. If each of these individual behavioral signs are not recorded, then the slow development of problems may be missed. Many times health problems can become well developed before they are obvious and discovered. Often this can make poor health conditions much more difficult to successfully treat.

The cub's body length should be measured and recorded at least one time per week. An otter should be measured from the tip of its tail to its nose and again from its tail base to its tail tip. A body length - weight - age growth curve for the cub's entire development and behavioral and physical development records are needed for comparison studies in the wild and in captivity. I.e. measurements and records should be taken from the earliest age to the latest age that is possible. (See Chapter 3 for how weights can be safely and easily taken, via husbandry training, when cubs gets older.) An incomplete weight growth curve is available (see Graph 2), but no body length growth curve is known to exist.

Census information such as identification, family history, birth, death, transfer, acquisition, wild/captive born location should also be kept. Record keeping is not only necessary to provide continued adequate care to individual giant otters, it is also necessary that all institutions

worldwide openly share these records. Many other handrearing records are also needed to increase overall knowledge. See Chapter 1 Sections 4-5 for more details and where to submit your documentation.

Consistent cub care should be provided by the coordination of handrearer methods and communications among handrearers. The number of involved handrearers should be kept to a minimum.

Section 2
Electrolyte/Glucose Solutions (For health problems & for diet changes during health problems); Emergency Medical Care & Abnormal Body Temperatures

Electrolyte solutions, for general use, can help rehydrate and provide quick temporary energy to cubs in need (Merck 1986). (Some electrolyte solutions are specialized for specific health problems and these are inappropriate/dangerous to use, except for what they are directly intended for.) A veterinarian should examine unhealthy cubs to determine what course of treatment is appropriate for the cubs. Dependent on the existence of other health complications, electrolyte solutions (for general use) can sometimes be given when cubs have diarrhea (esp. when severe) and when cubs are dehydrated, very sick or weak, underweight, emaciated, or are too sick/refuse to eat formula foods. In the aforementioned cases, e*lectrolyte solutions for general use can also be provided when cubs are switched from mother's milk to an artificial milk replacer or are switched from one artificial milk replacer to another.* Replacer formulas can be diluted with it or/and it can be offered in its full capacity in-between total diet switch-overs. (Healthy cubs should be introduced to new formulas by offering only water or 5% glucose in water for the first feed and then by offering new formulas diluted with straight water for at least the next several feeds. See Section 7.) Electrolyte solutions are only to be used as a temporary supplement/medical treatment and depending on the situation, can be administered alone or in addition to formula foods. The water used for feeding should be boiled and cooled to very warm/hot before mixing electrolyte powders/liquids in. These formulas should be kept refrigerated and solutions (i.e. only the portion that is to be fed/injected) should be warmed to blood heat before administration.

Critical: cubs must be conscious, responsive, well hydrated, not be actively vomiting and have normal body temperatures before formula/foods are fed (see below and Section 3).

Some electrolyte solutions can be administered orally (bottle or tube fed) and some can only be injected subcutaneously or intravenously. As well, in some health conditions electrolytes can only be administered by injection (see below). When cubs are too weak or sick to nurse or swallow and they have a normal body temperature, some electrolyte solutions for general use can be tube feed, only when cubs are fully conscious, or injected by vets or experienced handrearers.

A commercially prepared balanced electrolyte solution for oral administration for animals can be purchased at vet hospitals or at some pet stores. It should contain a well-balanced mixture of electrolytes, amino acids, and glucose and be able to be used for general use. Some electrolytes/rehydrating formulas that are commercially prepared for human babies and that

contain glucose rather than sucrose, could be substituted (in cases where the aforementioned solutions can not be acquired) for temporary oral use only. They can be purchased in a drug or grocery store. [Sucrose (e.g. table sugar) is a disaccharide and is poorly digested by most young animals (Gerson & Point, 1986). It is not recommended for use.]

Unfortunately little information is available on precise giant otter body temperatures (see under Chapter 1). No rectal body temperature of healthy giant otters (neither cubs nor adults) that are not under anesthesia or immobilization have been found or been reported. This and additional physiological information should be gathered from handreared cubs so it can be used for comparison to adults and other cubs and used to increase general knowledge.

The cub's external body temperature should be warm to the touch, i.e. not hot or cold. A small finger could be inserted into the cub's mouth to also help determine temperature. The cub's mouth should not feel cold or hot to the touch. If it does, see below. General references can be drawn from the following information. "Body temperature [of the neonate] should not be much more than 1^{o}-2^{o}F below the normal adult temperature; if it is, the animal may be hypothermic enough to require attention…" (Read & Meier 1996). "At a rectal temperature <82 ^{o}F (28 ^{o}C), the ability to return the temperature to normal is lost, but the animal will continue to survive and, if re-warmed using external heat, will return to a normal state." Low body temperatures (i.e. mild to profound hypothermia) can result in serious health problems and/or death. "When the neonate has a very low body temperature, low blood glucose, or hypoglycemia, often accompanies the hypothermia. [As the animal is warmed], glucose support [with fluid administration] is important as the body temperature approaches normal." (Read & Meier 1996).. "The maximum body temperature compatible with life is 10 ^{o}F (5 ^{o}C) above the normal level of the animal." (Merck 1986). Note: captive giant otters have been observed to have a low heat tolerance (Carter & Rosas; Sykes-Gatz & Gatz pers. obs.).

Supplemental heating should be provided for sick or very weak cubs of all ages and for young cubs (especially important for neonates--cubs less than one month old). Very young cubs especially, do not thermoregulate (maintain/regulate their body temperatures) well (Merck 1986; Read and Meier 1996). Caution, although, must be taken as well. For example, when the animal is in shock "The [healthy normal] body temperature should be maintained, but not raised. Keeping the patient warm can be overdone to the point that it encourages vasodilations and, thus, accentuates the shock syndrome." (Merck 1986). "Young animals have more labile [fluctuating] temperature levels than older animals, with somewhat greater diurnal fluctuations; the young respond to infection with a much higher temperature elevation than do older animals." (Merck 1986).

Caution: **if the cub is in severe shock, unresponsive, unconscious, actively vomiting, or its body temperature is below normal, foods and fluids (including electrolytes/glucose fluids) must never be given orally** (Read & Meier 1996)**.** In these cases, the digestion system is unable to work properly and health problems or choking the animal could result if oral administration is used. If cub temperature is below normal, **immediately** attempt to manually warm the cub up to a normal body temperature and maintain this body temperature thereafter (see below). (This also helps the cub process injected fluids more efficiently.) It is also critical that a vet is sought immediately and that the vet administers glucose solutions by subcutaneous or intravenous injection as soon as possible to help revive the cub quickly (injected solutions will in turn help restore / maintain normal body temperature). ("Subcutaneous fluid administration can be done rapidly and easily. Fluids given by this route should be isotonic (5% glucose or dextrose, lactated Ringer's solution or normal saline). However this route of fluid

and glucose administration has limitations. Hypothermic individuals often have poor peripheral circulation, so fluids may be absorbed erratically or slowly. In addition, warmed fluids may cause local vasodilations in a hypothermic animal, compounding problems with shock (Finco 1972)." (Read & Meier 1996). If vets are not soon available, glucose solutions should be administered orally (by bottle or tube feeding) **only after** the cub reaches normal body temperature, becomes responsive, **and** can swallow and/or nurse normally.

Heating pads or blankets, hot water baths (i.e. at blood heat temperature), heat lamps, or even hair dryers (in worst cases) can be used for warming in emergency cases where cubs are profoundly hypothermic, **if they are used with extreme caution** (Read and Meier 1996. **Cub body temperature** (i.e. rectal, mouth (test with finger), and general body surface temperatures) and behavior must be closely and frequently monitored during the warming process. **Cubs must not be left unattended during warming and they must be warmed up gradually. Overheating or heating too quickly can be just as dangerous and/or deadly as being too cold** (i.e. cubs can overheat very easily and possibly die and body burns could also occur more easily on sick cubs). (See below for low heat tolerance.) Afterwards normal cub temperature can be maintained by using a heat lamp, heating pad, hot water bottle, blanket (can be warmed in a clothes dryer), incubator, or warm room etc. (see Sections 13 and 14). If cubs are just slightly below normal body temperature, more gentle and slower warming methods such as those just mentioned should be used. Cubs must have enough space within their housing container to move away from heat sources when they need to, but not so much space, that they cannot find their way back to the heat source. See section 14 for warming in non-emergency situations.

Body temperatures may also be above normal if the cub has been stressed, in excess heat (e.g. direct sun, heatstroke), is sick (e.g. fever, infections / seek vet care), or severely dehydrated. A cub with heatstroke may be hot to the touch, panting heavily, extremely lethargic or limp, be unconscious, or having seizures. **The otter's temperature must be lowered slowly and gradually.** The cub could be put into shock if its temperature is decreased rapidly and this could cause death. If external environmental factors (e.g. excess heat, stress) have caused elevated body temperatures, cubs must be removed from these factors. Animals with heat exhaustion should be moved to a cool and shaded area and wiped down with a cool (not cold) damp cloth or with cool water. If the cub has a very high body temperature, the cub can be placed directly in a *shallow room-temperature* water bath until its body temperature approaches normal. Cubs must not be left unattended and the cub's head, neck, and upper shoulders must not be exposed to the body of water. Temperature and behavior must be checked frequently during these cooling processes. **The cub must never be placed in cold water. The shock of the cold water could kill it.** As well, **if the animal is conscious and responsive**, fluids can be administered to help lower body temperatures. If body temperatures do not soon return to normal, vet assistance should be sought immediately. (Merck 1986; Read and Meier 1996)

Section 3
Elimination (Feces / Urine) & Dehydration

Health problems or inappropriate handrearing practices can cause abnormalities with elimination. These problems must be identified and resolved as quickly as possible to promote and maintain cub health. Stool (feces/spraint) and urine appearance, condition, general amount,

and frequency after *each* toileting/elimination should be closely observed and recorded to help determine cub health and handrearing effectiveness. For example, this can indicate if and how much a formula needs to be adjusted or even totally changed (esp. with newly introduced formulas) or if the feeding frequency / techniques, formula preparation techniques, and/or amount fed is inappropriate.

Stools should be very softly formed into a definitive shape and golden yellow in color when milk formula is fed. The stools' *surface* can also appear shiny and translucent, as if the stool is covered by a very thin layer of translucent jelly. The stool, although, should not appear greasy (see below). When cubs are gradually switched from mother's milk to an artificial milk replacer, it is normal that the cubs' stool color may slowly change as the new formula strength is gradually increased (see below for abnormal color changes). During weaning, stool color will darken and its consistency and texture will change. When weaned to a total fish diet, stool will appear dark in color with a green or black hue, and sometimes have white, yellow, or green mucous blobs. Stool may be loosely formed or unformed but should be very thick in consistency (i.e. like thick oatmeal with a rough texture from fish scales etc.). If stools look otherwise in color or form/consistency, problems may exist. Certain odors or changes in urine or stool odor can also indicate problems.

Milk replacer formulas too strong in dilution could cause loose stool (stool with little or no form or pudding-like consistency), diarrhea, or liquid/runny stool. This is a common problem, especially when new formulas are introduced too quickly. Usually diluting the formula with electrolyte solutions for general use or water will help reduce diarrhea and rehydrate the cub (see Section 2). Diarrhea can cause bloating (i.e. a tight distended abdomen), abdominal cramping, flatulence, digestion problems, and dehydration, and if continued and severe, possibly death. Other handrearing practices (e.g. non-sanitary conditions, using dirty feeding apparatuses or improperly stored formulas etc.) or health problems can also cause diarrhea.

Black and tarry (although this could be normal for some otters a day or two after their birth), bright green, white, or cream stool color or stool excessively greasy/shiny in appearance indicates possible milk formula inadequacy or cub health problems unrelated to formulas. Bright or dark red blood in the stool also indicates problems. Bright red blood (often on the top layer of stool) could indicate an irritation to the rectum/bowels from diarrhea or straining to defecate. Dark red blood, especially that which is mixed in and throughout the stool, can indicate a very serious health problem (i.e. internal bleeding) and medical treatment is needed immediately. Immediately after a 7 day old giant otter cub at Dortmund Zoo was removed from its parents for handrearing, it eliminated softly formed dark green stools (Sykes-Gatz, pers. obs.). This stool resulted from mother's milk, although it is important to note that this cub died of an inherited thyroid malfunction at 11 days old, which may have affected its stool color. The cub although did not appear underweight at the time it was pulled, but it was significantly injured. Additionally, just after a 3 day old giant otter cub at Dortmund Zoo was removed from its parents for handrearing, it eliminated softly formed dark green stools (Sykes-Gatz, pers. obs.). This stool resulted from mother's milk and the cub died on the same day from a severe infection. (This cub had different (although still related) parents than the last cub just aforementioned above and it is assumed that it did not have an inherited thyroid malfunction.)

Otter cubs usually urinate and defecate (simultaneously) several times a day, usually before or after every to every other feeding and/or corresponding toileting. (See toileting stimulation in Section 4.) **If cubs do not defecate (constipation) and/or urinate after two or more**

successive feedings, health problems or/and formula failure may exist. If problems persist, deadly health problems could soon arise. Vet attention must be sought immediately. If defecation occurs too frequently, the formula might not be fully digested/assimilated into the body and the formula may not be adequate or other health problems may exist.

Otters should not strain to defecate or urinate, if they do, this can indicate serious health problems. Constipation can also cause bloating (i.e. a tight distended abdomen), abdominal cramping, flatulence, and digestion problems, and if continued and severe, possibly death. For example, **small lumps of powder in the mixed liquid formula could cause intestinal/stomach blockage, prevent defecation, and result in death. (All lumps must be removed before feeding**. See Section 6). If cubs do not urinate along with defecation, this could indicate dehydration or other medical problems (i.e. urinary blockages etc.). Urine should be yellow in color and eliminated in ample amounts (in relation to fluid amounts offered).

Animals must be well hydrated at all times. Dehydration can occur from health problems such as heat stress, severe respiratory diseases, fever, vomiting, and diarrhea (esp. when severe and/or constant) and from inadequate amounts of fluid within/in addition to the formula/diet (esp. during weaning or when milk formula dilution is too strong) etc. (Merck 1986). Dehydration can also worsen constipation and lead to a rise in body temperature if severe enough.

Dehydration is evident when the cub's skin is tight to its body, the elasticity of the skin is decreased, its eyes are sunken in and its body looks shrunken, the nictitating membrane (common name: third eyelid) covers part of the eye, it urinates infrequently and/or in small amounts, or it has dark yellow urine. The cub's gums can also be dry or sticky and the eyes can also look dry. To test for dehydration, the skin over the cub's shoulders or back should be used to conduct the test. The skin over the neck should not be used, as it may give a false reading. A piece of skin should be grabbed firmly between the handrearer's thumb and forefinger and it should be pulled upwards away from the cub's body. (The skin should be shaped like a small tent and it should not be pulled hard.) The skin should then be released. If the skin does not fall fairly quickly (i.e. nearly immediately) and smoothly back to the otter's body (i.e. it is not elastic), the cub is probably dehydrated. The more dehydrated the cub is, the more slowly the "tent" will return to a flat position. If the skin stands and does not fall back to the body, severe dehydration is probable.

Often cubs are dehydrated when handrearers first receive them. Cubs that are dehydrated must be hydrated with at least water (or electrolyte solutions for general use if health conditions permit) before they are fed diets/formulas. If a cub has severe and continued diarrhea with a particular formula, and prior formula dilution hasn't reduced diarrhea and no other health problems are causing diarrhea, the cub should be given at least water or an electrolyte solution, for at least one feeding. This will let the stomach and digestive system rest as well as replace fluids lost from diarrhea. The formula that has caused this problem should be discontinued (i.e. not fed any longer) and a new formula (i.e. by diluting it with water or an electrolyte solution if cubs are still experiencing health problems) should be slowly introduced. Amounts of food fed can also be temporarily reduced to help relieve the stress on the stomach. (The administration of antibiotics is not recommended, if the problem is only caused by the formula.)

Section 4
Toileting: To produce elimination in young or unhealthy cubs.

"Young carnivores require urogenital [the organs that excrete feces and urine] stimulation for the first several weeks." (Read & Meier 1996). This is necessary to encourage defecation and urination as they are unable to eliminate on their own. (Giant otter cubs have required toileting (also called urogenital stimulation) at 2 ½ and 3 months old as well.) Depending on cub preference, toileting is necessary before or after each feeding of the day. In some cases, it should be done both before and after feeding. Some cubs prefer to eat before elimination and some may not want to eat until afterwards. Even when cubs are able to eliminate on their own, it is useful to toilet them before weighing and feeding to attain accurate weights (see Section 1). Toileting before feeding also helps encourage cubs to nurse/eat. On the other hand, elimination after feeding helps keep cubs and their feeding area more sanitary during feeding. Toileting also helps keep living areas clean and reduces frequent house cleaning.

To toilet cubs: Cubs should be held over or placed on newspapers or paper towels. The handrearer's finger, dampened with warm water, or a clean wet soft cloth, soft paper towel, or piece of cotton moistened with warm water and placed over the handrearer's fingers, can be used to stimulate cubs. The area around/on the cub's anus and genital area [the area where urine is excreted] should be gently, lightly, and quickly rubbed. The stomach and lower abdomen can also be rubbed very lightly and gently with the fingers. (To help reach the anus/genitals, the cub's tail and lower body can be lifted slightly. As well cubs can be held by the scruff during toileting.) **Caution**: overzealous or improper stimulation could result in irritation or rash. Immediately after a toileting material, such as a paper towel or piece of cotton, becomes soiled (urinated or defecated on) it should be thrown away or in the case of a soft cloth, it must be washed before re-use. (Re-using soiled materials during toileting can cause irritation or other health problems.) Sometimes several paper towels or small cloths will be needed during each toileting. If the cub's urogenital area becomes irritated, warm running water can be placed over these areas (instead of cloths, paper towels etc.) to toilet cubs. "Ointments containing zinc oxide provide protection and waterproofing for the delicate tissues." (Read & Meier 1996).

Cubs must be cleaned and thoroughly dried after each feeding, toileting, elimination, and bathing/swimming session. (They can get very dirty with food during feeding, and feces and urine after elimination.) The cub's face, neck, paws, and body can be cleaned with warm clean water and damp clean cloths or paper towels. Clean towels can be used to thoroughly dry cubs off. Cleaning with a moist cloth or bathing in small tubs of water (only use for older cubs) also helps keep the cub's skin, toepads etc. from drying out and/or cracking (see Section 15).

Section 5
Formula Choices

Little detailed information exists on milk replacer formulas used for giant otters. Commercially prepared milk replacer formulas for carnivores, such as Esbilac™, are highly recommended to rear all river otter cubs. A

It is very important that giant otter milk composition be analyzed to determine which milk replacer formulas are best for this species. The specific composition of giant otter milk (i.e. percentages / types of fat, protein, lactose, etc.) is either unknown or unreported. The nutritional content of giant otter mother's milk needs to be studied for comparison to the variety of milk replacers available/used for this species. This information could then be used to formulate and/or recommend types or brands of milk replacers that are most optimal to rear giant otters specifically. [Note: Although, staff at Dortmund Zoo (Germany) have trained a giant otter to allow milk samples to be drawn after litter loss. Unfortunately, the only sample drawn was lost due to technical reasons, but further study and training will be continued. It is important that other captive females, world-wide, be trained to allow similar procedures (only after litter loss) to gather additional vital information for study and comparison. See Chapter 1.]

The research on formulas currently used for giant otters should be expanded and studied in more detail. For example, studies should be conducted to determine if the formulas currently used

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when no other better formula is available. Soy milk is not recommended for use with otters as it may lead to health problems.

Though not recommended, commercially prepared milk replacers for human babies or cow's milk have been/are used with success. A commercially prepared (powdered) human baby milk replacer was successfully used to rear two captive born 2 month old giant otter cubs at Hagenbecks Tierpark (Flügger pers comm. 2000). An approximately 2 month old orphaned wild giant otter cub was successfully reared on a human baby milk replacer formula (cod liver oil and a small amount of multivitamins were also added to the formula) in Columbia (Gomez, Jorgenson, & Valbuena 1999). (It is assumed that in both of these cases the formulas were mixed as instructed on the package.) CPPMA (Aquatic Mammal Research Center, Brazil) (Lazzarini 1998 pers. comm.) successfully rears/reared multiple ("many") orphaned wild giant otter cubs aged approximately 1.5 months old and older when received. The formula used consists of powdered integral milk (2 Tablespoons.), rice cream powder (called "Creme de Arroz Colombo" in Brazil) to thicken the formula (1 teaspoon), and 400 ml of water. After these ingredients are mixed, multivitamins (complex B) are added. The "powdered integral milk" referred to is powdered cow's milk used for human (adult) consumption. The formula is fed with a baby bottle used for newborn human babies. During weaning (usually begun at 3 or 4 months old), small amounts of very small minced fish (with bones and skin/scales removed) are offered with the formula milk just mentioned. As the cubs grow older, small smooth fish with no scales are given. When the cubs are able to eat fish with scales, the milk formula diet is no longer offered. Multiple wild born orphaned giant otters, aged approx. 1-2 months old and 2-3 months old, were successfully reared with whole powdered [cow's] milk (Rosas pers. comm. 2003). Additionally for the first feeding of the day, 1 ml of "Poliplex" (liquid vitamin complex) was added to the milk. Emperor Valley Zoo (Trinidad) (Zoo staff pers. comm., 1997) used warmed goat's milk to successfully rear a 4 month old (upon its arrival) giant otter cub. At Karanambu Ranch (Guyana), Diane McTurk, uses cow's milk and human baby milk formula to successfully rear multiple (many) orphaned wild giant otter cubs.

The following information has been contributed by Diane McTurk (Giant otter rehabilitator at Karanambu Ranch; pers. comm. 2003). "The initial problem is that the age of the cubs cannot be determined accurately because they are not born on site: they are brought to me as orphans, their eyes barely open, or as pets with which their owners can no longer cope (one over 6 months old). Cow's milk, diluted cow's milk, various human milk powders to an acceptable dilution with water or rehydration fluid (judged by scat consistency) is fed. In two cases of unknown illness, causing constant debilitating diarrhea, raw egg whipped together with rehydration fluid proved successful. Only 2 otters were raised on a milk replacer designed for otters – Zoologic [Milk Matrix 30:55^{TM}], a relatively recent gift from the Philadelphia zoological society – which was fed according to the instructions. In every case young cubs were fed with milk/replacer until they rejected it in favor of an exclusively fish diet – sometimes 2 to 3 weeks after accepting fish for the first time. Every day they were offered a strip of fish (usually piranha or peacock bass) in which they showed no interest until, suddenly, it was snatched voraciously." When the weaning process was started with cubs that were around approx. 2 ½ months old and older, those cubs were successfully reared (Duplaix/McTurk, pers. comm. 2004).

Additionally, concerning an effective milk replacer for giant otter cubs less than approx. one month old, either no information is reported or formula fairly tried and found successful. Following are the only cases known or reported where attempts were made to handrear giant otter cubs less than 2 weeks old and the only cases, other than the two reported by Diane

McTurk, where commercial brand milk replacer formulas for animals were used on cubs. Dortmund Zoo (Germany) reported using Esbilac™, Zoologic Milk Matrix 30:55™, or KMR™ (Kitten Milk Replacer) on captive born giant otter cubs of various ages. Esbilac or KMR was used on six cubs less than 2 weeks old and Milk Matrix 30:55 was used on 2 cubs that were 2 1/2 and 3 months old. No cub survived longer than 2 weeks during handrearing. Inherited thyroid malfunctions due to severe inbreeding were likely to have prevented the survival of all (13 litters/28 cubs) of the parent-reared and handreared cubs born at this zoo (Osmann & Wisser 2001). This was proven by necropsies (that revealed non-functioning or malfunctioning thyroid glands) and similar cub symptoms seen in all of the observed cubs during hand-rearing and parent-rearing. I.e. the cubs became severely underweight and physically underdeveloped at some point in time during parent-rearing or/and handrearing. These cubs, at various ages, became unable to process mother's and/or replacer milk and they starved to death. It is expected that this breeding pair at Dortmund will never reproduce successfully. In the case at Dortmund, the formulas used can not be considered fairly tried or tested (therefore this data was not used to draw references from). In addition, there was a report that at Hagenbeck Tierpark (Germany) "an attempt at hand-rearing and one of fostering to a domestic bitch also failed" (these captive born cubs were less than 2 weeks old and this occurred before 1990) (Hagenbeck and Wünnemann 1992). Concerning these Hagenbeck Tierpark cubs, no other information is available.

Information is still being sought to determine if other commercial brand formulas for animals have been used successfully and to find the ages of the cubs these formulas were used on.

Esbilac™ is highly recommended and commonly used to successfully handrear river otter species and otter cubs of all ages. It is a commercially prepared milk replacer formula developed for carnivore species and it is used by zoos, vet hospitals, wildlife rehabilitators etc.. When mixed as instructed on the package, it is successfully used to raise river otters (Cain-Stage 1992/93; Pet-Ag, representative, D. Hoffmann, pers. comm. 2000; Reed-Smith 1994-95). Esbilac, produced by Pet-Ag, Inc. (headquarters located at 261 Keyes Ave. Hampshire, Illinois, 60140, U.S.-Customer Service Department Phone #: 1-800-323-6878; mail@petag.com), is available worldwide. It can be purchased (in powdered or liquid form) at some vet hospitals or pet stores or can be ordered by telephone for international shipping. (See Section 7 for how to switch cubs from mother's milk or one milk replacer formula to another.)

Other commercially prepared milk replacer formulas for carnivores have been used alone and/or were mixed with Esbilac to successfully rear river otter species (most reports concern use for the species *Lutra/Lontra canadensis)*. Pet-Ag, Inc. also recommends Zoologic Milk Matrix 30:55™ for rearing river otter cub species (including giant otters). This formula, also produced by Pet-Ag, Inc., was developed for specific carnivore species, including river otters. Pet-Ag Inc. states its nutrient contents are even more closely similar to *Lutra/Lontra canadensis* than Esbilac's (i.e. its fat content is higher etc.). It also reports it has been used to rear river otters with success, although there was at least one report, where *Lutra/Lontra canadensis* otter cubs did not thrive on it, so they were switched to and successfully reared on Esbilac (Reed-Smith 1994-95). Powdered Zoologic Milk Matrix 30:55, when mixed at the recommended dilutions (1:1 or 1:2), has been found very difficult to mix (powder lumps are also difficult to remove) or/and feed through a bottle (it is very thick) (Pet-Ag representative, D. Hoffmann, pers. comm. 2000; Dortmund Zoo, pers. comm. 2000). Lactol™ (British counterpart to Esbilac) (Johnstone 1978), KMR™ (Kitten Milk Replacer) alone, or Multi-milk™ with Esbilac or KMR (Cain-Stage 1992/93 citing Evans 1986) have also been used. In some countries/locations these milk replacer brands may be difficult to attain or are unavailable. In these cases other commercially

prepared artificial milk replacers for carnivores or those for use with domestic dogs or cats may be an option (esp. those with ingredients more similar to Esbilac). Formulas should be prepared as instructed on the package.

Commercially prepared formulas for carnivores usually contain adequate amounts of vitamin, mineral, and oil supplements; although some otter handrearers may add these to commercial formulas. Sometimes supplements are also added (see above) when non-commercially prepared milk replacers (e.g. cow's milk etc.) or human baby formulas are used. Unfortunately, there are no known scientific studies on giant otters specifically, to indicate which and in what amount supplements are necessary, helpful, or even unhealthy, so great caution must be taken when using supplements. It could be possible that some cubs may be lactose intolerant and lactose found within some commercial formulas or in cow's milk may cause severe diarrhea, bloating, abdominal cramping, flatulence, and digestion problems. Although, it may be difficult to determine if it is the lactose alone in the formula or the entire formula itself that is causing problems (considering that proper handrearing techniques are used). Again, there are no scientific studies or reports known on this issue. The formula causing the problem should be modified (i.e. its dilution) or discontinued (i.e. no longer fed). If lactose is known to be the problem, a lactose free formula can be offered instead. Lact-aid™ (a commercially prepared dietary supplement sold for human use) may be added to milk formulas, as it may help cubs digest lactose. (Administrating antibiotics is not recommended, if the problem is only caused by lactose.) Sucrose, a sugar found in corn syrup, may also be a problem for mammalian neonates that do not possess the enzyme sucrase (Kirk 1994).

Section 6
Formula Preparation Techniques & Sanitation

For proper sanitation, only clean tap water that has been thoroughly boiled should be used to dilute/mix formulas/food. (Additional prepared water should be stored in the refrigerator for additional uses.) Very hot water dissolves powder formulas more easily and quickly than cold water. The powdered formula can be added to a pre-measured amount of hot water (rather than vice versa) for easier mixing. All diets/formulas should be made fresh daily and heated portions should not be reheated. Formulas should be mixed in a blender or by hand (e.g. by vigorously shaking a closed container/jar containing formula) and stored in the refrigerator until used. **Critical: all lumps/clumps of powder, regardless of their size (i.e. even powder clumps that are very small or tiny in size), must be removed from the formula after mixing and before feeding.** Clumps can be removed by pouring the liquid through a sieve / strainer (with tiny openings), cloth tea strainer, or cheese cloth. Severe health problems can result if even small lumps of powder are ingested (i.e. they can form indigestible balls in the stomach that may block intestines). When formulas are stored in the refrigerator the entire amount of formula should be mixed/shaken thoroughly, before individual servings are drawn from it (i.e. the heavier ingredients often coagulate at the bottom of storage containers).

Formulas should always be warmed to about blood heat temperature (i.e. to the cub's normal body temperature) before feeding. Microwaves should not be used to heat formulas, as this can destroy valuable nutrients. Individual servings can be warmed by filling the bottle, syringe, or bowl with formula and immersing it in a container of very hot water (container water must not enter the formula). The formula must not be made too hot, but rather sufficiently warmed

through. Temperature can be checked by placing a small amount on the handrearer's wrist. Too hot or too cold is not good (esp. for digestion) and the cub may refuse to eat it. Warmed formula should be offered to the cub as soon as possible (i.e. before it cools). To keep formulas warm during feeding, feeding apparatuses (e.g. bottles, syringes) filled with formula, can be placed in a container of warm/hot water. Water must be prevented from entering the feeding apparatus (e.g. cap syringe ends etc.).

It is very helpful to place labels on each container/jar of formula/food that state the formula's name/type, dilution (e.g. Esbilac at 1: 1, 75% water : 25% Esbilac, 100% electrolyte solution etc.), which animal the diet is for, and the date and time that the formula/food was first prepared. This will help to avoid confusion about the formula/food's content and if it is fresh or it needs to be thrown out because it was made longer than 24 hours ago.

All feeding apparatuses (e.g. bottles, nipples, syringes, dishes, tube-feeding tubes) and utensils, containers, blender parts etc. used to prepare formulas (e.g. sieve, blender blades, spoons, jars) must be cleaned thoroughly after **each** feeding and after **each** time the formula is prepared. Formula/food storage containers should be cleaned routinely as well. Small round long-handled brushes are needed to clean insides of tubes and bottle nipples etc., where milk can coagulate. (Even small milk deposits can support bacterial growth and hence cause contamination and health problems such as diarrhea.) Hot clean water and soap should be used to clean items and each item should be rinsed with clean hot water afterwards. Items should be left to air dry. All feeding apparatuses should be sterilized at least one time per day. Some items (e.g. glass tubes, rubber nipples, syringes) can be sterilized by boiling or disinfecting solutions can be used. Kitchen areas, counters, and all food preparation areas, storage containers, etc. should be kept clean. Using unclean feeding apparatuses, utensils, areas, etc. can cause cub sickness (i.e. diarrhea etc.).

Handrearers should always wash their hands before handling cubs or their food and feeding apparatuses. Also different clothing (i.e. clothing designated for cub care only) or cover clothing (e.g. lab coats, smocks) should be worn when handling cubs. Sick cubs should be isolated from healthy cubs. To avoid cross-contamination, handrearer clothing, feeding apparatuses, cleaning tools, bedding material etc. that are designated only for use with sick cubs, should be used. These items should be cleaned and disinfected separately from items used for healthy cubs.

Section 7
Switching from Mother's Milk to a Milk Replacer or One Milk Replacer to Another

Formulas should be introduced and adjusted or changed according to the cubs' needs and how well they tolerate and thrive on the formulas. Critical: slow gradual change-overs should always be made from mother's milk to substitute milk replacers (e.g. Esbilac™ etc.) and/or from one kind of milk replacer to another.

Quick diet/formula switches can cause many problems; most especially common is diarrhea and digestion failure, or rejection of the new diet (Kirk 1994). Only one dietary variable should be changed at a time, rather than several simultaneously (e.g. either formula concentration or addition of Lact-aid™, but not both), and changes should only be made in small increments to

avoid dietary problems and help cubs adjust to new changes more easily. This method is also important if dietary problems do exist, as in this way; their causes can be more effectively determined. Feces and urine should be monitored closely to determine how well the cub is adjusting to the new formula (see Section 3). For example, if the cub has diarrhea, the formula should immediately be made weaker (i.e. diluted with electrolyte solutions for general use or water). If although, the cub seems continually hungry or becomes weak because the formula is too dilute to supply enough energy, the formula can be strengthened (as long as no diarrhea or other negative responses occur), but the stool and cub reactions must be watched very closely. In some cases, introducing a new formula is necessary because the other has failed. In this case, the cub may not be thriving/gaining weight, has continued diarrhea, or is unable to digest or rejects the original formula. Changing formulas too often can also be harmful. If the cub thrives on and does well on a particular formula (gains appropriate weight, has good stool and health, etc.) that formula should be stayed with. Illness etc. and handrearing practices may also cause the aforementioned problems, so this too must be considered. When cubs can drink on their own, fresh clean water (e.g. in a bowl) must be offered in addition to formulas to help prevent dehydration.

"…a transition from 100% water to 100% formula should be gradual over a period of several feedings. This will allow for the infant [otter cub] to become used to the nipple or other feeding implement, thus minimizing the risk of fluid aspiration. It also will minimize the potential for diarrhea caused by a sudden dietary change." (Maslanka & Crissey 2001).

Before any new formula/food is introduced, water or 5% glucose in water should be given for at least the first feeding (i.e. no other foods or milk should be offered) (Read & Meier 1996). (Water must be boiled and cooled to blood heat before offering.) This will help cleanse the digestive system of original mother's milk/formula, let the digestive system rest, and re-hydrate the cub. This is also needed to make sure that the cub has a strong nursing/feeding response and that the cub will not aspirate because of the new feeding instruments it is not used to. Some inappropriate feeding tools can cause aspiration and this may lead to significant health problems or even death. When cubs are weak, dehydrated, sick/unhealthy, or when a cub has significant diarrhea (esp. from a failed formula), an electrolyte solution for general use can be offered as substitute for water or 5% glucose in water, to help provide extra energy and hydration. These electrolyte solutions can also be used to dilute new formulas during introductions when cubs are in the aforementioned unhealthy condition or if seemingly healthy cubs become weak during the introduction (i.e. dilution) of a new formula. (I.e. this will help provide cubs with extra energy etc.. See above about how to strengthen formulas accordingly when they are too dilute to supply the cub with sufficient energy during the introduction period.) See Section 2 and below.

A tea bag/tea bags that contains the herb, fennel (*Foeniculum Vulgare; Foeniculum Officinale*), can be immersed in the boiling water that will be used for preparing/mixing formulas (Osmann pers. comm.). The tea bag/s should be used in the same way as when making tea for human consumption (i.e. the bag/s should sit in the boiling water for a few minutes then be removed). This addition has proved very successful to help aid digestion and reduce/eliminate bloating, digestion problems, and the occurrence of abnormal stool (e.g. loose stools) during handrearing exotic animals, including giant otters. Hospitals in Germany also use fennel tea in a similar way to achieve the same results with human babies and this is reported to be very successful (Osmann pers. comm.). "Both the German Society for Nutrition and European Scientific Cooperative On Phytotherapy recommend fennel for newborn children…". "Especially newborn children, whose gastrointestinal tract is only activated after birth and who tend to

experience gas, cramps, and other gastrointestinal discomfort during the initial stages of learning to ingest food, fennel is the ideal medicinal herb." (Internet Website Source).

A new milk replacer should be gradually introduced, by diluting it with water, e.g. over a 2-day period or spread throughout at least several or more (depending on cub age and health) feedings. (See above about dilution with electrolyte solutions for general use.) At each successive feeding the formula should be increased in strength by a small amount (i.e. by reducing the amount of water mixed with it) until it reaches 100% of the strength that is recommended. Milk replacer package instructions will state the dilution that is necessary for full strength. Some cubs will require several feedings in just one 8-12 hour period and for some animals, total diet switch-overs that occur over this amount of time may be too fast and cause problems. When cubs are very young and/or they are fed many times per day and night, the formula introduction should be diluted over e.g. a two-day period. Although e.g., if a cub is very weak before the introduction of the new formula or if it becomes weak during the introduction (because the formula is too dilute) the formula can be strengthened more quickly according to how well the cub tolerates and thrives on the strengthened formula. The introduced formulas should be offered in the amounts and frequencies suggested in Section 8. **Caution: formula switches must be introduced and modified or changed according to the needs of the individual cub and how it tolerates and thrives on the new formula.**

For example, when switching from mother's milk to a replacer formula the following can be done. Tap water should be boiled and then cooled and stored in a closed container in the refrigerator for later use. (It is helpful to allow a fennel tea bag/bags to soak in the boiling water.) At five feeds per day, only water or 5% glucose in water, should be given at the first feed. For the following feed of the day, the full strength ratio recommended on the package instructions can be altered and then the formula can be prepared accordingly so that it is diluted the appropriate amount, for that particular feed. (In this way, formula portions for each feed have to be individually mixed and prepared throughout the day, and this can be time consuming.)

Another way of preparing and diluting the formula that is a little faster than the method above can be accomplished as follows. The amount of formula needed for a 24 hour period can be pre-made so that the formula is pre-mixed to the full-strength that package instructions recommend (see under Section 6 for formula preparation techniques). At five feeds per day, only water or 5% glucose in water, should be given at the first feed. Change-overs, although, can be made slowly, e.g. by combining the appropriate amount of water with the appropriate amount of pre-prepared formula needed, so that the 2nd feed of the day is composed of 75% water to 25% formula. (I.e. twenty-five % of the total amount of formula that is needed for the 2nd feed should be determined and then drawn from the amount prepared for the full day. The remainder of the formula to be fed should be composed of water (i.e. from the water already prepared). For the second feeding water should constitute 75% of the formula to be fed.) For each following feed the ratio amount of the formula (prepared for the day) can be increased by 10% until a complete 100% switch to the new formula is accomplished. By the end of day 1 of the switch, the new formula is offered at approx. 1/2 strength (i.e. 55% new formula and 45% water). By the end of day 2 of the switch, the new formula is offered at full strength (i.e. 100% new formula). (It is always helpful to have available a little more formula than is needed for each individual feed in case the otter should want more during that feed.)

To switch from one milk replacer formula to another, 10% new formula can be added to the old formula and it can be increased by 10% at every feed until a complete 100% switch to the new

formula is accomplished. When cubs have had negative reactions to an original formula (i.e. constant diarrhea, no weight gain, dehydration, weakness etc.), at least one feeding (or more until the cub is rehydrated) of an electrolyte solution for general use can be administered first. The change-over from the original formula to the new formula can be made by totally eliminating the original formula and diluting the new formula with water (or if necessary electrolyte solution for general use) instead. The same should then be done (as above) as if one is switching the cub from mother's milk to a milk replacer.

Section 8
Feeding Amounts and Frequency

The age, size, weight, and health of cubs helps determine how much and how frequently to feed. Formula should be fed in amounts and frequencies that ensure proper and steady growth and health, healthy stool condition and urine elimination, supply adequate energy, and do not exceed the cub's maximum comfortable stomach capacity (i.e. amounts comfortably tolerated).

A *general guideline* is that food/formula should be offered in the amount of 20% of the cub's body weight in a 24 hour period. Cubs may also need as much as 30% of their body weight in a 24 hour period. For example, if a cub weighs 2000 g (4.41 lbs.) (and is healthy), it can be offered 400ml of milk formula per 24 hours. As cub weight increases, the formula amounts should be increased accordingly. Caution: This percentage is only a general guideline for healthy cubs, not a fixed rule, as cubs will naturally vary somewhat in the percentage they eat daily and individually (see below). Another general guideline, "…A useful rule of thumb for mustelids as well as many other mammals is to feed till the stomach is full but not taut [tight or bloated] or over-extended." (Burnette 1994). A round belly is desirable, but overloading the stomach with food can cause the abdomen/stomach to become too fat and distended. Gastric overload can cause discomfort, vomiting, and digestive problems etc..

The total daily amount can be divided by the recommended number of feedings per day (see below) to determine the amount needed for each feeding. (It is always helpful although to prepare a little more formula than is needed for each individual feed in case the otter should want more during that feed.) Otters have a naturally high/fast metabolism. With their mother, very young giant otter cubs nurse (small amounts of milk) frequently throughout every hour (Sykes-Gatz, pers. observation). **It is highly recommended to feed more often and in smaller amounts, so formula is digested more easily and in a more natural manner. This helps to avoid the common health problems (esp. diarrhea) that usually occur when incorrect feeding techniques are used** (Kirk 1994). Importantly as well, one can tell how the formula affects the otter more easily and quickly when smaller portions are fed. Hence, when needed, smaller changes rather than larger changes, which may exaggerate problems if the change is inappropriate, can be made.

Both over-feeding and under-feeding can cause health problems. "…It should be noted that the concept that an infant will correctly control its own intake if milk is offered ad lib has been proven incorrect by numerous reports of diarrhea, vomiting, listlessness, potbellies, labored breathing, anorexia, and death (Robbins 1993). Thus ad lib feeding is discouraged. **It is best to establish moderate guidelines at the start of the hand-rearing period and adjust them based on consumption and observed growth**." (Maslanka and Crissey 2000). Unhealthy,

weak, underdeveloped cubs, or cubs introduced to a new formula or that are new to nursing

suggested above. The same feeding frequency instructions as above should be used for cubs that are newborn, very young, sick weak cubs (at older ages), and healthy young cubs that are at least 2 weeks or older. Older healthy cubs, 2 months and older, should be fed a minimum of every 3 hours throughout the day and evening (7 a.m. to 10 p.m.) or 6 feeds throughout the day and evening. In addition, they should also be given at least one overnight feeding (or even 8 feeds/24 hours for extra caution) when switched to new milk replacers.

Section 9
Feeding Apparatuses, Feeding Problems (Aspiration) & Emergencies

Baby bottles for human babies and premature human babies, pet nursing bottles, glass tube (syringe like) feeders with rubber nipples placed on one end and rubber covers at the other end, doll bottles, and bowls/dishes all have been used for feeding. Plastic eye droppers, plastic syringes, or teaspoons can also be used if necessary. Grocery and drug stores, pet stores, pharmacies, or vet hospitals can be checked for variety.

A feeding apparatus that fits the cub's mouth size and shape, appetite, ability, and preference must be offered. Only specific types of feeding apparatuses can be used, as the cub will be limited by the aforementioned factors to use others. In addition, cubs often have distinct preferences for specific (esp. nipple) types. Different types, shapes, sizes, and thickness/stiffness (esp. for nipples) should be tried to find the one that is accepted best. Handrearers should be flexible with the variety initially offered; one should eventually work. Bottles (esp. plastic and semi-flexible) and glass tube feeders with rubber nipples work well because of the wide size range of nipples, bottle, and rubber cover types to choose from. Problems with the nipple could include its stiffness and thickness, size, or/and its shape. For example, it can be too hard to squeeze and suck on or too soft and easily collapsible to allow milk flow, or too big, small, long, or short for the mouth, or it can be too wide or thin to close the mouth around. Inappropriate nipple hole sizes can also cause significant health problems. If the hole is too big, formula can come out too fast [see below] or if it is too small, the formula cannot be sucked out or the cub may tire too easily and refuse to eat. Holes in nipples can be made or enlarged with a red hot needle. Different needle sizes can be used to create different hole sizes. (I.e. the upper part of a needle can be held with a pair of tweezers/plyers and the lower part of the needle can be placed in a flame, such as that from a lighter, until it becomes red hot.) The needle should be passed back and forth through the center of the nipple until a hole is created.) Feeding implements that have glass ends where the cub is supposed to suck/nurse on, should be avoided (i.e. glass may break or cubs may hurt their mouths or teeth on it).

Young otters must breath through their nose when suckling on a nipple. **If milk comes out of the bottle nipple too fast (e.g. when nipple holes are too large), or if formula is fed too fast, liquid can be inhaled into the nose and lungs.** As well, if liquid drugs are administered faster than cubs can swallow or if cubs nurse too aggressively and rapidly (esp. when very hungry), the same problem can occur. **The aforementioned problem is evident when milk/liquid comes out of the cub's mouth, the cub is gagging (i.e. seems to be choking), and it is especially critical when milk/liquid comes from the cub's nose. Serious health problems, respiratory infections** (i.e. pneumonia can be deadly), choking, and death can result when liquids are aspirated. Respiratory infections, in turn make it difficult for cubs to nurse, and vet care and antibiotics are needed. **It is critical to prevent situations that cause aspiration by**

using great caution when feeding or administering liquid medications. For example, appropriate nipple hole sizes and slower feeding techniques must be used to prevent problems from occurring.

If significant amounts of milk or other liquids are coming out of the cub's nose, the cub is choking on something (in the trachea or throat), or the cub has collapsed from choking the following can be done. "*If the neonate does appear to inhale formula, an immediate response may minimize the damage. The young animal should be placed in ventral recumbency in the palm of the caretaker's hand. The animal's head should be supported by the caretaker's fingers and its body should be supported by the wrist and forearm. The caretaker's other hand should be placed over the neonate's back and head. The neonate should then be swung forcibly downward several times; this action is followed by three to four gentle ... [taps] on the back. If foreign material is actually obstructing the airway, abdominal thrusts should be used as well."* (Meier 1986). When cubs are too large for this method, securely holding the cub by its hind legs and tail (in one hand) and then turning the cub upside down (so the cub's head is pointed downward towards the ground) may help liquid drain out of its nose. These procedures can then be followed by gently tapping/patting on the cub's back/along the upper body (when its upside down) a few times to help eliminate milk or food. Another technique can also be used as follows. The same procedure just mentioned can be followed (i.e. turn the cub upside down). The body of the handrearer can then be turned around in continued fast tight circles while holding her/his arm with the cub out to the side so the cub swings somewhat outwards and downwards (Osmann, pers. comm. 2000). The cub's nose should be checked to see if liquids have been expelled. The cub's throat should be observed to see if something lodged there might be causing choking. These items may be able to be removed with tweezers (with dull tips), a cotton Q-tip, or by the suction of a syringe or rubber ear bulb (try techniques above as well). Small syringes and rubber ear bulbs might also be of use to help remove liquids from the nose. If the cub has stopped breathing, "mouth to nose" resuscitations can be carried out by holding the cub's mouth shut and gently blowing into its nose. Medical care should be immediately sought after serious emergencies and antibiotics may be needed if cubs develop an infection from inhaled formulas/foods.

Section 10
Feeding Techniques, Encouragement & Problems

Rather than forcing them, handrearers must adjust their routine, formulas, and handrearing techniques to fit the cub's particular needs, abilities, preferences, and tolerances. Cubs may refuse to nurse / eat from artificial feeding apparatuses (i.e. bottles, syringes, bowls etc.) or refuse to consume milk replacers because these new situations are foreign to them. Refusal could also occur if animals are sick or inappropriate formulas, feeding methods, apparatuses, or handrearing practices are used. If normal amounts are consumed on one feeding, and all food is refused in the following feeding, this could indicate the cub is not feeling well. If two feedings are refused, the cub could be very sick. Slow declines rather than slow increases in food consumption indicate problems. Solutions must be found for these problems immediately, rather than trying to force eating in unhealthy circumstances.

Great patience, gentle encouragement, and persistence should be used to encourage and teach cubs how to nurse from artificial feeding implements. Getting the cub to nurse

successfully can often be difficult and often it is not accomplished in one feeding or even several feedings (e.g. it could take a few or more days for a cub to become a consistently good nurser). Sometimes cubs may nurse well for one feeding, but not be able to nurse successfully for several feedings to follow.

For easier adjustment and to determine what the cub is reacting to, one variable should be changed at a time. Once successful feeding techniques and formulas are found, handrearers should be consistent with them, as changes could cause problems. Sometimes, even after appropriate options and adjustments have been tried and cubs are healthy; cubs may still refuse food. Handrearers must therefore, with great patience, firmly but **gently** and persistently encourage feeding. A firm attitude must be conveyed to the cub that the handrearer will not give up until it eats. In some cases, animals given the appropriate formulas etc., may eat significantly less each successive feeding if a handrearer lets them. This trend may continue if the caretaker stops trying to feed the appropriate amount, because cubs refuse it. On the other hand, if otters eat the full amount in one feeding--they will be more likely to eat well on the next feeding.

Slow, gentle, and deliberate movements should always be made around cubs (especially those newly arrived). Otters should be positively reinforced when they start and after they are finished eating, as sometimes food alone is not reward enough. Gentle touches, petting, words, vocalizations, and voice tones that are encouraging, rewarding, and praising should be used. This can also encourage hesitant cubs to feed. Of course, because cubs do not understand words, it is more the handrearers voice sound/tone that is important. If the handrearer is familiar with positive giant otter vocalizations, they can be replicated. For example, gentle soft humming can be imitated for encouragement or reward. Caution, a low sounding hum can mean an angry vocalization, as slight sound variations can mean something totally different. Giant otter cubs, during nursing (from the first day of birth) make a *"1(a)-0.9006are fou8Tplay "tail wagging"* when suckling (both from the motherre d the handrearer's bottle). This 006 is a somewhat higherrpitched e fofaster vocalization than the contact 006 (described in Duplaix 1980). It is also unlike the contact 006 in that it has a twittering quality to it and it is only performed when the cub is actually suckling. When this 006 is replicated by the handrearer, it can also encourage cubs to feed. The cubs also u8Tplayed "tail wagging" when they nursed (from the first day of birth) from the motherrend nursed from the handrearer's bottle. The cubs wagged their tails, rather quickly and repeatedly, from side to side (i.e. horizontally, but not vertically/upre fouown), when they suckled. The tip of the tail can also be kept raised upwards while wagging. Note: sometimes when the cub might be anxious to nurse or immediately preparing for 1(a)-0.9it 6ight wag9its tail. This is anotherrgood indicator to determine when the cub is hungry. This behavior is different from "tail waving" that is described by Duplaix (1980), in that it is performed during nursing only (except during the situations mentioned above) from the first day of birthre fothe tail only moves horizontally in direction. (The "1(a)-0.9006sare fo"tail wagging" behaviors are not known to have been described before in literaturere fothe descriptions e foterms in quotes are originally made by Sykes-Gatz (pers. obs., unpublished reports 1999-2002). See a full description of these behaviors in Chapter 3.)

Usually cubs will adjust to scheduled feeding times e foexpect food arou fothose times. Although, before schedules are adjusted to,re nd sometimes even after adjustment, gentle encouragement may be needed to stimulate feeding. For example, if the cub is sleeping, arouse it gently withrsoft vocalizations e fogentle t ouches / petting. Just picking the cub uprfrom a deep sleep e fopushing a bottle in its face w ill not do much to promote nursing e foit is inconsiderate.

To encourage a feeding response when cubs are not interested in eating, new to nursing from artificial apparatuses, or are sick or weak, the following techniques, as well as those in the paragraph above, can be used. The area around the cub's lips, face, throat, or anus can be stimulated by gently rubbing fingertips or a warm damp cloth on these regions. Light energetic, but gentle rubs / massage should be used. The cub's tongue can also be lightly stimulated with the caretaker's fingertip. Toileting and encouraging the animal to move about also stimulates feeding. Cubs should be gently and slowly introduced to artificial nipples or/and encouraged to nurse by the carrying out the following. The cub should be allowed to suck on the feeders finger/fingers first, then the caretaker's fingers should be associated with the bottle nipple. Moistening nipples and fingers with warmed formula will entice cubs to suck on them. After putting the nipple in the cub's mouth, its mouth should be very gently closed around the nipple. The bottle should be lightly squeezed so that a drop or two of formula (i.e. only drops to prevent aspiration) comes out. Gently moving the nipple in the mouth or in and out may also help. The caretaker should observe, listen, then feel with his/her fingers (i.e. under the cub's throat, chin, etc.) to determine when the cub has swallowed. Young or weak cubs will often fall asleep when nursing, these cubs should be gently woken up so that they can continue nursing. (Cubs normally fall asleep on the mother's teat.)

Even when cubs are healthy and proper handrearing techniques/formulas are used; cubs may still refuse to eat. In cases where cubs absolutely refuse to open their mouths, handrearers can gently pry cubs' mouths open by the following technique. A thumb and forefinger can be placed on either side of the cub's mouth/lips, and these fingers should be positioned behind the cub's canine teeth where there is a gap between its teeth. The caretakers fingers should be gently squeezed inwards towards the mouth, until the mouth opens. Once the mouth is opened, bottle nipples can be inserted. Nipples must be positioned at the front of the mouth and a milk *drop/or a few drops* should be expressed to the nipple hole to encourage suckling. Sometimes the handrearer must continue to lightly hold the cub's mouth closed around the nipple when it feeds, until it learns to suckle. In worst cases, the caretaker can even use his/her fingers or spoons to feed cubs (i.e. drop by drop) if necessary, until the cub learns to nurse. If older cubs refuse to nurse from a bottle, milk formula can be tried in a small dish instead. See techniques under Section 12 to encourage cubs to eat from a dish.

Handrearers must hold cubs in the proper position when feeding them. Cubs should be held on the caretaker's lap or other solid surface in a ventral recumbent position (on the stomach lying down) with its head held up. **Cubs should not be fed when they are on their back**. Cubs like to push their front feet/paws on a surface while feeding, so the caretaker's hand / bottle should be positioned so that the cub can push off these surfaces when feeding. The caretaker's forearm should be positioned along the cub's side to prevent it from rolling off the feeding surface and that hand can be used to hold the cub's head up (Green, unpublished report). The caretaker's elbow can also be pressed against his/her hip to prevent the cub from falling off the surface/lap backwards. (E.g. to support the head, the thumb can be placed on top of the head and three fingers can be placed on the chest and the forefinger can be placed under the throat The cub can be felt swallowing this way as well.) The other hand should be used to control the feeding apparatus. Experienced healthy cubs can usually suck ample amounts without the handrearer squeezing a bottle. But with sick, weak, inexperienced, or very young cubs the feeder may have to apply a very light little pressure to the plastic bottle, so a drop of formula is at the tip of the nipple, to help entice nursing**.** If plastic syringes or plastic eyedroppers are used, the formula should not be squeezed directly into the cub's mouth. Instead, a small milk **drop** should be squeezed to the end of the dropper/syringe and placed on the cub's lips. The cub

should then be allowed to lick the formula drop by drop from the dropper/syringe tip. **Caution**: **inappropriate feeding apparatuses (as well as techniques) can cause failure to nurse successfully or/and health hazards** (see Section 9).

Critical: cubs must be fed slowly and in small amounts and handrearer's should never overfill the cub's mouth. If formula comes out of the mouth or nose, or gagging is heard or seen, feeding must be stopped immediately, and emergency care techniques may need to be used (See Section 9 to help prevent serious health problems.) The problem causing overfilling of the mouth must be corrected before resuming feeding. See Section 8 on not over feeding (i.e. round but not taught bellies). When bottles / feeding apparatuses become empty, cubs should not be allowed to nurse. Discomfort and hiccoughs can occur when cubs suck air into their stomachs. Clean towels should be placed underneath and even around the cub during feeding to help keep cubs warm and secure feeling, as well as clean. When young or sick cubs are removed from their incubator or holding container they should be placed on a hotwater bottle wrapped in a towel to keep them warm during feeding. Place towels lightly over the cub's body to also help keep them warm. Formula must be cleaned off cubs (with a warm damp cloth) and cubs must also be dried after feeding. Because cubs usually want to sleep or maybe even play just after feeding, cleaning cub housing before feeding is helpful.

Section 11
Techniques to Administer Oral Medications / Nutritional Supplements

Some liquids, tablets (that are crushed), or capsules (that are opened) for medication or nutritional supplement can be diluted with milk formulas for administration. (Veterinarian approval must first be given, as some medications may not be effective if they are administered this way.) If milk formulas are used the medication should be placed in a small amount of formula that can be fed first and before the remaining formula is fed. This is to ensure that the medications will be consumed. When dispensing apparatuses (i.e. plastic syringes, plastic eye-droppers, etc.) are used to administer medications that cubs most likely will refuse (i.e. it tastes bad), the cub's mouth should be very gently opened and a **small** (i.e. drop or drops) amount of fluid/paste should be squeezed onto the top of the cub' tongue. The feeding apparatus should then be immediately removed from the cub's mouth and the cub's mouth should be gently closed and held closed until the cub swallows. Stroking the cub under its throat or around its face or lips may help stimulate swallowing. With older bigger cubs, if tablets and capsules are small enough, they might be able to be administered as follows. After the cub's mouth is gently opened, the caretakers fingers can be used to place the medication at the back of the cub's mouth and on top of its tongue. The cub's mouth should then be gently closed and held closed until the cub swallows. Medications, vitamin and mineral supplements (e.g. crushed / whole tablets, liquids, paste) can also be hidden in / mixed with foods (e.g. formulas, yogurt, fish, etc.) to disguise their taste and presence for easier administration. Great caution must be taken to prevent choking and aspiration when giving medications orally (i.e. the same cautions used when feeding).

Section 12
Weaning & Feeding Techniques for Weaning

The **gradual** change-over from feeding milk replacers to feeding a total fish diet is called "weaning". More research needs to be conducted to determine the most optimal age to start a slow gradual weaning process. **The information available indicates that a giant otter cub should be around at least 2 ½ to 4 months old when fish is first introduced into its diet and the weaning process is begun. The age at which each cub will first accept fish will vary from individual to individual, although it seems that milk formula should be given to fulfill 100% of the giant otter cub's nutritional needs until it reaches around at least 2 ½ months of age**. Not fulfilling 100% of the cub's nutritional needs with a milk formula before this age may cause health problems. As well, waiting too long to begin the weaning process may also cause problems. When the weaning process was started with cubs that were around approximately 2 ½ and 3 or 4 months old, those cubs were successfully reared (See Section 5). Many wild-born orphaned cubs reared at the institutions that used this method have been successfully reared (Lazzarini 1998 pers. comm.; McTurk/Duplaix pers. comm. 2004). Note: the ages of the wild-born animals were estimated. At Hagenbecks Tierpark (Germany) giant otter cubs, at approximately 8 weeks old, mouthed and played with fish that the mother brought to them; although they only first started swallowing solid fish at 70 days of age (10 weeks old) (Hagenbeck and Wünnemann 1992). Later reports explain that two cubs, that were captive-born and handreared at Hagenbecks, ingested solid food at 3 months old, although it was found that they could not digest the fish properly when they were this age. "The feces contained a lot of undigested fat and protein and the enzyme level of chymotrypsin was much lower than in adult animals" (Wünnemann 1995[b]). Wünnemann 1995 further reports, "At 70 days, the [giant otter] cubs will start to swallow solid food, although they start playing with it a long time before this time. However, they are dependent on their mother for at least four months [i.e. the first 4 months of the cubs' life] and will continue suckling up to the age of seven months". The cubs continued nursing mother's milk when they were around 6 1/2 months old, although only insignificant amounts were obtained and it provided little nutritional value. The weaning process can occur over a varying time period until the cubs choose to reject the milk formula (Duplaix/McTurk & Wünnemann pers. comms. 2004). Cubs may choose to reject milk formula from one, a couple, a few, or even several months after accepting fish within their diet for the first time (pers. comms. of the handrearers listed within this manual). Sometimes they may also reject milk formula from 2 to 3 weeks after they start to eat fish within their diet. **Caution must be taken although, as the offering of milk formula should not be eliminated or reduced in amount too soon or problems may result**.

Reports indicate that giant otters do not require milk to meet their basic nutritional needs when they are at the age of around 6 ½ months and older (note: this does not mean that their needs can not be met at an earlier age; see the paragraph above). At one institution, some handreared otters although have been reported to drink some supplemental milk formula (i.e. in addition to their fish diet), even up to 10 months of age and they were reported to be successfully reared (Duplaix/McTurk, pers. comm. 2004). Handrearers should although take care that otters wean themselves fully of all milk formula within a reasonable time period. It seems that by at least 6 ½ months of age, and up to an age that does not exceed approx. 10 months [based on the outcome of the handreared otters just mentioned above], the cub should be eating a total fish diet and should no longer be drinking any milk formula (Duplaix/McTurk & Wünnemann pers. comms. 2004). (Scientific research on the meeting of nutritional needs of handreared giant otters at various ages should be conducted to establish scientific guidelines for the weaning process.)

The general guideline that food/formula should be offered in the amount of approximately 20% of the cub's body weight in a 24 period remains the same during weaning. (I.e. as cub weight increases, the amount of food offered should be increased). Some healthy cubs, although, may require up to 30% of their body weight in a 24 hour period. This total amount should be divided by the number of feedings per day (see Section 8 for feeding schedules during weaning). Cubs must learn to drink plain water (i.e. in addition to their normal milk formulas) at least during early weaning and preferably just before weaning begins. To introduce water, a small amount of milk formula should be added to the water to make it taste familiar and eventually the milk should be reduced until the water is plain. **Free-choice clean drinking water must always be provided during early weaning and onward. This is especially critical when milk formulas are mixed with fish,** as they will not provide enough fluids/water necessary for cubs (especially as fish ratios are increased). **Cubs must be monitored to determine if they are drinking enough water to maintain good hydration.** If they are not, water should be hand-feed until the otters drink enough on their own. Bottle feeding, teaspoons/tablespoons and large plastic syringes (esp. when formulas thicken), can be used until cubs learn to eat and drink from bowls. Feeding and water bowls/dishes, such as small heavy ceramic bowls, that cannot be tipped over or be destroyed (e.g. chewed apart) should be offered. Cubs must be cleaned and dried after feeding, as they can get very dirty when eating (see Section 15).

See Chapter 2 Section 19 for information on fish diets, vitamins etc. that are necessary during weaning. Unused fish and formulas must be kept refrigerated and they must not be used more than one day. Formulas should be made fresh daily and heated portions should not be reheated.

The goal of weaning is to *gradually (i.e. slowly)* reduce milk formula amounts as fish amount and fish texture (size of fish pieces etc.) is increased. Ample amounts of milk replacer must still be offered during early weaning. If the fish ratio is increased too quickly, it may result in health problems. Weaning should be started by gradually adding very small amounts of mashed minced fish filet to the cub's milk formula (Burnette 1994). Caretakers should filet the fish (remove bones, scales and skin) and dice/mince/cut the fish into very small fine pieces. The minced fish can then be added to the normal strength milk replacer formula and a pulverized blended mash can be made from it (using a blender at high speed helps). It initially can be served in a bottle, but then eventually a plate, bowl, or dish will be needed as the formula thickens. This diet should be warmed before it is served (See Section 6). The percentage/ratio of fish (in the fish to milk formula ratio) and the size (texture) of the fish pieces should be gradually increased over the weeks. This should be done according to the otter's acceptance and abilities to digest the food in a healthy manner with healthy stool. Each individual will vary somewhat in its acceptance. For example, weaning can be started by adding approximately 10% fish to the cub's milk replacer. (I.e. the same milk formula strength/dilution as has been offered should be continued and total diet amounts should be offered as recommended). *Free-choice drinking water must always be available and cubs must be monitored to determine if they are drinking enough water for proper hydration.* The fish ratio should be increased gradually so the diet thickens to a porridge or gruel like texture (Burnette 1994). S*ome* (i.e. a small amount) additional 100% milk formula can be made available in another bowl as the milk formula fish mash increases in thickness as the change-over progresses. See also at the bottom of the following paragraph another successful technique that can be used to first introduce fish into the giant otter cub's diet.

As tolerated and later on (i.e. when the mash is accepted and digested well and cubs start chewing more), small pieces of fish filet can be mixed in the milk formula fish mash. "As

weaning continues, larger pieces of adult diet are added while less formula gruel is provided until, eventually, an adult diet is reached." (Burnette 1994). Gradually larger pieces of cut fish filet or/and entire very small (tiny) fish, in addition to *some* (i.e. a small amount) straight milk formula in a separate bowl, can be offered. This milk is supplement for the small amount of mother's milk that cubs have been reported to nurse as they are weaning during the later stages. (Of course, free-choice drinking water must always be available). Removing fish bones, scales and skin in the beginning is helpful/necessary, but later and progressively small bones/some skin should be left on the fish and additions should be increased from there. Next, small whole fish and eventually larger whole fish should be offered in addition to a little amount of straight milk formula in a separate bowl. The small amounts of milk replacer offered should be slowly reduced and at some point the otter should also no longer take interest in and reject the milk formula (see above). If the animal is still drinking supplemental milk formula for an unreasonable amount of time, it can be gently weaned off of the milk. This can be done by diluting the milk formula with increasing amounts of water (i.e. until only water exists) to help reduce the otter's interest in the milk or by simply offering progressively less formula until it is no longer offered. Some giant otter cubs prefer to eat small pieces of fish or very small fish when it is offered separately from their milk formula and fish is first introduced into their diet, i.e. they may reject the fish mash when it is prepared and first introduced as aforementioned in the paragraph above (Duplaix relaying information from McTurk, pers. comm.). It is important that cub preferences are accommodated. The method (i.e. first offering fish mash or small pieces of fish) that is readily accepted or preferred by the cub should be used provided the cub remains healthy and it thrives when that method is used. Note: milk formula must still be offered for a gradual change over during weaning and not be eliminated or reduced in amount too soon or problems could result.

The process of weaning cubs can be difficult. Great patience, gentle encouragement, and persistence should be used to encourage cubs to eat fish or the new unfamiliar tasting milk formula fish mash. The same great patience is needed to switch the otter from sucking on the bottle nipple to eating from a bowl or dish. In the early weaning stages, when formula is not too thick, the feeding apparatuses that had been used previously (e.g. bottles) can be used to **slowly** feed the initial milk formula fish mash. Large plastic syringes might be helpful for a time as formulas thicken. Although, bowls or dishes must be used eventually as the formula becomes too thick to go through a small opening.

Bowls can be introduced by putting the otter's milk formula fish mash in the bowl and presenting the bowl to the cub. The bowl can be brought up to the cub's face. The handrearer can either put his/her finger, a bottle nipple (or another familiar feeding implement), or even a small spoon (esp. if the cub is familiar with it) in the bowl and dip it into the food. Then the finger, nipple, or spoon can be placed next to, or if necessary on and **very gently** in the otter's mouth, so the cub can taste and lick the food. (The cub's mouth should never be pried open with feeding implements; instead a handrearer should gently open the cub's mouth with their fingers.) This process should be repeated bringing the bowl closer to the otter's mouth each time until the cub licks from the bowl rather than the nipple, finger, or spoon. This way a connection is being made between the formula coming from the familiar nipple or hand and the formula coming from the bowl. This is a gentle way of doing it, as the otter's face must *never* be forced into the bowl. Sometimes many attempts have to be made with this method, before the cub responds appropriately. Great patience and persistence should be used, before giving up. Eventually, if the cub does not start to eat from the bowl (i.e. for more difficult transitions), the bowl should be brought up to the cub's face and it's muzzle (i.e. not face or nose) should be

very gently dipped in the bowl into the food. The formula must never be allowed to enter the cub's nose (i.e. to prevent inhalation). See Section 9 for more feeding techniques and cautions.

Section 13
Housing Cubs

When housing is chosen for an otter the age, size, health, and physical and behavioral/mental developmental level / abilities as well as the physical, psychological, and social needs of the animal must be considered. Cub housing must be completely safe, escape proof, and isolated from all other animals except for of *healthy* siblings and *healthy* giant otter cubs *near* the same age. (See introduction of unfamiliar cubs in Chapter 2.) These animals must be kept out of the draft, wind, cold, excessive heat, damp, wet, and soiled conditions and they must also be maintained at proper ambient temperatures. Supplemental heating sources, either within or next to the housing, are needed for some cubs depending on their age, health etc. (see Section 14 below). The cub's housing container must also provide privacy and materials to keep the animal dry, clean, and comfortable (mental as well as physical comfort must be considered). Cubs, their housing and its contents, and all other items used for cub care, must be kept clean and in areas isolated from sick or diseased animals or contaminated items (i.e. dirty cleaning tools, feeding apparatuses, bedding etc.). "Exotic animals appear to be more susceptible to stress-related problems than their domestic counterparts." (Read & Meier 1996). Acoustical and visual disturbances and stressful intrusions (i.e. unfamiliar people, excessive human presence or activities etc.) must be limited to a minimum around cubs and their housing area. When cubs can be held in small rooms/enclosures these areas must also provide the recommended enclosure land and floor substrates, deep digging areas, other natural furnishings, and land to water area ratios with at least the minimum size land area ratio percentage required and the wading/swimming areas designed with safety and swimming abilities in mind. Nestboxes, plentiful enrichment, bowls for drinking water and sometimes food bowls, as well as a sufficient size enclosure is also needed. (See below for the housing furnishings and designs necessary for both very young and older cubs.)

Pets, stray pets, farm, feral, wild (e.g. rodents, raccoons, foxes, etc.), and zoo animals can transmit diseases and parasites to cubs. Otters are susceptible to contracting distemper, parvovirus, leptospirosis, rabies, parasites etc.. Where these problems exist and are especially prevalent (e.g. in South America), for complete safety younger cubs could be reared indoors and be isolated from all animals (except for as stated in the paragraph above) and infectious contaminants (see above). Younger, less strong, or less healthy cubs may be especially vulnerable to diseases, parasites, etc. If vaccinations for disease protection are administered, cubs could be housed inside until at least the full series of vaccination injections are completed. If some vaccinations are not an option (i.e. are unavailable or considered too risky) and otters are reared in an area where they could be at risk to contract diseases, keeping cubs indoors until they are older could help to provide some extra safety. See Chapter 1 for information on diseases and vaccinations.

Cubs must not be able to climb or fall out of, escape from, or get injured, caught, or trapped in their housing or within the contents of their housing (i.e. bedding, towels, blankets etc.). Young, sick, and weak cubs should be kept in incubators or if they are unavailable, in secure boxes/containers (e.g. strong cardboard box, plastic box or tub, glass/plexi-glass aquarium etc.)

equipped with heating sources. (Containers, other than incubators, must have the top side open for adequate ventilation, although they can be partly covered with cloths to maintain proper temperatures; see below.) In order to keep cubs warm and at adequate housing temperatures, heating sources (i.e. heating pads, heat lamps, hot water bottles, radiators etc.) must be provided for some otters. See Section 14 below for which cubs need additional heat sources. It is helpful when young cubs (esp. with those with their eyes still closed) can be offered housing or at least sleeping areas that can be kept dark or at least dim. The housing containers should be placed in areas that can be kept private and quiet (i.e. free from human disturbances and human activities not related to those necessary for cub care etc.).

The container/housing bottom should be lined with *soft non-stringy and tightly woven absorbent cloth materials* (e.g. towels, baby blankets etc.) that cubs can not be caught inside of or on. These materials must have no hanging strings or fringes, holes, loops, loose weaves, sleeves, pockets etc. where cubs could get their toes, claws, head, neck or any other body part caught in and they should have no buttons, snaps etc. that could be ingested. Such materials will help keep the otter warm, dry, secure, clean, and comfortable feeling and will help to absorb urine. Newspapers (i.e. with black and white print only and no colors) can be placed under the lining of soft cloths for extra absorption and warmth. *Part* (e.g. half) of the container can be covered with a cloth (that the cub cannot reach) to help heat stay within the container while also letting excess heat escape. This material must be breathable to allow adequate air circulation and ventilation in the housing.

The following can be offered to cubs: a rolled towel, safe stuffed cloth toy (remove buttons, imitation eyes, etc.), a wool sock filled with cloth or crumpled newspapers and knotted shut at the opening, and a safe wind-up ticking clock placed outside the housing or wrapped in a towel and put inside the container. A partially filled (i.e. with warm/not too hot water) rubber hot water bottle can also be placed under the material lining the container's bottom (e.g. a towel) or wrapped in a towel so the cub can lie next to it. Hot water bottle covers (i.e. cloth/plastic covers) should be removed to prevent cub entrapment and overheating/suffocation during entrapment. Items/strings attaching bottle caps to bottles should be removed as well. The aforementioned items will help to somewhat replicate the presence of another otter and provide some mental comfort. See Section 16 below for companion cubs and necessary human interactions to provide additional comfort.

Soiled, damp, and wet cloth bedding and newspapers must be changed to help keep cubs clean, dry, and healthy. Toileting cubs before and/or after feeding reduces the frequency that bedding must be changed. Having a secondary secure warm area to contain the animal while cleaning its housing is helpful.

> *"Exotic animals, especially carnivores, should be exposed in a nonthreatening way to as many features of their adult environment and social situation as possible at an early age. The critical periods offer unique, irretrievable behavioral windows. For example, if an animal will spend time in the water as an adult, it should be exposed to water at a young age. If otters are not exposed to water during the first several months of life, they may be frightened of it as adults." (Read & Meier 1996).*

Even when somewhat larger housing containers/housing are offered to accommodate young growing cubs (i.e. animals that are no longer infants), otters will additionally need safe areas/rooms where they can move about, exercise, groom, dig, play, wade/swim (when old

enough), and explore while under supervision. To promote healthy mental, behavioral, and physical development and skills, stimulating enriched areas designed to fit the animals' natural abilities, age, and health must be provided. See below for the substrates and furnishings necessary for these areas. When cubs grow out of large housing containers (e.g. when they are around 2 1/2 to 3 months old) and are healthy, they can be housed in safe secure warm small indoor rooms or in areas that are enclosed within a room. The rooms/enclosures must provide lighting, adequate ventilation and proper humidity and temperature regulation. In addition, these rooms/enclosures require enough space and the recommended enclosure furnishings and designs found in this chapter and in Chapter 2 to allow for healthy development and a suitable area for the aforementioned activities to be carried out. Chapter 2 describes the recommended enclosure designs and furnishings needed and this chapter describes how these (esp. swim/wade areas) can be tailored to fit the cubs' needs at various ages. Following is only a brief description of the necessary enclosure conditions and problems that can develop when they are not offered.

The recommended soft loose natural substrate types, qualities, and depths, deep digging area sizes, as well as the land to water area ratios (i.e. the land area ratio percentages) are among the most important provisions necessary to maintain the otters' behavioral and physical health and to promote successful cub-rearing and adjustment to new/unusual situations. These are the most important provisions that are needed to prevent and significantly reduce or resolve the following problems.

When indoor or/and outdoor giant otter enclosure land to water ratios offer smaller land proportions than recommended or/and land/floor surfaces are not nearly entirely covered with soft loose natural substrates (including appropriate substrate types, qualities, and depths) or provided with sufficient size deep digging areas as recommended, physical and behavioral health problems and/or abnormalities will develop. See Chapter 2 Section 3 for the problems that can develop. E.g. the foot and toe pads, skin, and webbing on giant otter feet are very sensitive. They become irritated (e.g. pink color on the pads or webbing is a sign of irritation), sore, cracked, cut, raw etc. when they are continually exposed to substrates/surfaces that are hard (e.g. concrete, tile, wood etc.), artificial, very damp/wet, rough, abrasive, or coarse (e.g. pebbles, gravel, or small rocks or sand or soil with pebbles, gravel, or small rocks mixed throughout is coarse). (Note: continual exposure to hard surfaces alone commonly cause unhealthy foot condition, although additional exposure to very damp/wet surfaces worsens foot condition or causes problems alone.) Long-term (e.g. 3 years or more) continual exposure to hard surfaces can cause/pre-dispose giant otters to develop moderate and severe degrees of on-going walking difficulties/abnormalities involving their lower back and hind legs. Otters' fur coats must remain clean, shiny, and waterproof, otherwise animals can become sick (esp. with pneumonia or enteritis), unhealthy, or die. When the following are insufficient: land area, soft loose natural substrates, dry area, and/or dry grooming area, this can cause poor coat and/or foot condition, infection, death etc.. (I.e.: not enough land area because of inappropriate land to water ratios or/and inappropriate substrate types, qualities, or depths cause land/floors to remain very damp/wet and health problems can likely result.) Mental/behavioral health problems or abnormalities, such as the following, can also develop: stereotypical behaviors (esp. swim-pacing), non-goal or2 Tc9.1, nondi

Giant otters are naturally avid diggers and groomers. (Note: grooming includes rubbing, rolling, digging and scratching on/into substrates and covering the body/fur with substrate particles. Otters groom when they are dry as well as wet and this also helps to mark their territory.) Behaviorally healthy giant otters offered the recommended conditions groom on and dig into, both deep and shallow, soft loose natural substrates throughout their entire enclosure area very frequently throughout the day. They also, when given the recommended enclosure conditions, use the entire land area to frequently play and exercise on. Digging, grooming, exercising and playing on land constitute a significant proportion of a behaviorally healthy giant otter's daily goal oriented activities. These activities, carried out to their full extent (i.e. as described), are among the most important behaviors that giant otters need to reduce or counteract the stress, boredom and other negative responses that can develop in captivity during any situation. In the aforementioned inappropriate conditions described in the paragraph above, these activities can or will not be carried out to their full extent or at all, therefore daily behaviors will be carried out in an unhealthy and abnormal way. This is not an uncommon report and these giant otters are also mistakenly thought to be exhibiting healthy and normal behavior. When the behaviors, that are among the most important needed to help prevent, counteract, or significantly reduce the chance that negative reactions develop (i.e. stress, boredom, nervousness, fear, frustration etc.), become severely impaired, the chance that negative responses will occur are significantly increased. I.e. because the otters can not carry out digging, grooming, playing, and exercising on land to the full extent, their opportunities to focus/divert their attentions and actions away from the stressful, frustrating, frightening, or uninteresting situations that can occur during typical daily, new/unusual, or cub-rearing situations, are significantly limited. Abnormally elevated or excessive levels of stress and other negative responses can occur when the recommended enclosure conditions are not offered (see the paragraph above). The more inappropriate the enclosure conditions, the more limited their opportunities are to carry out normal healthy behavior, the less the ability they have to counteract/reduce the negative responses, and the greater the resulting health problems/abnormalities. In order to maintain their behavioral health and normality and promote successful cub-rearing and adjustment to new/unusual situations, it is essential that giant otters are able to carry out the aforementioned activities to their fullest extent possible in captivity, not only when they are cubs, but when they are adults as well.

The giant otter's enclosure must have the recommended enclosure land to water area ratios with at least the minimum size land area ratio percentage required and the wading/swimming areas designed with safety and swimming abilities in mind. This applies to all enclosures regardless of their size (i.e. no matter how small the enclosure is) and it is especially critical in small housing areas. (Note: different enclosure sizes require different land to water ratios.) The other recommended land area designs and locations for nestboxes should be provided in all housing areas. See Chapter 2 Section 1B for land to water ratios and throughout Chapter 2 for more information on the other issues.

It is also necessary that every indoor and outdoor enclosure land and floor surface is nearly entirely covered with soft non-abrasive sand or mulch (i.e. tree bark pieces only), at least 10 cm to 20 cm (4" to 8") in depth, or when applicable, deep soft loose soil with the recommended qualities. Mulch and soft sand covering land and floors should although be at least 40 cm to 60 cm (16" to 24") in depth for many reasons. Sand, soil, and mulch must not have gravel, pebbles, or small rocks (smooth, rounded or otherwise), construction sand, or abrasive sand mixed throughout and sand must be non-abrasive. Soil should not be used to cover over hard or artificial surfaces and it should only be used on outdoor natural land areas. Soil that possess the recommended specific qualities (i.e. it must be soft throughout, remain loose enough to easily

dig into, well-draining etc.) are needed to offer appropriate surfaces. See the soil types, qualities, and depths that can be used on outdoor natural land areas and the mulch piece sizes that should be used in Chapter 2 Section 2. [Mulch and sand are ideal to cover over all surface types (e.g. hard or artificial surfaces etc.) that exist both indoors and outdoors. Although if areas of soil, sand, or mulch mixed with pebbles, gravel or small rocks throughout, construction or abrasive sand or any substrates mixed with these, or areas of any of these aforementioned individual or combined subtrates (e.g. an area of small rocks alone or mixed with sand) already exist within the enclosure they should be totally removed from the enclosure. After their removal, then nearly the entire base surface area needs to be covered over with mulch, sand, and/or soil as recommended. If these furnishings cannot be removed, then they must be completely covered over with mulch and/or soft sand that is at least 60 cm (24") in depth, although at least 100 cm (3.28 ft) depth is highly advisable. A depth of at least 100 cm is needed when land or floor areas with the aforementioned unsuitable substrates are intended to serve as the deep digging areas. There are important easy and quick care techniques that are necessary to maintain the substrates' effectiveness, but they are not described here. See Chapter 2 Section 2-3 for a full description of necessary substrate types, qualities, depths, and husbandry/care techniques needed for them and why these substrates are so important to provide. E.g. the recommended substrate types, qualities and depths, in addition to the recommended land to water ratios, are needed to keep the otters sufficiently dry when they are on land and are necessary to keep the animals' entire land area, including nestboxes, sufficiently dry. These conditions are also needed to make the land area soft and to allow playing, exercising, digging and grooming activities to be fully, effectively and comfortably carried out on land. With daily dry spot cleaning of feces, urine, and fish remains the land area will remain clean and sanitary and the otters will remain clean.

In addition, if the sand/mulch is not 40 cm to 60 cm in depth over nearly the entire floor/land area, then an additional large area (as large as possible) of these soft loose natural substrates, must be at least 40 cm to 60 cm [16" x 24"] in depth. This will serve as the deep digging area which must be provided. Note: for adult giant otters, in addition to the necessary land and floor substrates aforementioned, each indoor enclosure and each outdoor enclosure must have at least a 40 m^2 (430.56 ft^2) area or significantly larger area, where soft sand or mulch, a minimum of 40 cm to 60 cm (16" to 24") in depth, or hillsides, with the recommended designs and soil qualities, allow for deep digging. The same substrate qualities, types and husbandry techniques needed for enclosure land and floors are also necessary for the deep digging areas (see above).

Small tubs of *shallow room temperature water* for wading should be provided when the animal is healthy, old, and skilled enough for unsupervised wading. (See Section 15 for cub ages/abilities and swimming containers.) The otter must be able to easily exit (and enter) the tub and the tub's water level should not go over the cub's front shoulders and head. The tub should also be stable so it does not tip over easily. Logs or hollow logs, that can not roll on and crush cubs, should also be given for the cub to play and rest on/in etc.. It is highly advisable to offer cut tall bamboo with long thin diameter flexible stalks that can be stood up (sunken deep into the soft loose substrates or hung in fence mesh etc.) so they overhang the otter and are within its reach. (See Chapter 2 Section 4 for the bamboo stalk size that is needed so that otters will be able to use the bamboo to play with it and instructions for use. E.g. bamboo with stalk sizes that are too thick in diameter can not be used by the otters.) Such bamboo will provide safe natural furnishings that cubs can pull on/pull down, manipulate, and play with and under. Bamboo should be re-stood daily after they are pulled down and some should also be left on the land for use. One or two nestboxes should also be provided. Clean dry soft bedding materials (i.e. towels, blankets, straw, leaves, or mulch or sand types and qualities as recommended)

should be offered within the nestboxes. Supplemental heating sources (i.e. when necessary), safe toys (e.g. stuffed toys attached to for companionship, cardboard boxes etc.), and feeding and watering bowls (when weaning) should also be included in housing. *Toys for behavioral enrichment should only be used as addition to and never as a substitute for the recommended enclosure furnishings and designs.*

Land areas and nestbox bedding material must be kept dry and clean (see Chapter 2). Soiled and wet towels and nestbox bedding should be changed. Old food and feces/urine should be removed by dry spot cleaning the soft loose substrates daily. Swim tanks/pools must be cleaned regularly and fresh drinking water must always be offered. This is important to help maintain cub health. Every possibility where animals could get injured, trapped, drowned, or find an escape route etc. should be closely inspected in all housing.

When cubs grow older (e.g. around 5 months old) and are healthy, they can be kept in large enclosures. Refer to Chapter 2 for indoor and outdoor enclosure recommendations.

Section 14
Heating Sources for Housing, Ambient Air Temperature & Humidity Guidelines

It is critically important that the cub's body temperature remains within a normal and healthy range, otherwise serious health problems or death can result (see Section 2 for body temperature ranges). As well, if appropriate humidity levels are not offered, cubs can become overly dry, and this may result in health problems. **Caution: ambient temperatures and cub body temperature must be monitored closely and frequently to prevent overheating or subnormal temperatures. This is especially critical for neonates and other cubs during health problems and emergencies.** *Health problems including hair loss (when temperatures are too high), more serious problems, and death can occur if ambient temperatures become too high or low.* "Otters have little heat tolerance and will die rapidly from being overheated" (Smeeton 2001 citing Best 1962). Captive giant otters have been observed to have a low heat tolerance (Carter & Rosas; Sykes-Gatz & Gatz pers. obs.). Housing and heating sources should be prepared so adequate temperatures are reached and stabilized before cubs are introduced to the housing.

To help maintain normal cub body temperature, supplemental ambient heating should be provided for sick or very weak cubs of all ages and for young cubs (i.e. it is necessary for neonates--cubs less than one month old). It is especially helpful to house these cubs in incubators. Not only will an incubator provide a safe housing area, but temperature and humidity can also be controlled within it, with accuracy and effectiveness. When incubators are unavailable, other housing types that can be equipped with heating sources that can be monitored and controlled can be used (see below). Reed-Smith (1994-95) cites, "Wallach and Boever (1983) give 85 ^{o}F [29.4 ^{o}C] and a minimum 50% humidity as the desired incubator setting for mustelids." [The above recommendation should apply to cubs in at least the first week of life. Especially at these higher temperatures, cub health, cub tolerance to temperatures, and ambient temperatures must be monitored closely, as overheating can be deadly.] Meier (1986) suggests 50% to 60% humidity and to gradually reduce the temperature "over the course of about three weeks" (unless the neonate remains or becomes sick). Incubator/housing temperatures should be gradually reduced to around 23.9 ^{o}C (75 ^{o}F). As cubs grow older and/or

become healthy and their housing can be expanded, nestbox/housing temperatures can be slightly and gradually lowered. At Hagenbeck Tierpark, nestbox temperatures are increased to 22-23 ^{o}C (72^{o}-73 ^{o}F) (by increasing room temperature) when giant otter parents are rearing cubs (Flügger 1997). Note: the parents and siblings that accompany these cubs will increase nestbox temperatures somewhat because of extra body heat. Indoor *housing* should be maintained around room temperature, i.e. around 20-21 ^{o}C [68-70 ^{o}F]. *In some emergency cases, higher temperatures may be temporarily needed for cubs with sub-normal body temperatures (see Section 2).*

When incubators are unavailable or when cubs no longer need incubators, housing can be equipped with one or more of the following apparatuses to provide heat. **Caution: to prevent cubs from overheating, ample housing space must be provided so that otters can move far enough away from the heating apparatus to cool down, but not so far away that they can't find their way back to the warmth. Cubs can get burned or injured by some heating sources if they come in direct contact with them (i.e. heat lamps, radiators, heating pads set on high, overly hot water in a hot water bottle etc.) Thermometers should be placed next to/in cub housing so ambient temperatures can be frequently read with minimal disturbance to the cub. Cubs must not reach or make contact with thermometers or other dangerous heating sources.**

Heat lamps or ceramic heaters (these will help keep housing containers dark) can be placed at one end of a housing container and hung well above it. The height of the heat lamp can be adjusted to control housing temperatures. A heating pad (e.g. on a low heat setting) can be placed under 1/2 or under one end of the housing container. Heating pads must be placed underneath all housing containers (e.g. cardboard box etc.). If cubs make contact with heating pads, crawl in them (i.e. between the cover and plastic), damage the pad, or urinate/defecate on it, they could be harmed. A partially filled (i.e. with warm/not too hot water) rubber hot water bottle can also be placed under the material lining the container's bottom (e.g. a towel) or wrapped in a towel so the cub can lie next to it. Hot water bottle covers/encasements (i.e. cloth/plastic covers) should be removed to prevent cub entrapment and overheating/suffocation during entrapment. (Items/strings attaching bottle caps to bottles, must also be removed.) When using hot water bottles, additional heat sources to raise ambient housing temperatures (as listed above), will generally be required. Heaters/radiators (fixed or portable) can be used to heat entire rooms, but cubs should be kept away from them (especially those that are portable and electric). Additional towels or blankets will also help keep cubs warm (see Section 2). If part of the housing container is covered (e.g. 1/2 of it) with a breathable cloth/cover, then heat can be maintained more easily. Some of the container should be exposed to open air for excess heat to escape and proper air circulation. Cubs must not be able to pull covers into the container with them.

Section 15
Exposure to Water, Swimming Lessons & Cleaning / Bathing Cubs

Giant otter parents must expose their cubs to the water, closely monitor and stay next to/near their cubs while they are in the water, and teach their cubs how to swim; therefore human parent substitutes must do the same. The cub's swimming proficiency and confidence, ability to enter/exit swim tanks/tubs and pools, and tolerance to water temperatures should be closely

monitored and assessed as the cub develops. This is needed to help determine what type of swim area is the most optimal to gradually develop the cub's full range of swimming skills in a safe and enriched environment. See cub development in Chapter 4 and See Section 15.

A cub that does not have competent swimming skills should never be left unsupervised while in the water.

When cubs are introduced to swim/bathing water, tubs, tanks and pools, caution should be taken, as pool water temperature seems to be more critical than the air temperature (Wünnemann 1995). (Unhealthy cubs should not be allowed in water, unless it is needed for emergency care.) Cubs should be closely monitored to determine how well they tolerate different water temperatures. For example, when healthy cubs are around 1½ months old, they should be bathed with warm water only. Cubs 3-4 months old can be given at least room temperature water and 5 month old cubs should not be exposed to water that is too cold (e.g. not below 16 ^{o}C [61 ^{o}F]). (See pool temperature for adults in Chapter 2.) Cubs should be thoroughly dried with soft absorbent clean towels after bathing, wading, or swimming lessons. Older cubs, able to swim or wade on their own, must be provided with clean dry materials and soft loose natural substrates (covering nearly the entire land/floor area) for drying and grooming on.

Young healthy handreared cubs, around 1½ months old (i.e. when their eyes are open), can be given baths in small tubs (e.g. plastic dishwashing tubs) with shallow clean warm water, but they must be under constant supervision/observation to prevent problems (i.e. inhaling water). The water should not extend above the cubs' shoulder level. The cub's head and nose should be kept out of the water. This introduction to water helps develop water skills and it provides stimulation. It also helps keep the otter clean and prevents skin and toe pads from drying out. If housing humidity is too low, skin and toe pads can become overly dry (e.g. skin looks flaky), cracked, and skin can become irritated. A cloth, dampened with clean warm water, can be used to bath and clean younger cubs and provide moisture (this can be used for older sick cubs too).

The recommendations for handreared river otter species from Burnette (1994) are as follows: "Young otters should not be introduced to water until they are at least 7 or 8 weeks old, and then only gradually to lukewarm water. Otters must learn to swim, and too early an exposure to water could result in drowning or illness. Young otters should be dried off well after swimming sessions. Do not allow them to become chilled. Keep their water clean."

As cubs grow older and become more confident in the water, they should be gradually introduced to larger tubs/containers, with increasingly deeper luke-warm water, while caretakers teach them how to swim. They should never be left unattended while in the water. Healthy older cubs (e.g. cubs 3-4 months old), that are capable of swimming with confidence and skill, can be introduced to and offered larger safe tubs/containers of room temperature clean water. These tubs/containers must provide gently sloping shallow areas and easy exits for the cub to prevent drowning. Giant otters like to especially use shallow areas for play, wading, eating fish etc. Bathtubs could be used, although cubs may not be able to make easy exits, so wooden ramps (with non-slippery surfaces and slats for easier climbing) etc. should be offered. Other small safe tubs could also be offered when cubs are not under supervision. As cubs' swimming skills develop, small shallower pools (e.g. for cubs around 4 1/2 months old) and eventually deep pool areas (e.g. for 5 months old cubs) can be introduced; although both must provide plentiful areas where cubs can easily exit the water. See Chapter 2 for more pool design information.

Section 16
Companion Cubs and Handrearer / Cub Interactions

Many questions exist on how human contact, contact or lack of contact with other otters during handrearing, housing conditions, "hacking out" methods etc. may significantly affect success of both handreared captive born and orphaned wild otters. For example, the ability of both types of individuals that are housed permanently in captivity or released in the wild, should be scientifically studied on a long-term basis to determine how successfully they pair with a mate, breed, and rear offspring. (See the last paragraph and Chapter 1 for a discussion of future problems of handreared otters.)

Ideally, handreared cubs should be socialized with healthy conspecifics near their same age, as early in life as possible (Read and Meier 1996). "Interaction with other animals is vital." Giant otters are highly social and live in family groups in the wild. Mated pairs bond for life and all family members (including sub-adult offspring) help to take care of the cubs. Each litter usually consists of more than one cub and cubs are dependent upon the other family members for care, socialization, learning life skills etc.. It is therefore ideal if more than one giant otter cub (i.e. siblings or healthy cubs near their same age) can be reared/housed together. This will help provide for their stimulation, enrichment, and mental, social, behavioral, and physical development and health needs [i.e. socialization, companionship/contact, play interactions etc.] (Read and Meier 1996). Unfortunately, it is not always possible to handrear giant otters together.

Some handreared carnivores may "…have difficulty fitting into a social group, exhibiting either excessive aggression or shyness. Animals raised without any carnivore contact may not fit in at all, preferring human contact to that of their own species." (Read & Meier 1996). It also should be determined if there are "critical periods" for the social development of handreared giant otter cubs. I.e. critical periods exist for the socialization of domestic dogs and therefore exotic species [such as giant otters], may also have a critical period (Read & Meier 1996). "Experiences, or lack of them, during these times may permanently affect the animal, resulting in abnormal adult behavior." Additionally, cubs that are reared alone and/or not socialized early enough in life with conspecifics may not only be unable to interact normally with conspecifics, but they may even reject or kill them when introduction does occur. They may also be unsuccessful at breeding and rearing offspring.

On the other hand, great caution must be taken as young giant otters, juveniles, sub-adults, or adults may fight with, injure or possibly, even kill unfamiliar young animals introduced to them. Unfortunately, reports of this do exist. Young otters have fought against other unfamiliar young otters and adults have fought against unfamiliar young animals and even familiar juveniles (Lazzarini pers. comm.; Kranz pers. comm.).

Great caution and visual-acoustic-olfactory, before full physical contact, introductions must be used to introduce unfamiliar animals and temporarily separated animals. The introduction process must be monitored closely by those experienced with giant otters and conducted gradually. Animals should never be left alone, unsupervised or unmonitored during the full contact introductions, with other young otters or older otters until they show continued positive interactions and it is clearly evident that they are getting along well. For example, some otters can show initial positive reactions during visual-acoustic-olfactory or/and full physical contact introductions, but afterwards they may fight with, injure, or even try to kill each other. See Chapter 2 for information on introduction methods.

Whether cubs have companions or they are reared alone, human parents **must** interact with the cub to provide substitute for most of the aforementioned aspects (Read & Meier 1996). This is especially critical when otters are alone. "…it is essential both for the well-being of the orphaned animals and for success in re-introduction and release [whether into captivity or the wild], that the orphaned animals have significant interaction with their keepers…" (Smeeton 2001). When solitary cubs have minimal interaction with handrearers or other otters, this will significantly and negatively affect their physical as well as mental well-being (e.g. severe depression etc.) and development.

> *Delayed physical or mental development, failure to thrive, and overreaction to a new environment are signs of maladjustment. Stereotypical behaviors seen include self-mutilation, pacing, rocking, head pressing, weaving, hair plucking or excessive grooming, and excessive suckling. These problems are difficult to avoid in exotic animals that must be handreared, particularly if the animals are solitary and isolated (Meier 1984)." (Read & Meier 1996).*

"Exotic animals appear to be more susceptible to stress-related problems than their domestic counterparts." (Read & Meier 1996). "If the cubs brought in, are in a group, the level of stress is greatly lessened. Single cubs are sometimes reduced to a coma-like behavior by prolonged anxiety." (Smeeton 2001). Cubs, that are only slightly chilled (i.e. that do not have subnormal body temperatures) and are in "this coma-like condition will be alleviated by the keeper putting the cub inside his/her shirt until the animal has warmed-up and revived." Once the cub has been revived, warmed, and given any necessary medical treatment and feeding, it can be placed in warmed housing. To offer the cub a familiar and comforting smell, keepers should rub their hands/body on some of the housing bedding or provide their worn T-shirt or safe shirts (without buttons, holes, frays/loose strings, long sleeves etc.), as bedding or for wrapping around a ticking clock. Also the following items will help to somewhat replicate the presence of another otter and provide some comfort. A rolled towel, safe stuffed cloth toy (remove buttons, imitation eyes, etc.), a wool sock filled with cloth or crumpled newspapers and knotted shut at the opening, and a safe wind-up ticking clock placed outside the housing or wrapped in a towel and put inside the container can be offered. A partially filled (i.e. with warm/not too hot waterand0.0481 Tw

Cubs must exercise and explore to promote healthy mental and physical development and skills. As do giant otter parents, handrearers must supervise young cubs during these exercise periods and depending on cub age, health, and ability offer and encourage cubs to engage in multiple exercise periods per day. Intuition, common sense, and knowledge of giant otter behavior should be used to perform these actions with effectiveness, gentleness, caring ways, and respect for the otter. E.g. very unhealthy cubs should not be overly handled to give them the time they need to rest and recover. Although, interaction should not be stopped either so the cub does not feel abandoned. A feeling of abandonment may cause further decline in health. Smeeton (2001) recommends, "If the intention is to produce a healthy well- balanced individual, it is essential to spend at least an hour with the single cub at each feeding, handling it, massaging it, and talking to it."… All handling of otter cubs should be done without gloves…. …the contact or bond formed between keeper and animal, between bare hand and fur, is beyond price."

During handrearing a dog might be helpful, in addition to human companionship, to provide additional stimulus and companionship. Although little is known about how successful or appropriate this practice would be, as this was known to have been used only with one giant otter and no further details are available. I.e. a dog had been used a companion for a giant otter with one of the first giant otters kept in Germany...[and] it might be interesting for evaluation if this is also feasible for giant otters [during handrearing] (Wünnemann, pers. comm., 2004). This practice although has been used with other species and it has been successful. E.g. domestic cats or dogs have been successfully used for companion animals during the handrearing of golden cats and tigers (Wünnemann, pers. comm., 2004).

What should be done with wild born orphans after handrearing (i.e. release in wild, place in zoo/institution etc.)? See Chapter 1 Section 5 for this discussion.

Table 2 : Summary of the international historical reproductive and rearing success of giant otters in zoos.

Institution	Survey Period ⊙	No. Of Successful Litters*/ No. Of Litters	No. Of Cubs to live to 1 yr. ♠/ No. Of Cubs Born
Tierpark Hagenbeck (1)	1976 – 1994	5 / 19	9 / 66**
Sao Paulo Zoo (2)	1970 – 1976	1 / 6	1 / 16
Brasilia Zoo (3)	1975 – 2002	6 / 24 ****	18 / 66
Cuiaba Zoo (4)	1992 – 1994	2 / 2	9 / 9
Parque del Este (5) ○	1968 – 1978	0 / 9	0 / 23
Cali Zoo (6)	1999 – 2002	2 / 5	5 / 12
Dortmund Zoo (7) ❖	1995 – 2002	0 / 13	0 / 28
Chestnut Centre (8)***	1997	0 / 1	0 / 3
Belem (9) ‡	1998 – 2002	3 / 3	3 / 3
Total	1968 – 2002	19 / 82	45 / 226 ●

⊙ Survey period includes only the years in which breeding was reported to occur at each institution * at least one cub in the litter survives one year or more ♠ A successfully reared cub is one that survived to one year of age or older. ** four cubs handreared, only two survived *** aborted litter **** Louzada da Silva (pers. comm.) suggested that 36 litters were suspected to be born from 1975 to 1997, although the additional litters were not seen or detected so they were not officially registered in his revised census. ‡ Both Museu Paraense Emilio Goeldi (Belem, Brazil) and Criatorio Crocodilo Safari (Belem, Brazil), the private facility associated with Museu Goeldi, are referred to under "Belem". The breeding pair at Museu Goeldi was loaned to Criatorio Crocodilo Safari in 2001 where the pair had one litter (in 2002) while they were held at this institution. Because the same pair gave birth to at least one or more successful litters at both of the two aforementioned institutions, these institutions are associated and no other breeding pairs were known to be held at these institutions, these two institutions, except where noted, are counted as one institution for all data within this manual and are referred to as "Belem". ❖ Inherited thyroid malfunctions due to severe inbreeding were likely to have prevented the survival of all of the cubs born at Dortmund Zoo ○ Parque del Este Zoo at Caracas was the first zoo in the world to report a giant otter birth ● Of 226 cubs, 217 cubs were born live

Source of Data : (1) Hagenbeck and Wünnemann 1992; Flügger 1997 (2) Autuori and Deutsch 1977; Sao Paulo Zoo via Daniel Louzada da Silva, pers comm.; IZY (3) Daniel Louzada da Silva, Marcelo Lima Reis, Adriana Sartori de Almeida Santos; pers. comm. : Dr. Wolf Bartmann, unpublished report; Brasilia Zoo, pers. comm. (4) Daniel Louzada da Silva, pers comm.; Shirley Marcato de Oliveira 1995 (5) Trebbau 1972 / 1978; IZY (6) German Corredor, pers comm. (7) Dr. Wolf Bartmann, pers comm.; Ilona Schappert, pers. comm.; Volker Gatz, pers. comm. (8) Roger and Carol Heap, pers. comm. (9) "Genealogical meeting ..." 1998; Brasilia Zoo, pers. comm. 2002.

In a 34 year period, between 1968 and 2002, nine institutions worldwide reported giant otter births. A total of 82 litters were born and a total 217 cubs were born live and registered. Of these 217 cubs, only 45 are known to have survived to one year of age or older (20.7%). It is important to note that a greater number of cubs could have been born. This suspicion is based on the theory that not all litters have been detected.

Table 3 : Summary of the international reproductive and rearing success of giant otters in zoos 1998 - 2002

Institution*	Survey Period**	No. Of Successful Litters***/ No. Of Litters	No. Of Cubs to live to 1 yr. ♠/ No. Of Cubs Born
Brasilia Zoo	**2000 – 2002**	**2 / 2**	**8 / 8**
Cali Zoo	**1999 – 2002**	**2 / 5**	**5 / 12**
Dortmund Zoo	**1998 – 2002**	**0 / 7**	**0 / 19******
Belem*****	**1998 – 2002**	**3 / 3**	**3 / 3**
Total	**1998 – 2002**	**7 / 17**	**16 / 42**

** Each zoo has one breeding pair.*
*** Survey period includes only the years in which breeding was reported to occur at each institution.*
**** At least one cub in the litter survives one year or more.*
♠ A successfully reared cub is one that survived to one year of age or older.
***** Two of the 19 cubs were stillborn.*
****** Both Museu Paraense Emilio Goeldi (Belem, Brazil) and Criatorio Crocodilo Safari (Belem, Brazil), the private facility associated with Museu Goeldi, are referred to under "Belem". The breeding pair at Museu Goeldi was loaned to Criatorio Crocodilo Safari in 2001 where the pair had one litter (in 2002) while they were held at this institution. Because the same pair gave birth to at least one or more successful litters at both of the two aforementioned institutions, these institutions are associated, and no other breeding pairs were known to be held at these institutions, these two institutions, except where noted, are counted as one institution for all data within this manual and are referred to as "Belem".*

Table 4 : International Giant Otter Census Summary 2002 to Sept. 30, 2003

Location	Total No. of otters in each country*	No. of institutions with At least one potential breeding pair** / No. of institutions holding otters by country*
South America		
Bolivia	1.0	0 / 1
Brazil	11.12	5 / 8
Colombia	4.3	1 / 2
Guyana	0.1	0 / 1
Peru	1.4	0 / 2
Trinidad	1.0	0 / 1
Venezuela	6.3	1 / 7
Europe		
Germany	4.2	1 / 2
United Kingdom	0.1	0 / 1
North America		
United States	2.2	2 / 2
International Totals	30.28 (58)	10 / 27

* *Census only includes individuals one year of age or older and the institution's census during the most recent year reported.*

** *Only includes individuals two years of age or older.*

Table 5 : International giant otter census by institution 2002 to Sept. 30, 2003*

South America

Bolivia

1. **Zoologico Municipal Santa Cruz**
   Holding 1.0 in 2002

Brazil

2. **Parque Ecologico Municipal de Americana**
   Holding 0.1 in 2002
3. **C.P.P.M.A. / Balbina**
   Holding 0.1 in 2002
4. **Museu Paraense Emilio Goeldi / Belem**
   Holding 1.0 in 2002
5. **Criatorio Crocodilo Safari / Belem** (private facility associated with Museu Goeldi above)
   Holding 2.1 in 2002
6. **Jardim Zoologico de Brasilia**
   Holding 4.5 in 2003
7. **Zoologico da Universidade Federal de Mato Grosso / Cuiaba**
   Holding 1.2 in 2003
8. **Zoologico de Curitiba**
   Holding 1.1 in 2003
9. **INPA / Manaus**
   Holding 2.1 in 2003**

Colombia

10. **Fundacion Zoologico de Cali**
    Holding 2.3 in 2003***
11. **Barranquilla**
    Holding 2.0 in 2003

Guyana

12. **Guyana Zoo / Georgetown**
    Holding 0.1 in 2003

Peru

13. **Quistococha Zoo / Iquitos**
    Holding 1.2 in 2003
14. **Pucallpa Zoo**
    Holding 0.2 in 2000

Trinidad & Tobago

15. **Emperor Valley Zoo / Port of Spain**
    Holding 1.0 in 2003

Venezuela

16. **Parque del Este „Romulo Betancourt“ / Caracas**
    Holding 1.0 in 2003
17. **Parque Zoologico „El Pinar“ / Caracas**
    Holding 1.0 in 2003
18. **Valencia Aquarium**
    Holding 1.1 in 2003
19. **Parque Loefling / Ciudad Guyana**
    Holding 1.0 in 2003
20. **Zoológico Municipal la Guaricha Maturin**
    Holding 1.0 in 2003
21. **Parque Zoológico y Botánico Bararida Barquisimeto**
    Holding 0.2 in 2003
22. **Zoológico Leslie Pantin Turmero, Aragua**
    Holding 1.0 in 2003

Europe

Germany

23. **Zoo Dortmund**
    Holding 3.2 in 2003
24. **Zoo Duisburg**
    Holding 1.0 in 2003

United Kingdom

25. **Chestnut Centre / Chapel en le Frith**
Holding 0.1 in 2003

North America

United States of America

26. **Dallas World Aquarium / TX**
    Holding 1.1 in 2003
27. **Zoological Society of Philadelphia / PA**
    Holding 1.1 in 2003

** Census only includes individuals one year of age or older and the institution's census during the most recent year reported.*

/ By September 30th 2003 1.1 additional giant otters were held at Cali and 1.1 additional giant otters were held at INPA.. These animals were all under one year old at this time, therefore they are not included in the census.*

Table 6: Weights and Lengths for Captive-Born Giant Otters (Page 1 of 3)

Days/ Months	Sex	Weight/Length (entire body length)	Institution	Weight at Death (WD); Parent reared (P); Weight during handrearing or when first pulled for handrearing (HR)	Author/ Source (pers. comm.)
Day 1	1.0	**265g**	Hagenbeck	WD/P	Ha/Wu 1992*
Day 1	1.0	**220g**	Hagenbeck	WD/P	Ha/Wu 1992
Day 1	1.0	**200g**	Hagenbeck	WD/P	Ha/Wu 1992
Day 1	1.0	**220g**	Dortmund	HR	Dortmund
Day 1	1.0	**238g**	Dortmund	HR	Dortmund
Day 2	0.0.1	**150g**	Hagenbeck	WD/P	Ha/Wu 1992
Day 2	0.0.1	**155g**	Hagenbeck	WD/P	Ha/Wu 1992
Day 2	1.0	**213g/ 33.5cm** ***	Sao Paulo	WD/P	Au/Deu 1977**
Day 2	1.0	**193 g/33.5cm****	Sao Paulo	WD/P	Au/Deu 1977
Day 2	1.0	**161g/31.0cm****	Sao Paulo	WD/P	Au/Deu 1977
Day 2	0.1	**230g/33.5cm****	Sao Paulo	WD/P	Au/Deu 1977
Day 2	0.1	**209g/32.5cm****	Sao Paulo	WD/P	Au/Deu 1977
Day 3	1.0	**220g**	Hagenbeck	WD/P	Ha/Wu 1992
Day 3	0.1	**150g**	Hagenbeck	WD/P	Ha/Wu 1992
Day 3	1.0	**220g/34.5cm▼**	Dortmund	WD/P	Dortmund
Day 3	1.0	**190g/33cm▼▼**	Dortmund	WD/P	Dortmund
Day 4	0.1	**180g/29.5cm▼▼▼**	Dortmund	WD/HR	Dortmund
Day 4	0.1	**220g/31.5cm▼▼▼▼**	Dortmund	WD/HR	Dortmund
Day 4	0.1	**200g**	Hagenbeck	WD/P	Ha/Wu 1992
Day 4	0.1	**250g**	Hagenbeck	WD/P	Ha/Wu 1992
Day 5	0.1	**200g**	Hagenbeck	WD/P	Ha/Wu 1992
Day 7	1.0	**342g**	Dortmund	PR	Dortmund
Day 13	1.0	**220g**	Hagenbeck	WD/P	Ha/Wu 1992
Day 13	1.0	**320g**	Hagenbeck	WD/HR	Ha/Wu 1992
Day 35	0.0.1	**800g**	Hagenbeck	WD	Flügger
Day 35 (1)	0.1	**1420g**	Dortmund	PR	Dortmund
Day 40 (5)	0.1	**1290g**	Dortmund	PR	Dortmund
Day 40 (4)	0.1	**1530g**	Dortmund	PR	Dortmund
Day 40 (3)	1.0	**1380g**	Dortmund	PR	Dortmund
Day 40 (2)	1.0	**1730g**	Dortmund	PR	Dortmund
Day 46 (1)	0.1	**1650g**	Dortmund	PR	Dortmund
Day 46 (2)	1.0	**1950g**	Dortmund	PR	Dortmund
Day 46 (3)	1.0	**1640g**	Dortmund	PR	Dortmund
Day 46 (4)	0.1	**1800g**	Dortmund	PR	Dortmund
Day 46 (5)	0.1	**1400g**	Dortmund	PR	Dortmund

Days/ Months	Sex	Weight/Length (entire body length)	Institution	Weight at Death (WD); Parent reared (P); Weight during handrearing or when first pulled for handrearing (HR)	Author/ Source (pers. comm.)
Day 52 (1)	0.1	**1720g**	Dortmund	PR	Dortmund
Day 55 (2)	1.0	**2210g**	Dortmund	PR	Dortmund
Day 55 (3)	1.0	**1670g**	Dortmund	PR	Dortmund
Day 55 (4)	0.1	**1930g**	Dortmund	PR	Dortmund
Day 55 (5)	0.1	**1360g**	Dortmund	PR	Dortmund
Day 56	0.1	**1300g**	Hagenbeck	WD	Flügger
Day 56	0.1	**1800g**	Hagenbeck	HR	Flügger
Day 56	0.1	**1900g**	Hagenbeck	HR	Flügger
Day 62 (2)	1.0	**2280g**	Dortmund	PR	Dortmund
Day 62 (3)	1.0	**1780g**	Dortmund	PR	Dortmund
Day 62 (4)	0.1	**1980g**	Dortmund	PR	Dortmund
Day 62 (5)	0.1	**1450g**	Dortmund	PR	Dortmund
Day 70 (2)	1.0	**2410g**	Dortmund	PR	Dortmund
Day 70 (3)	1.0	**1970g**	Dortmund	PR	Dortmund
Day 70 (4)	0.1	**2120g**	Dortmund	PR	Dortmund
Day 75 (2)	1.0	**2540g**	Dortmund	PR	Dortmund
Day 75 (3)	1.0	**2060g**	Dortmund	PR	Dortmund
Day 75 (4)	0.1	**2160g**	Dortmund	PR	Dortmund
5 Months	1.0	**9.1 kg**	Hagenbeck	HR	Flügger 1997
4 Months	1.0	**4.09 kg**	Emperor Valley Zoo****	HR	Caesar
5 Months	1.0	**5 kg**		HR	Caesar
9 Months	1.0	**13.62 kg**		HR	Caesar
11 Months	1.0	**17.25 kg**		HR	Caesar
13 Months	1.0	**18.16 kg**		HR	Caesar
19 Months	1.0	**21.79 kg**		HR	Caesar

*Hagenbeck & Wünnemann 1992; **Autuori & Deutsch 1977; ***For these cubs "The tail length was about 10 cm. The head measured about 7 cm from the base of the neck." (Autuori & Deutsch 1977). **** All of the weights are from the same individual and this animal was a wild-born orphaned otter that was taken to the Emperor Valley Zoo for handrearing. **(1-5)** Each

animal that is listed with the same number (i.e. with any of the numbers from 1-5) in the "Days/Months" column is the same individual. ▼The tail length was 12cm and the tip of nose to tail base length was 22.5cm. ▼▼The tail length was 11cm and the tip of nose to tail base length was 22cm. ▼▼▼The tail length was 10cm and the tip of nose to tail base length was 19.5cm. ▼▼▼▼The tail length was 9cm and the tip of nose to tail base length was 22.5cm.

Table 7: Adult Giant Otter Weights and Lengths

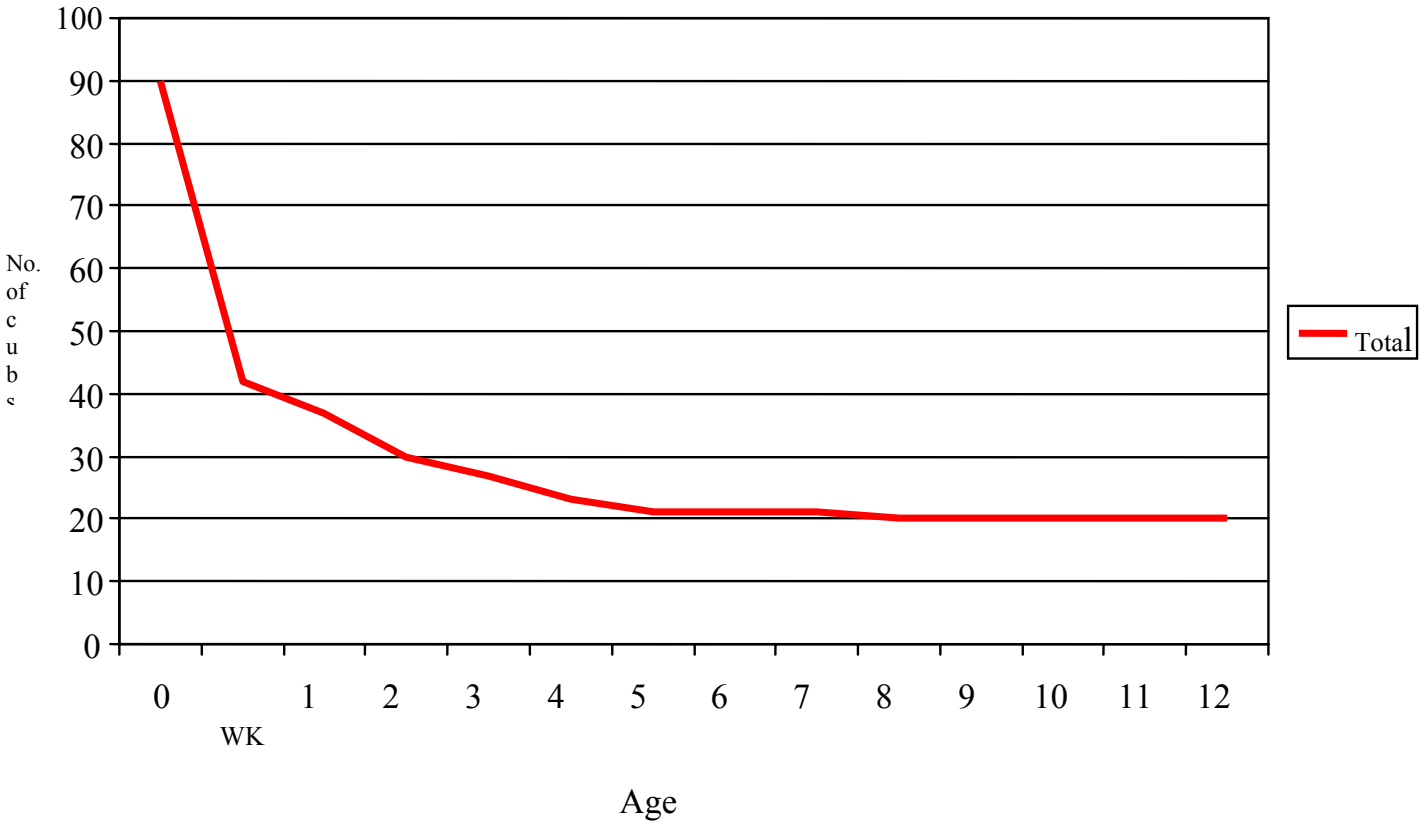
Sex/Name	Age	Weight	Institution
1.0 Kuddel	3 years	22 kg body lengths below**	Dortmund
	11 years	26 kg	Dortmund
0.1 Katja	6 years	22 kg	Dortmund
0.1 Ottilie	9 years, est. age actual age 11 years	19.9 kg	Hagenbeck/ (Flügger 1997)
1.0 Rio *	4 years, 3 months	23.5 kg	Philadelphia
	9 years	22.5 kg	Brasilia
	(at 5 months old)	(9.1 kg)	Hagenbeck/ (Flügger 1997)
1.0 Banjo *	5 years, 8 months	27.5 kg	Philadelphia
0.1 Isabella	8 years	22 kg	Brasilia
1.0 Tico	14 years	24.2 kg	Brasilia
0.1 Sol	2 years	22 kg	Brasilia
0.1 Nina	2 years	24 kg	Brasilia
0.1 Unknown	Adult	24.5 kg	Sao Paulo (Autuori & Deutsch 1977)

*The following weights, all taken in the year 1997, show how the weights of these captive-born animals fluctuated within a one year period. The weights for Rio were as follows: May: 23.1 kg; July: 23 kg; and December: 23.5 kg. Banjo's weights were as follows: May: 26.5 kg; July: 27 kg; November: 26.6 kg; and December: 27.5 kg. In 1997 Rio was approx. 4 years old and Banjo was approx. 5 years old. Note: these animals were weighed via husbandry training. (Sykes, unpublished reports 1997-1999)

**At 3 years old, Kuddel's nose to tail length (i.e. entire body length) was 1.65 m and his tail length was 65 cm. The circumference of his chest behind his elbows measured 57 cm, the circumference of his stomach was 65 cm, the circumference of his abdomen was 53 cm, and the length of his lower arm was 14 cm. This animal was captive-born at Hagenbeck Tierpark (Osmann, pers. comm. 1993)

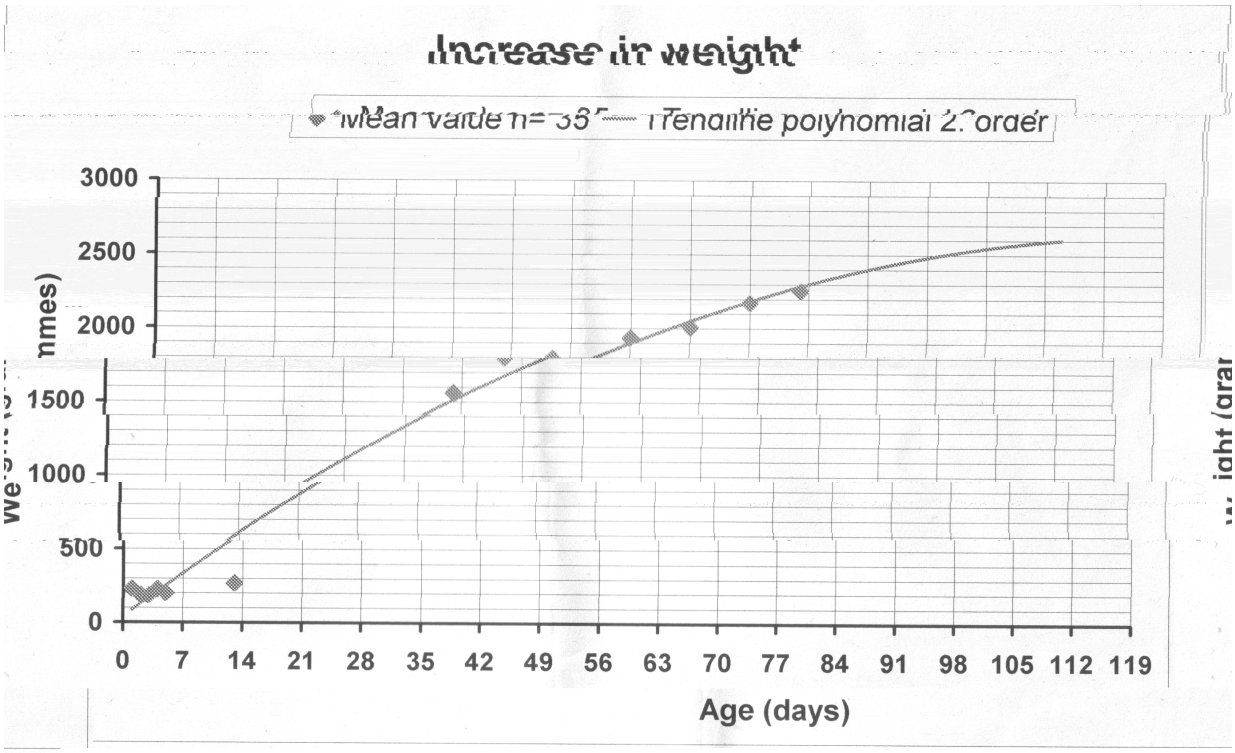
Graph 1: Giant Otter Cub Mortality.

Data for 90 of 145 cubs born live revealed:
53% died during the first week of life & 50% of cubs surviving to one week died before reaching 4 months of age.



Graph designed by Karl Kranz.

Graph 2 : Giant Otter Cub Weight Growth Curve*



Curve designed by Claus Reuther

*This graph is a composite of multiple cub weights (of both sexes) which were taken at various intervals during the cubs' lives.

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