

Summary of Husbandry Guidelines For Giant Otters (*Pteronura brasiliensis*) In Zoos, Aquariums, & Wildlife Sanctuaries

Contributors: N. Duplaix, C. J. Heap, T. Schmidt, T. Schikora, J. Carvalho, I. Rubiano,
D. Iaeggio, S. Rivera

Photos: Contributed by C. J. Heap, T. Schmidt & D. Wooddell

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Chair & Editor: Jan Reed-Smith



Photograph taken at New Forest Wildlife Park, United Kingdom; Antony Flowers

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Introduction

This manual has been created by an international body of experts with collective experience in giant otter husbandry. It seeks to encourage and inform collection managers and animal keepers to recognize the basic minimum standards of care required when keeping giant otters in captivity. All the recommendations are derived from sound scientific knowledge and/or practices proven successful by institutions working with this species. Contributor contact information is available at the end of the document; please contact any of them for additional advice or documentation. Not all information is attributed to the source, because it is gathered from personal expertise of contributors. However, where it is attributed you will find the source number in parenthesis; source specifics are in the Reference Section.

This document is not comprehensive and is designed to be used as a supplement, for animal caregivers to the more comprehensive Giant Otter Husbandry Guidelines available from AZA (Association of Zoos and Aquariums), EAZA (European Association of Zoos and Aquariums), Dortmund Zoo publications (Sykes-Gatz, 1999 – 2006, 2005, 2011, 2014), and other publications. Many are available at: otterspecialistgroup.org, OZ Task Force link. Readers are welcome to use the contact information for giant otter professionals listed at the end of the document.



Natural History

Range

The giant otter, *Pteronura brasiliensis*, endemic to the rain forests and wetlands of South America is the largest of all otter species. Historically giant otters ranged throughout the tropical lowland rainforests and wetlands of South America. Currently remnant populations exist in Bolivia, Brazil, Colombia, Ecuador, French Guiana, Guyana, Paraguay, Peru, Suriname, and Venezuela, but the giant otter is considered extinct in Argentina and Uruguay (1).

Description

An adult male giant otter weighs between 26 and 32kgs and can reach up to 1.8m in total length (nose to tail tip) (1). Females are only marginally shorter at up to 1.7m total length but are lighter at 22 to 26kgs (1). Each otter has a unique speckled brown and cream throat patch which renders easy visual identification of individuals. In the wild the lifespan of a giant otter is approximately 9 years; in captivity ages of up to 22 years have been recorded but this is exceptional. Giant otters are predominantly diurnal, active during the day, with activity coinciding with crepuscular peaks however recent studies have shown they are sometimes active at night coming out of dens to mark campsites (31). Typical dive lasts 72 seconds or less (2).

Senses

Giant otters hunt by sight and are reported to be able to recognize conspecifics and known humans at a distance of up to roughly 50 m (2). Hearing is considered acute as is smell both

of which play a prominent role in communication between conspecifics. Their sense of touch is concentrated in their facial vibrissae. Early studies of otter brains indicated enlarged areas that corresponded, “...to an increased sensitivity of the facial vibrissae which are noticeably long, stout and abundant in this species. This adaptation is of great advantage in prey location in muddy water when vision is impaired” (2, pg. 533).

Status and Threats

Giant otters are classified by the IUCN Red List of Threatened Species as “Endangered and Decreasing” (January 2015 ver. 2014.3) due primarily to exploitation of their natural habitat, illegal harvesting of their pelts, and persecution for perceived impact on depleting local fish stocks. Acceleration of habitat destruction and degradation throughout its territory is considered the most serious and ongoing threat to this species over the next 20 years (36).

Habitat Choice, Home Range and Core Areas

Preferred habitats include areas of abundant, readily available, and vulnerable prey in slow moving waters that include well vegetated, low, sloping banks with easy access to forest creeks and swampy areas (2, pg. 515). Duplaix (2) also reported in wider rivers they showed a preference for areas with access to shallower water with “*rapids or waterfalls with pools and ponds between boulders and sand bars*”.

Home range size will vary; Duplaix (2) recorded a range for one family group as being approximately 12 km long and 12 km wide. Preferred shorelines for core areas consisted of sloping banks with good cover (2). Territory lengths ranged from 5.2 to 19.7 km (mean = 11.4km) in one study of giant otters living in a Brazilian river (30). Territories are actively defended by family groups (30).

Campsites are areas of intense activity where otters clear ground vegetation via digging, rolling, and pulling down vegetation. These areas, where they groom, rest, play, and raise young are core areas to giant otters’ home range and activity. The campsite may be associated with dens and contain well-used communal latrines (areas where feces, urine, and anal gland secretions are deposited). Communal latrines may or may not be located at campsites. Latrines can also be found along trails on forest paths at cross-over sites (otters move between bodies of water); these latrines do not show the usage pattern of those located at campsites. Dens typically consist of a tunnel (up to 3 tunnels at some dens) roughly 30cm to 40cm wide leading to a chamber (or more rarely two chambers) typically varying in diameter from 1.2 to 1.8m (2; pg. 603).

Diet and Feeding Behavior

Giant otters are piscivorous carnivores that do all of their foraging in the water. In the wild they primarily consume fish, but will catch crustaceans, snakes, and small birds. Due to a high metabolic rate and rapid digestion, giant otters will spend a great deal of time hunting. Based on a study done in Columbia by Gómez and Jorgenson; “*When the characteristic diet of the giant otter in this area is compared with that extracted by the commercial fishing enterprises it can [be] seen that, although the otter is consuming fish that have some commercial importance (i.e. Curimatidae, Myrenidae, Serrasalmidae and Pimelodidae), the great majority of its diet is based upon families of no importance (i.e. Erythrinidae, Cichlidae, Anostomidae, Ctenolucidae, Osteoglossidae, and Cynodontidae)*” (38; pg. 3).

Social Behavior

There is a high degree of “pair-bonding” in this species resulting in the alpha pair forming the family group foundation. These family groups include the monogamous pair and multiple generations of offspring who usually remain with the family at least until they reach sexual maturity at approximately 2 years of age. However, many cubs remain until the age of 3 years while in some cases of large groups cubs are recorded as leaving earlier than age 2 (30, 36). Young females tend to stay longer in their natal range if the resources are available than young males; this is theorized as a method of gaining cub rearing experience (30). Cubs of both sexes remain with parents through the birth of the next litter and learn valuable parenting skills. Wild family groups of up to 15 individuals have been recorded but the average group number is 6 to 8 otters (2). Grooming consumes a great deal of time, and plays a vital role in giant otter group cohesion, stress reduction, and home range identification. Duplaix (2) states that this species spends fully half of its time on land with a great deal of this dedicated to marking (urinating and defecating), resting, grooming, and clearing campsites; all activities important to stress reduction and group cohesion. Duplaix (2) contains an excellent introduction to giant otter behavior and Duplaix et al. 2015 in press provides a good overview of recent behavioral findings.

Communication

Primary forms of communication with conspecifics are olfactory, vocal, and postural.

Olfactory communication takes place via the use of urine, feces, and anal gland secretions deposited at communal latrines and marking sites. These deposits create scent posts which serve to communicate presence and may also create a group smell as a result of the members spreading the feces around with their paws and/or rolling on substrates where deposits have been left.

Vocal communications were originally identified by Duplaix (2; pg. 552-560) as falling into 9 basic calls divided into three categories: agonistic, affiliative social contact, and parent-cub sounds listed below. Subsequent to her study Leuchtenberger et al. (2014), Leuchtenberger (2012, 2014), Mumm et al. (2014a, 2014b) and others have described in greater detail the complexity of giant otter communication as well as additional calls.

Agonistic

- HAH – low level of concern or alertness
- Explosive Snort – signifies sudden alarm or high alarm over potential danger
- Wavering Scream – harsh, whining scream which may be accompanied by a bluff charge; can signify excitement
- Growl – low intensity offensive threat which can escalate

Affiliative

- Hum – reassurance, close contact calls between individuals
- Coo – close contact call between individuals or parent-cub; excited friendly greeting
- Whistle – not heard often, may be contact call between two groups that know each other

Parent-cub

- Newborn cub squeaks/parent purr – heard only for first few days of cubs’ life during transport between dens

- Cub whines/wails – distinctive cub calls apparently communicating a need to parents or when separated from family group.

Reproduction

Estrus generally occurs every three months, typically lasting 5 to 7 days with a range of 1 to 11 days (3; 4; 5; 6; 7; 8; 9; 10). The pair will begin exhibiting an increase in rough play and chasing behaviors a few days prior to breeding. These behaviors may continue throughout the estrus period. Copulation generally takes place in the water, but may also occur on land. The copulatory act is typically repeated several times a day over the course of 5 to 7 days and may last from 30 seconds to 30 minutes or more. Generally, this species produces one litter annually in the wild. Typical gestation ranges from 64 to 71 days.

Females exhibit more obvious indicators of sexual maturity to include subtle physical changes such as some nipple enlargement, and obvious behavioral changes consisting of extreme mood swings, aggression towards or attacking siblings, and obvious attempts to try and assume the Alpha role within the group. Other than testicular development, which completes at roughly two years of age, males do not show similar behavioral changes. Generally it is the sexually maturing females that present behavioral problems and cause social disruption in established family groups. Ex-situ population records show that at 2 years and 5 months, females can come into their first estrus, mate, and bear a litter at the age of 2 years 7 months. Males can mate at 2.5 years of age, with their first litter sired born when they are 2 years and 8 months. Due to limited records, it is not known if this is the earliest age at which giant otters can become sexually mature and bear litters.

Dispersal

Typically, dispersal of sub-adults occurs at roughly 2 to 3 years of age with young females inclined to remain longer in their natal home range than males. Young otters leave in search of a mate and a home range of their own.

The 12 Most Important Things About Caring For Giant Otters in Zoos

- They are a semi-aquatic, social species with groups based on multiple generations.
- They spend more time on land which means they require large spaces with adequate containment, good substrate for digging/rolling, hiding places, complex shorelines, and dens. The proportion of land to water should be 3:1 to 4:1 depending on enclosure size.
- They need well drained, dry, natural substrate land areas to maintain their health and coat quality.
- They need pools for swimming which offer water of appropriate temperatures, length, different depths, and complex shapes.
- They require protection from both cold and sun. Their comfort zone is between 10°C and 38°C. In temperatures below 1°C they should be given access to heated spaces and water. They always should be given access to protection from the sun with shady areas provided.
- They can be sensitive to loud noises and need privacy and well-designed dens to raise their cubs.
- They need a variety of good quality fish for their diet with nutritional supplements if it has been frozen.

- They need off-exhibit dens that offer enough appropriate entrances, space, good flooring, pools, and nest boxes.
- They need quality health care that provides vaccinations and monitoring of physical health.
- They need varied environments and quality care that offer physical, sensory, and interactive enrichment.
- They need fresh drinking water daily and to have their enclosures kept clear of uneaten food or accumulating feces.
- **Most important!** They require trained keeper staff that know the otters and are sensitive to their behavioral cues, eating habits, and physical health.

7 guidelines when considering housing giant otters at an institution.

- The size of the enclosure required
- Species husbandry knowledge availability
- Facility size and collection's resources need to be considered
- Should the otters breed; is the enclosure large enough to hold a family unit?
- Reliable fresh fish vendor source
- Experienced health care provider accessible
- Options to separate individuals in case the social group falls apart

***Special Note:** To date giant otters have never been housed with other species.

Enclosure, holding area/dens, and nest box size

Enclosure

Although giant otters enjoy and spend a great deal of time in water they are principally land animals and require dry land for social activities including resting, grooming, digging, raising cubs, and feeding. They are not aquatic but semi-aquatic, i.e. land mammals that swim, therefore the land area in the enclosure is more important than the water area.

Duplaix-Hall (11, 12) and Sykes-Gatz (9, 29) recommend a minimum size of 240 m² for a pair which includes indoor dens as well as outdoor exhibit space. Additional size should be considered for institutions intending to breed giant otters and maintain multi-generational groups. However, the land to water ratio is critical for the welfare of the otters (9, 29). Obviously, the enclosure should be as large as possible and have the correct land to water ratio. A minimum of 60% land to 40% water dependent on the size of the enclosure is recommended. This calculation should be used for indoor and outdoor areas. While smaller, highly complex and managed enclosures have been successful it is recommended that existing enclosures, not providing this balance, should be modified. The Giant Otter Husbandry manuals (<http://www.otterspecialistgroup.org/Library/TaskForces/OCT.html>) provide more detail but below are some examples from Sykes Gatz (29; page 13):

- 70 m² enclosures should offer 77% land/23% water
- 150 m² enclosures should offer 69% land/31% water
- 200 to 240 m² enclosures should offer 60% land/40% water

Indoor Dens/Holding Areas

Where seasonal daytime temperatures fall below 10°C to 15°C heated indoor enclosures (also referred to as dens) must always be available for giant otters; adults will only spend short times in air temperatures below 10°C. The minimum size of the indoor enclosure recommended is 75m²; the larger the group the larger the indoor area required. Examples of land/water ratio below are from Sykes-Gatz (29; pg. 13).

- 10 m² dens should offer 83% land/17% water
- 20 m² dens should offer 82% land/18% water
- 50 m² dens should offer 79% land/21% water
- 70 m² dens should offer 77% land/23% water

*An indoor pool is important where outside temperatures regularly fall below 10°C.

This indoor area should be divided into two to three separate dens (rooms) each with 2 nest boxes as parents like to move their cubs from nest box to nest box. Individual den sizes range between 4.5m² to 9.5m² (29). This arrangement allows the otters to be briefly contained in one of the rooms when necessary such as for cleaning purposes. (*Photo: two dens*)



Two, preferably three separate dens ensure keeper safety, otter privacy, and the extra den can be utilized during introductions. Each den must be able to accommodate the whole group at one time to avoid anxiety in the group. The dens should each have shift doors (sliding or guillotine door) placed so the otters have access through one to the main tunnel or doorway leading outside and one between other dens. A keeper door for easy, safe access into these dens is required and should be fitted with a visual panel if made of solid

material. All doors can be weather proofed using removable, cleanable, heavy plastic or vinyl car wash strips.

Indoor dens should be constructed of non-transparent materials e.g. concrete, gunnite, or brick thus ensuring minimal visual and acoustic disturbance to the otters especially when cubs are present. Sykes-Gatz (29; pg.19) reports: “*Fence/lattice mesh size that is 5 cm x 5 cm (2" x 2"), 5 cm x 20 cm (2" x 8"), and 2.5 cm x 2.5 cm (1" x 1") have been used to front dens. Mesh should be strong and prevent entrapment of body parts (toes, feet, and head).*” This mesh front, as an alternative to solid doors with windows, provides a location for behavioral training, and allows for easy visual assessment of otters. Indoor dens should have food portals, with doors that close and latch from the outside, large enough to allow fish to be fed through if mesh used for den fronts is not large enough to feed through. (*Photo: feeding door*)



Substrate for indoor housing should be as described in Enclosure Features and Complexity – Substrate and Vegetation; if hard surfaces comprise most of the flooring it is important to provide large, flat boxes filled with soft sand or sand/mulch mixtures for digging and resting activities. These alternative substrates should not include any sharp items like gravel, rocks, pebbles, or rough wood chips. They also should be kept dry at all times.

Provision of one or two tunnels leading from the outside enclosure to the indoor accommodation should be considered (9, 29). The tunnel should be large enough for one otter to move through easily without crawling or crouching (~40cm wide). (Photo: PVC tunnels into dens)



Constructing a 45° bend in this tunnel reduces potential draughts into the nestbox or den area (39). (Photo: tunnel from den to nestbox)

Otters frequently run directly from the pool into the dens without shaking excess water off their coats so it has been found valuable by two U.K. institutions (39) to screw a soft brush-head to each side of the entrance tunnel. These brushes

should be arranged so the otter can pass through easily and comfortably but the brushes are close enough to remove excess water from the otters pelt. The otters soon become habituated to walking through the brushes which also help to limit draughts in addition to removing excess water from their coats. Brushes should be replaced when they begin to break down. (Photo: brushes at den entrance)



The shift doors to the enclosure should be solid and be able to be locked open or closed; there should be locks on both sides of the door. Giant otters have incredibly strong forepaws and can lift unsecured sliding doors causing injury to themselves or potentially to the keeper. These inquisitive otters are able to unscrew bolts so daily checks of bolted down drains and other items are advisable.

The brush and tunnel arrangement can also be used on the entrance to their nest boxes (39). Ideally the otter should pass through 2 to 3 brush systems before finally entering the nestbox to keep it dry and the humidity low. Other options for drying the otters' coats in the indoor dens are providing large diameter logs, large bristle brush mats, or car wash strips that they

can roll and rub on. Such items should be monitored to ensure the otters are not chewing on them and removed for cleaning, drying, or disposal on a regular basis. Most institutions do not use the “brush and tunnel” system and have not had problems however, adequate substrates should be provided for the otters to dry their coats and feet on.

Ambient Temperatures

Heated indoor temperatures must be maintained at a minimum of 18° to 20°C. Giant otters are inquisitive and should be safeguarded from contact with harmful heating/electrical equipment. For example: if overhead infrared heat lamps are used these must be placed outside the physical reach of a jumping otter and secured firmly to the infrastructure of the building with a protective grill mesh cover. Heaters should also be boxed in a strong mesh container.

Nestboxes should be kept at 20°C and slightly warmer at 22° to 23°C during cub rearing (29). The increase in nestbox temperature during cub rearing should be accomplished by heating the den, not the nestbox itself as heating of the box directly can cause the environmental conditions to become overly dry (29). Indoor pools do not need to be heated providing the ambient temperature is within the above range.

Humidity

Since otters should always have water features available to them, humidity does not seem to be a factor in their outdoor environment unless it is excessive (> 70%) when it is hot as relative humidity and the corresponding heat index varies with temperature. High humidity causes the environment to become damp and the heat index to rise. To calculate the heat index of a given temperature and relative humidity, or dew point, go to <http://www.hpc.ncep.noaa.gov/html/heatindex.shtml>. Excessive humidity leading to an inability to adequately dry off or over-heating can be lethal for all otter species, and should be avoided. The industry accepted relative humidity of indoor exhibits should range between 30-70%. Nestboxes and dens should be provided with good ventilation and placed in locations that do not remain damp or humid for long. All substrates should be well drained and dry to prevent injury to feet, tails, and over-all condition of the otters.

Nestboxes

Nestboxes need to be large enough for all the otters in the group to sleep, nurse, move, and turn around in. Creation of a secure, safe nestbox space is considered key to successful cub rearing and maintaining compatible groups. Recommended size is 1m wide x 1.2m in length and 0.75m high (29); this may seem like a snug fit but it corresponds to the size of a family den in the wild. Larger boxes may be required for larger groups (29).

These should be constructed from wood or plywood and lined with a cleanable material (e.g. Corian®). The nestbox walls can be further sound-proofed by using insulated wall panels (e.g. Kingspan® or Celotex®). The entrance at one end is 30cm wide x 40cm high approximately, with a ledge of roughly 10 to 15cm to prevent cubs from falling or crawling out (29).

One long side or the top of the nestbox should be hinged as a door to allow easy access for inspection and cleaning. (*Photo: nest box*)

The nestbox is entered through a tunnel for privacy that also provides an extra area for family members to rest (29). Tunnel dimensions should be approximately 30cm long x 40cm wide and can be fitted with brushes or other similar fittings for drying off before entering the nestbox. Small holes should be drilled into the nestbox floor to aid in moisture drainage if needed; these holes should be small enough that appendages do not get caught (29, 39).



Underfloor heating or a heat mat may help maintain the required temperature in the nestbox. **During hot weather this should be turned off.** The underfloor heating or mat **should not** cover the whole floor area so the otters can move off if they become too warm. Please note all heat sources need to be monitored carefully to prevent skin burns or malfunctioning equipment. All electrical equipment should be waterproofed. Generally, giant otters do not like any bedding in their nestboxes or tunnels even during cub rearing. If provided the otters will remove it (29). Some collections have used heavy rubber mats on the bottom of the nestbox which can be removed and cleaned as required.

Nestboxes are dark, so the use of one or two infra-red cameras with microphones are a great advantage for monitoring the otters at rest or the mother and cubs from a distance without interruption. Wiring and camera should be protected with a PVC tubing construction (*Photo: cover for camera*). Details on how to do this can be obtained from detailed husbandry manuals or experienced institutions.



Enclosure features and complexity

The site of the enclosure should be situated away from excessive loud, frightening sounds and the public viewing areas restricted to specific sections to ensure privacy for the otters. Ideally, these public viewing areas should be constructed at the front of the enclosure so the otters can move towards the back of the enclosure if they wish to be quiet and rest. Visual barriers within the exhibit allow the otters to make a choice for privacy. Otters will acclimatize well to various everyday sounds over a period of time however, in zoos where there are new loud sounds, such as heavy machinery, the otters should be screened from them and have the freedom to retreat indoors.

Behaviorally healthy otters kept in appropriate enclosure conditions typically spend more of their daytime hours on land than in the water; note however, that some individuals may choose to spend more time in the water. As avid diggers and groomers, otters dig, root around, and groom extensively in soft loose natural substrates. They groom when wet or dry by rubbing, scratching, and digging into soft loose dry substrates, often covering their body fur with the freed particles. These behaviors are among the most frequently performed activities in zoos and aquariums, and otters will use the entire expanse of their land area to carry them out. Together with foraging, exercising, and frequent play bouts on land, these terrestrial behaviors constitute a significant proportion of otters' daily activities. These behaviors are also considered essential to maintaining the otters' behavioral health including adjusting to new or unusual situations, as well as to the promotion of successful cub-rearing practices.

It is important that otters be given sheltering locations in their outside enclosures to get out of the sun, rain, and other inclement or extreme weather conditions. Ideally they should have the option to enter their indoor dens at will, and is recommended in cold temperatures. If this is not possible den structures should be constructed in the enclosure. These can take the form of artificial caves, log, or rock piles as long as they cannot collapse or be pulled apart.

Substrate and Vegetation

It is best if the otters live on natural substrates with natural enclosure furniture (i.e. logs, grasses, and leaf litter). Use of hollow logs, non-toxic natural trees and small bushes, smooth boulders of varying sizes, grassy or sandy banks and other vegetation are important for the otters and create a pleasant habitat for the viewing public.

Suitable substrates are recommended to cover all indoor and outdoor areas of the enclosures where the flooring is unsuitable e.g. concrete, coarse soil, stones, smooth pebbles are unsuitable. Areas of high usage where the ground becomes hard and impacted will require extra substrate and regular turning of the soil. (Some facilities do not cover the entire indoor den surfaces preferring to provide large boxes filled with various substrates for the otters' use.) Suitable substrates include:

- Soft sand
- Pebble/rock-free soil
- Tree bark mulches - 2 types are recommended; however, many types could be experimented with. Recommended are:
 - Mulch with inflexible pieces with an average size of 4 to 6cm x 2 to 3cm wide and
 - Mulch with flexible pieces with an average bark size of 10cm x 4cm

The tree bark mulch can be used at varying depths with the minimum being 30cm up to 60 cm. Depending on use and weather conditions the mulch breaks down and should be topped up or replaced regularly to maintain the correct depth. At least twice a year, it is recommended, all the tree bark mulch should be removed and replaced with new, fresh tree bark mulch. This will vary depending on weather and use. Several areas of deep (≥ 60 cm), soft sand or sand and mulch mixed are recommended to encourage digging as this is a natural and important social activity. Deep holes should be filled in regularly with fresh sand to prevent collapse on an otter. All areas of naturally vegetated land should be checked regularly and turned over or replaced to ensure they do not become hardened by overuse or water logged due to poor drainage.

IMPORTANT NOTE

To avoid health problems i.e. foot and tail abrasions, fungus infections, limping, or bunny hopping which can indicate spinal problems it is important that all the substrates are kept clean, soft, and well drained. Daily checks of the substrate condition will result in fewer health issues.

Enclosure Perimeters

Giant otters are strong and potentially dangerous. They can be aggressive towards each other and other species, including humans. Enclosures must be designed with these considerations in mind. Each institution should have an “escape plan” as well as escape equipment in place for use in emergencies.

Giant otters are excellent diggers and reasonable climbers therefore fencing should be buried approximately 80cm into the ground angled (cantilevered) inward if possible as well as 180cm high (9, 29). If using chain-link or other climbable material, it is important that it is topped with a 90° horizontal, cantilevered, non-climbable overhang extending 60 to 80cm into the enclosure. Bricks, stone and concrete (gunnite) walls must be finished smoothly so they are not climbable. Hotwire can be placed at the top edge of the containment barrier or fixed to the overhang. Hotwire must never be accessible to an otter in the water and should be checked regularly to ensure it is working correctly. Some collections have electrical barriers midway up the containment barrier, as well as along the top of the barrier, to prevent otters from climbing too high and then falling back and injuring themselves. Toughened reinforced glass, thick Plexiglas[®], and acrylic panels are recommended as viewing areas for guests.

Because otters can climb -- trees, large shrubs, and rocks must be located away from the exhibit perimeters so they cannot be used as escape routes. Evaluating the exhibit trees' health and stability quarterly is advisable. Trees close to the perimeter or with accessible overhanging branches should have a 1m wide aluminum flashing or cuff fitted at approximately 1m up the trunk, or electrical barriers to discourage climbing. The perimeter fence must be checked visually daily and the electric fence tested.

All gates into the enclosure require a double entry system to avoid escapes when entering or exiting. Gates can be made of mesh (5cm x 5cm) or solid material. If using solid doors a viewing panel is necessary so the keepers can establish the whereabouts of the otters before entry. Entering an enclosure with an otter present is not advised.

Outdoor Pool

Both natural and artificial pools can be successful with the former providing greater enrichment provided it can be drained. All pools should be designed to include:

- Shallow areas i.e. 12cm to 20cm for wading and easy entry and exit from the pool. Shallow areas are also helpful for cubs learning to swim and for sick or older otters. Otters will eat in shallow areas along the pool edge.
- Deep areas – There should be several at least 1 - 2 m in depth (29) to allow the otters to swim with its natural undulating rhythm.
- The pool sides should be non-abrasive (gunnite/concrete pools may be utilized at some collections but should be non-abrasive) and gently sloping for an easy and safe access/exit.

Pool shorelines should be irregular (e.g. not circular, oval, etc.) with rock or log features that provide places for the otters to lay-out and sun themselves.

- Pool bottoms should be gently sloping without sudden drop-offs.
- Partially submerged large branches and trees overhanging the pool are good enrichment for otters while in the pool and add aesthetic value.
- To prevent excessive substrate material entering the pool thin logs or similar can be bracketed together forming a small edge to the pool side (29).
- Drains and filters should be covered with wire mesh to prevent substrate entering the filtration or drainage systems. Drain covers should be bolted down as giant otters are able to remove drain bolts easily.

Indoor Pool

In temperate climates an indoor pool is useful for both temporary and permanent use. Indoor pools range in size from 2m² to 7m² and must be at least 40 - 70cm deep (29). For easy access the pool can be sunk into the floor with steps, or substrates can be raised to the upper edge of pool. Wooden ramps leading up to the pool have proven less successful than the use of shored up substrate. Water tanks with ramps can be used but should be emptied and filled with suitable natural substrates when not in use (29). When cubs are present caution should be taken to insure they cannot fall and hurt themselves when using this type of tank setup.

Giant otters rarely shake their coats dry after swimming therefore the greater the distance between the water and nestboxes the better for maintaining dry nestboxes. This situation can be further enhanced by using soft brushes on the entrance tunnels of the nestboxes, previously described, or car wash strip material along with large diameter logs for haul out/dry off areas.

Giant otters in collections in the northern hemisphere may have access to outdoor pools even in snowy conditions. This has not been shown to be detrimental to the otter providing the water is not frozen over and they have permanent access to their heated housing after a swim. However, should the ground become icy and hard rather than snowy they can be kept indoors with an indoor pool for short periods.

Pool Maintenance Recommendations

Giant otters urinate and defecate on land but they do eat in the water so it is important to keep the pool clean. Most facilities use a variety of filtration and water treatment systems. These include biological, chemical, and mechanical filtration that may include chlorine, bromine, or ozone among other methods of water treatment. If filtration is not used water should be changed regularly and pool sides monitored for excessive algal build-up. It is recommended pH levels are monitored daily and coliform levels are monitored weekly. If chlorine is used, it should be kept below .05ppm and monitored closely as it can damage otter coats. It is also recommended that the water in artificial pools be drained and refilled on a weekly basis or, as needed, depending on the type of filtration system being used. Natural ponds/streams with good flow-through water do not need regular cleaning but may require draining to ensure they remain clean and at an adequate depth.

Water Quality Checks

The health of the water is just as important as the health of the otters. It is recommended that the following water quality tests be carried out on all pools and water sources.

- Daily- alkalinity, pH, chlorine, and temperature.
- Weekly, bi-monthly, or monthly coliform tests.

A comprehensive log should be kept with all test results noted and if needed the entire filtration system or the pool cleaned.

Cleaning

Clean water for drinking should always be available and changed daily. Water and food bowls should be cleaned and disinfected daily as well.

A cleaning schedule should include:

- Daily spot cleaning of natural substrates, i.e. removing fecal waste, urine soaked substrate, left over fish, bones etc., and any other contaminated substrate.
- Regular hosing down of hard floor areas where otters defecate and urinate and removal of fish scales and uneaten fish.
- A regular schedule of disinfecting hard floor surfaces, walls, etc. should be maintained with all disinfectant washed down after cleaning.
- The floors should be left as dry as possible by using rubber squeegee mops and/or fans and de-humidifiers before covering the floor with fresh dry substrate.
- Enrichment toys can be washed, disinfected and dried when required.
- Removal of uneaten fish overnight limits the attraction to rats that may transmit leptospirosis or other diseases and also prevents the otters eating spoiled food.
- Hard, compacted areas of soil, mulch, and sand should be loosened and turned over daily as necessary to keep it soft and prevent abrasions to the otters' feet and tails.

Social Group Recommendations

There is a high degree of “pair-bonding” in giant otters; in captivity they become stressed and anxious when separated for a short time, with some individuals, even two minutes apart, can cause anxiety. Thus, it is important that they are near and within sight of each other constantly. In each family group the breeding female is the dominant controlling member and all group members are influenced by her general behavior and emotional state. Cubs remain with the family group for at least 2 years; during this time non-harmful confrontations or minor aggressions often occur during feeding. While these should be monitored they are normal unless injury or escalation is observed.

Recommended social groupings are:

- A male and female pair, usually for breeding.
- Family groups containing young up to ~2 years of age.
- All male groups - usually 2 but rarely 3 or 4 male giant otters can be kept together successfully. They should be reared together or if unfamiliar a slow, patient introduction process is necessary. This grouping is recommended for non-breeding institutions.

- Adult female groups are NOT recommended as this commonly results in significant injury or death. If a grouping of this type is contemplated for management reasons other institutions should be consulted first (see last point).
- Juveniles, same sex, and unrelated otters should be introduced to each other before reaching sexual maturity. Slow, patient introductions are required and only 2 or 3 individuals should be together in the group.
- A breeding female and her female adult offspring can remain together providing they have never been separated. However, extra vigilance is necessary during breeding seasons.
- Two U.S. institutions have mother and male adult offspring living together and one has mother and mixed sex adult offspring living together. In the mixed group all of the females have contraceptive implants.

Group Management and Introductions

Group Management

This species lives in family groups with pairs and older offspring jointly raising new cubs. Therefore, a pair should never be separated during pregnancy or cub rearing. Typically, animals should not be separated from the family group unless health problems, change in social status, or family friction develops. Removal of any member of a group during cub-rearing, or close to parturition, will likely cause litter loss.

Separation of group members is not recommended however, through appropriate operant conditioning to prepare for possible veterinary procedures giant otters can become acclimated to short separations and successful reintroductions after that separation. Animals separated for extended periods should be put through a standard introduction; including visual, acoustic, and olfactory contact first, and then physical contact. Even a few days of separation have been known to be long enough to cause difficulty, such as serious fighting, when reintroduction was attempted. Secondary accommodations should be provided for giant otters to allow for the temporary separation of family members if needed. These secondary enclosures should provide husbandry conditions similar to primary enclosures.

Cubs from previous litters up to the age of about two years generally stay with the family group (22); after this time, they emigrate to set up a new family group. In the wild, Duplaix (2) reports that sub-adults may leave the family group after 2 years, before birth of the next litter, or be pushed out by the adults with a fight. Staib (24) found that animals dispersed at the age of 2 to 3 years, and separations were gradual, without aggressive behavior.

In zoos and aquariums, offspring should be left with the parents for at least the first 6 to 12 months of life, but preferably they should be left together until they reach sexual maturity at approximately 2 years of age (9,10, 25, 29). This provides a more natural social structure, and allows older siblings to gain experience helping to rear cubs, which is highly beneficial towards developing their future parenting skills. Caution should be taken, as in one case three zoo-born otters between the ages of 6.5 and 8.5 months were suspected of competing for milk with their younger siblings. This behavior persisted over a two-month period, causing the death of a younger sibling and the necessary removal of the emaciated survivors for hand-rearing (15). In two other cases, sub-adults were suspected to have caused litter loss because of their over-zealous play with, and attention to, their younger siblings (15, 26). However,

experience has shown that removal of any member of a giant otter group during cub-rearing or close to parturition will likely cause litter loss due to the excessive stress caused to the parents by this human disturbance and unnatural social structure change (9, 10, 29). If it is necessary to remove a group member from a breeding pair, it should be done when the mother is not pregnant or at the latest in the early stages of pregnancy. Cubs younger than 6 months of age should not be removed.

Based on years of experience the authors offer these guidelines as key to their successful management and breeding of this species:

- ✓ High level of the otters' intelligence and their willingness to participate in operant conditioning (training).
- ✓ Keepers' ability to know personalities of individual otters and understand how each fits into the group dynamic.
- ✓ Keeper/animal bond and noting observations of otters' group cohesiveness through family bonding.
- ✓ Strong social bonds are key to the success of the group; this includes the keeper.
- ✓ Maintaining consistency before, during, and after cubs (includes; keeper activity schedules, routine noises such as radio playing or noise level in general, cleaning, and operant conditioning).
- ✓ Allowing the otters to become accustomed to all keeper activities and multiple keepers.
- ✓ Close observation of postnatal development and family structure dynamics including changes (sibling interactions, methods and level of aggression when teaching cubs to swim, and social status of each individual).

Introductions

Giant otters being introduced for the first time or even those individuals who have been temporarily separated for more than a few days should be introduced following these guidelines. All phases of introductions need to be monitored and carried out by experienced keepers, in particular staff that are known to the individual otters. Introductions should be carried out in areas where the keepers have full control should an unexpected situation develop. All participants should review and understand the introduction plan before introductions proceed.

ALL introductions should proceed along the following steps (9, 29, 40):

- Step 1 – Olfactory and auditory;
- Step 2 – Visual, olfactory, and auditory;
- Step 3 – Physical introduction;
- Step 4 – Monitored association

Step 1 Olfactory and acoustic exposure; familiarization with outdoor enclosure

- Otters to be introduced should be kept in separate dens with auditory and olfactory contact only.
- Switching of substrate material and feces between dens is helpful during this and all stages of introductions.
- Each otter should be given daily time in the enclosure to familiarize themselves with the smells, sounds, design, and terrain. Each otter can be rotated in for part of each day.
- This phase should be continued until the otters coexist in this situation with no behavioral problems.

Step 2 Visual exposure

- Otters should be allowed visual access through a “howdy” door or gate; they can see, hear, and smell each other but not touch each other. A “howdy” gate is made of fine mesh (1cm x 1cm) double thickness netting, strong lattice fencing, or from Plexiglas®. This is to provide a protective barrier to prevent the otters touching each other and causing injury to tails, paws, and noses. The “howdy” gate allows the otters to see both size and body posturing of the future partner. After approximately a week of visual contact without aggression problems the keepers can progress to full contact between the otters.
- It is important at all stages to provide appropriate visual barriers and escape routes for all otters involved in this process; particularly during Step 3.

Step 3 Physical introduction

- A well thought out plan must be in place, all appropriate staff present (multiple keepers, veterinarian), tools (hose, blow pipe for darting) etc.
- Full contact must only be initiated after both otters have shown continual positive interaction and calm interest in each other.
- Introduction should be conducted in a neutral area (not one of their dens) where otters can hide or escape from one another and keeper staff can quickly intervene if aggression occurs.
- Both otters should be allowed into the introductory enclosure together; their behavior will dictate how long they should remain in contact - any signs of stress, fatigue or aggression separate them by closing them into their own dens and try again another day.
- Some screaming, lunging, and stand-offs may occur but it is the keepers’/veterinarians’ decision when unacceptable signs of aggression are displayed.
- Introductions should be gradually increased in length over several days.
- Keepers should be present for all physical introductions until the otters are cohabiting without aggression both indoors and outdoors.
- Pools levels should be reduced as one otter may try to drown the other (typically the dominant female is the aggressor towards new adult males, sub-adult males, males or subordinate females).

Step 4 Monitored association

- Giant otters are usually able to remain together permanently if they are exhibiting positive behavior to each other and are sleeping side by side.
- Many institutions still separate them for the first few nights even if they are showing positive signs of compatibility; in these cases they are separated by a fence so they still have visual, olfactory, and auditory contact.
- If all goes well they may be able to stay together after the first day of physical introduction but if there are any doubts regarding their behavior to each other it is wisest to separate them again and repeat the following day.
- Keepers need to remain vigilant over the first several days as stress, anxiety, dominance, and minor fights may occur. Providing these are only minor occurrences the otters should remain together.

NOTE:

All of the above steps must be done slowly and at the otter’s pace; if any aggression is apparent go back one or two steps and start again. Time spent at each stage leads to a safer

outcome. Depending on the otters' personality, sex, and age each period could take a couple of weeks or a couple of months. Take notes to track progress and ensure all keepers are informed of the progress and behavior. Be patient and vigilant.

Feeding Behavior, Nutrition and Diet

Giant otters are piscivorous or fish eaters. In captivity, they require a healthy, balanced, enriched diet that accommodates eating preferences. Staff should work to avoid any fixation on fish types by individual otters (some otters tend to have preferences for certain fish depending on the season and/or size of the fish) because of potential future shortages in supply. Recommended diet is almost exclusively fish with additional vitamins and mineral supplements. Food from their daily quota may be offered as behavioral enrichment or part of training programmes. Giant otters do not forage on land so land-scatter feeding for enrichment, as used for other otter species, is not required.

Feeding Guidelines

(Adapted from 9, 29, 41)

- **Fish** - must be good quality fresh-water fish, which is low in thiaminase and fat.
- **Fresh fish** is fed whole with bones and organs intact.
- **Frozen fish** must be completely thawed before feeding to the otters and all fish eggs removed.
- **Vitamin/mineral supplements** (further information below) are required to cover the loss of nutrients occurring during the freezing/thawing process.
- **Types of fish** should be a variety of good quality, fresh-water fish low in thiaminase and fat as the main diet (14). Saltwater fish, high in fat, should only be offered occasionally.
- **Live fish** can be fed (check with veterinary staff protocol and legality before doing this) and offers both a good source of nutrition and enrichment. It is important to verify the quality of the fish as poor quality fish may carry diseases and parasites.
- **Quantities** fed will vary; an average amount fed is up to 4kgs of fish per day per otter; typically 2 to 3 kg. Carter et al. (1999) report on average, captive otters eat 10% of their body weight per day (cited 37; pg.19). Hot or cold weather, amount of physical exercise, age, and general health will affect the average quantity.
- **Lactating or pregnant** females require an increase in food intake to approximately 6kg/day, or as much food as she can consume when lactating. Females and cubs are fed ad lib until satiated.
- **Uneaten fish** should be removed every day for hygienic reasons.
- **Fresh drinking water** should be available at all times both indoors and outdoors. Consider using insulated water bowls and/or an automatic watering pipe such as Lixit®'s for colder climates. Place buckets, tubs or any type of stable, indestructible, and immobile water container in a strong metal/wooden frame attached to the wall of the building to prevent spillage.

One experienced U.S. facility reports (41) that the feeding of high quality fish species similar to those the giant otter consumed in the wild has “*proven to be both well received and to maintain the animals in excellent condition*”. This otter species should be fed 3 times daily at a minimum, most institutions feed 4 or 5 times daily and some offer up to 8 feedings. Many institutions report less than 4 feedings per day increases agitation, undesirable vocalizations, and decreases focus on the keepers. Results of a survey of facilities housing this species

indicate that all of these institutions offer fish daily (thawed, frozen, live, and/or freshly caught) as the main diet.

Fish species offered include the following:

- Carp (*Cyprinus carpio*)
- River fish (unidentified)
- Tilapia
- Redeye (*Rutilus rutilus*)
- Common bream (*Abramis brama*)
- Felchen (*Coregonus albula*)
- Channel catfish (*Ictalurus punctatus*)
- Roach
- Herring* (*Clupea harengus*)
- Mackerel* (*Scomber scombrus*)
- Rainbow or Brown trout*
- Salmon*

Fish species marked with an asterisk () are high in fat and should be used only as a training reward or for vitamin delivery; other species used occasionally for rewards are catfish and small tilapia. Any fish routinely fed can be used for training as well as vitamin delivery.

Following is a list of fish, by family, determined to be consumed by wild giant otters (36; cites several sources; pg.18-19); *members of these families identified less often by observation or in scat:

- Cichlidae (Cichlids)
- Erythrinidae (Trahiras, Tarariras)
- Characidae (Tetras)
- Anostomidae
- *Prochilodontidae
- *Auchenipteridae
- *Doradidae
- *Loricariidae
- *Pimelodidae
- *Gymnotidae
- *Sciaenidae

Vitamin Supplements Information

If thawed frozen fish constitute the bulk of the diet the otters should be given supplementary B₁ (thiamine) and vitamin E. To ensure each otter receives its daily supplements it is best practice to place the vitamin/mineral into the throat or gills of a small fish and feed/throw to each otter by hand.

Fish types containing high thiaminase and/or high polyunsaturated fat levels should be avoided as they can cause malnutrition, sickness, and even death (43). Diets containing fish high in thiaminase can lead to thiamin (vitamin B₁) deficiency in the otters fed this diet (43 cited in 41). The process of fish storage (freezing), thawing, and preparation, can lead to fish nutrient loss, particularly vitamins B₁ and E, and especially in fish with high fat and/or high thiaminase content (42 & 43 cited in 41).

Vitamin supplements of vitamin B₁ (thiamin), vitamin E, and a multivitamin, should be added when fish is the main diet. The recommended vitamin supplementation regime for fish eating animals is as follows (41):

- Thiamin: 25-30 mg/kg fish fed, fresh weight as fed basis (27)
- Vitamin E: 400 IU/kg dry weight basis (28)

Based on the information above, the following food items represent a sample diet for giant otters (9, 41):

- 2 to 3 kg fish/day/adult

- 400 IU Vitamin E daily
- 100 mg Vitamin B₁ daily
- Multi-vitamin/mineral supplement 3 times per week

Note: Other institutions offer 400 IU Vitamin E three times per week; 100 mg Vitamin B₁ daily and a multi-vitamin daily.

Speak to your veterinarian or nutritionist for the appropriate and available vitamin and mineral supplements. Listed below are commercially available supplements used for giant otters. In many countries some of these supplements are available online at Amazon.com. If you require advice on nutritional supplements please contact one of the nutritionists listed in the contact section.

- ✓ Aquavit[®] is a nutritional vitamin and mineral supplement designed for fish eaters in captivity and is available from International Zoo Veterinary Group www.izvg.co.uk
Information on content available at: <http://www.izvg.co.uk/aquavits.pdf>
- ✓ Mazuri[®] marine mammal fish eater vitamins are similar and may be found at many on-line sites. Information on dosing can be found at http://www.mazuri.com/product_pdfs/Mazuri%20Marine%20Mammal%20Tablets.pdf
- ✓ Centrum Adult – or equivalent
http://www.amazon.com/s/ref=nb_sb_ss_i_0_9?url=search-alias%3Daps&field-keywords=centrum%20adult&srefix=Centrum+a%2Caps%2C165
- ✓ Thiamin 100 mg http://www.amazon.com/s/ref=nb_sb_ss_i_2_7?url=search-alias%3Daps&field-keywords=thiamine+100mg&srefix=Thiamin%2Caps%2C134&rh=i%3Aaps%2Ck%3Athiamine+100mg
- ✓ Natural Vitamin E (d-alpha tocopheryl acetate) 400 IU
http://www.amazon.com/s/ref=nb_sb_ss_c_0_17?url=search-alias%3Daps&field-keywords=natural+vitamin+e&srefix=Natural+vitamin+E%2Caps%2C132&rh=i%3Aaps%2Ck%3Anatural+vitamin+e

How to Feed

Giant otters are highly protective of their food therefore the otters should be fed a distance apart from each other to avoid unnecessary confrontation. These otters learn quickly and respond well to keepers conditioning them to be stationed (position themselves and stand) at their individual feeding areas (40, 41). Hand-feeding is recommended, i.e. throwing each otter a fish ensuring each otter finds it and takes it away to eat then immediately throwing another fish to the next otter (40, 41). This ensures the keepers can check every otter is taking and eating enough fish at each feed and no aggression is created during feeding time. It is important to remove all uneaten food every day, particularly in warmer months. Sick or injured otters may need to be fed smaller meals more frequently throughout the day. Finally, it is quite possible captive otters will enhance their diet by catching whatever prey ventures into their enclosures e.g. frogs, birds (herons, ducks), rabbits, and other small wildlife. This should be watched for and otters monitored if any of this predatory behavior occurs.

Reproduction and Cub Rearing

More detailed information on reproduction, cub development and mother- or hand-reared cubs can be found in many of the works which are listed in the Reference Section or by contacting individuals on the contact list who are experienced. More detailed giant otter husbandry manuals are available on the IUCN Otter Specialist Group website, OZ Task Force link (otterspecialistgroup.org).

Reproduction

There can be an estrus 5 to 7 days post-partum/post-loss of a litter that lasts for 3 to 5 days (5; 6). Delayed implantation occurs in zoos (8, 9, 10, 15) and false or pseudo pregnancies are not uncommon in this species (9). The typical gestation ranges from 64 to 71 days. In one case a gestation of 77 days occurred in a 9-year-old however; this was unusually long for this female (3, 4, 5, 6, 8, 9, and 14). Often the female's mammary glands become enlarged 30 days prior to parturition and the vulva may become swollen about 14 days prior.

Giant otters (particularly mothers) are susceptible to any human disturbance especially within the surroundings of the natal den, and to discomfort created by enclosure variables (9, 10). Several steps have been recommended to increase the comfort of the reproductive pair and older siblings, and improve cub-rearing success (9, 41):

- ✓ Build a positive keeper-animal relationship and allow only familiar staff to work with the otters after parturition.
- ✓ The provision of food and clean water should be accomplished with minimal disturbance to the otters during cub rearing.
- ✓ Cleaning should be minimal and not disruptive to the otters.
- ✓ Reduce stress as much as possible, including loud sounds, unfamiliar people, and the introduction of anything new to the exhibit.
- ✓ Prohibit visitor and zoo staff (other than immediate caretakers) access to the enclosure area.
- ✓ Provide multiple nestbox choices located in separate locations to allow parental choice according to their comfort level.
- ✓ Provide appropriate substrate and exhibit conditions to include the recommended land/water ratio, substrate depth, digging opportunities, and dry substrate conditions.
- ✓ Isolation of the natal den and limitation of all human activity in the vicinity at, prior to, and just after the birth is very important.
- ✓ Monitoring of the natal den and early cub rearing should be done from a hidden location or carried out via audio and video monitoring equipment with infrared capability.

Exhibits should be provided with multiple den sites; these can include both natural (e.g., dug by the otters) and man-made dens. Dens are often 4.5 to 9.5m² in size (9, 29). Ideally, nestboxes just large enough to hold the adults, older siblings, and cubs should be placed within the dens to allow the parents choices and maximum privacy. Dens should be provided in locations where the animals are removed from all outside disturbances (9).

Nestbox temperatures should stay above 20°C (22° - 23°C). Den area temperatures (where nestboxes are located) were increased to 22° to 23°C during cub-rearing at one institution (15). Giant otters in zoos have been observed to have a low heat tolerance (9, 10, 17, 29), and cubs can be very susceptible to overheating or becoming too cold. Very young cubs especially do not thermo- regulate well (18). Cubs <5 months of age should not be exposed to air temperatures below 15°C, and cubs >5 months of age should not be exposed to air

temperatures below 10°C (9, 29, 41). Parents should be prevented from taking cubs outside if temperatures fall below these parameters.

In at least the first days after parturition, mothers have been seen to be protective of the cubs when the father tries to become involved with them. This is not abnormal behavior. Soon afterwards, the father will become equally involved (and his involvement will be accepted by his mate) in the care of cubs. Under normal conditions, it may appear that both parents and older siblings sometimes treat their cubs a little roughly. This kind of behavior may be carried out whether otters are in the nestbox, on the land, or in the water. This is especially evident when parents or older siblings are teaching cubs to swim. This seems to be normal behavior for giant otters. However, the situation should be closely monitored to ensure that parents and older siblings are not actually too rough with their cubs, as this is abnormal. Starting at 2 to 3 weeks of age, parents will push cubs under the water then let them go to resurface on their own or with help. This may be repeated several times to teach them to submerge (3). Parents and older siblings have been known to teach zoo-born cubs to submerge starting at 2 to 6 weeks of age by holding the cub with their front feet and rolling over sideways 360° a few times; this has been called ‘Eskimo rolling’ (10). Cubs may also be gently pushed or pulled into the water to encourage swimming.

The following is a list of parental and older sibling behaviors observed in zoos that often resulted in cub death and may be a result of sub-optimal environmental or rearing conditions (9, 29, 40).

- Cubs handled, carried, or moved to pools or new nestboxes too frequently.
 - Older cubs may tolerate more frequent moving, generally no more than 3 times a day. In general, cubs should not be moved to new nestboxes on a daily basis or, at most more than once or twice a day. Frequent movement of cubs should be closely monitored without disturbance to the parents.
- Frequent entering of the nestbox by the parents, e.g., 1 to 3 times per hour is normal, more can be abnormal.
- Generally, cubs < 2 weeks of age should not be taken into pools, if this occurs it is rare and should be closely monitored.
- Cubs 2 weeks old or older should not be taken into pools more than 1 to 2 times per day.
- Excessively forceful pushing or throwing of the cubs into pools or elsewhere may be indicative of a problem and should be monitored, without disturbance to the parents. In general, excessively forceful, rapid, or uncoordinated interactions with cubs are abnormal.
- Inappropriate mothering behavior by the mother may include:
 - Neglecting the cubs, not lying still or lying incorrectly preventing cubs from nursing, not staying long enough to allow for sufficient nursing by the cubs, not visiting the cubs frequently enough to allow for sufficient nursing, and pulling cubs off their teats.
 - These behaviors may indicate an inexperienced or stressed mother, or problem with lactation such as insufficient milk production. This failure to produce sufficient milk has been known to occur for varying periods of time as a reaction to stress.
 - Biting, hitting, or laying on the cubs.
 - Attempted drowning of, or eating cubs.

Cub Development

- Cub or pup Day of birth to 6 months
- Juvenile 6 months to 1 year of age
- Sub-adult 1 – 2 years of age

An outline of giant otter cub development is provided below (6, 9, 10, 13, 14, 16, 41):

- Weight at birth – 150 to 265 g
- Birth pelt is grayish in color and darkens by 6 to 7 weeks of age
- Nursing “hums” (9), heard from day 1 when cubs are successfully nursing
- “Tail wagging” (9), also observed when cubs are nursing successfully
- Nursing occurs often throughout the day
- Eyes begin opening at ~28 days and are fully open by ~45 days
- Cubs should be moving on their own by 39 to 50 days
- First leave the nestbox on their own at 63 to 67 days
- First swimming lessons at 20 to 60 days, or as early as 11 days in rare cases
- Cubs can be reliably sexed at 10 weeks (See Appendix 1)
- Cubs swim on their own for the first time at 63 to 67 days
- Cubs will begin playing with solid food at roughly 56 days, but generally do not consume any until about 70 to 90 days.
- Cubs will begin weaning at roughly 4 months of age, but can nurse insignificant amounts (this provides little nutritional value) until 6.5 to 8 months of age.
- Fish should first be offered cubs at 2.5 to 4 months of age
- 100% of their required caloric intake should be offered in formula/mother’s milk form until roughly 2.5 months of age

When hand-rearing:

- Cubs should be weaned from formula between 6.5 to 10 months of age
- Cubs should be weaned on a fish based diet; rice cereal has been used successfully as a dietary addition for hand-reared cubs. Formula should not be offered in a bowl, as giant otters tend to inhale liquids into the nose until they are proficient at eating solid foods.
- Cubs are approximately $\frac{3}{4}$ the size of adults at 10 months of age, although this will vary

Cub Rearing

Giant otters are highly susceptible to stress so typically it is not advised that cubs be removed from the family group for regular weighing, measuring, etc. However, some females have been comfortable with brief separations during which cub wellness checks and weighing/measuring can occur; this should be assessed on a case by case basis (40). Cub development and health should be monitored via video or from a distance. Hand-reared cubs should be weighed daily at the same time and before a feeding. Detailed information on mother-reared cubs and hand-rearing cubs is available in giant otter husbandry manuals.

It is recommended that contingency plans for hand-rearing of cubs be developed but only undertaken to save the life of the cub. Advice and additional resources are available from any of the contributors to this document.

Health care

The giant otter husbandry manuals provide extensive health care information. All new animals to an institution should be quarantined to prevent transmission of disease to resident otters. These animals should undergo fecal exams for parasites and treated accordingly. If separate quarantine facilities are not available they should be kept apart from other otters until determined parasite free and healthy by veterinary staff. Listed below are some general recommendations as well as health issues experienced by giant otters at reporting institutions. These are samples of veterinary issues on record as impacting giant otters in zoos, etc. with suggested causes and possible solutions. Veterinarians should always be consulted immediately when any health or nutritional issues are identified.

Vaccinations/De-wormers:

Consult your veterinary staff for appropriate administration of de-wormers and regionally recommended vaccinations. Veterinarians should consult with experienced colleagues before administering any vaccinations in this species to verify efficacy and safety.

Anesthesia/immobilizations

Anesthesia or immobilizations of giant otters should only be performed when there is a medical indication for the procedure. Preventive immobilizations are of high risk for the animals, and should be substituted with regular visual examinations and testing of fecal samples, vaccinations, etc. Administration of transponders, examination of the oral cavity, blood sampling etc., should be completed only when immobilizations are necessary for medical reasons. Evaluation of the reproductive tract can be performed in animals that are regularly involved in a medical training program. In well-trained animals, sonography of the uterus may be possible, as well as the visual or palpable inspection of mammary gland and testicles.

Due to their large size, a deep IM injection is recommended for good anesthesia. The breathing of the animals should be carefully monitored, and the temperature tested frequently to avoid hyperthermia (20). The following anesthesia protocols have been used with giant otters (41):

- Ketamine at 7.5 mg/kg (5-10 mg) in combination with Xylazine at 1.5 mg (1-2 mg/kg). Combining Ketamine with Xylazine (Rompun[®] 2%, BayerVital GmbH, 51368 Leverkusen) gives a short-term anesthesia with good muscle relaxation and analgesia. Xylazine may be reversed with Atipamezole (Antisedan[®], Pfizer GmbH, Pfizerstraße 1, D-76139 Karlsruhe) (19).
- Give Xylazine at 2.5 mg/kg, wait 15 minutes and give Ketamine at 2.5 mg/kg; when done, reverse with Yohimbine (20).
- For a single injection, use Medetomidine 0.03 mg/kg and Ketamine 3 mg/kg, and reverse with Atipamezole 0.125 mg/kg. Although easier to use, this regimen can lead to poor breathing at the start of the procedure (20).
- One institution reported needing to use 0.04mg/kg Medetomidine and 4mg/kg Ketamine and then after 15 minutes another 1.5mg/kg Ketamine so they could draw blood from a young adult male.
- Supplemental oxygen should always be available for administration, if necessary. For longer procedures, animals should be maintained on Isoflurane.

Contraceptive Use

European institutions have used Suprelorin[®] implants in males at a dosage of either 4.7mg (duration about 6 months) or 9.4mg (duration about 12 months); it becomes effective in 4 to 6 weeks (45). The individual's libido is reduced, the animal is less aggressive. Visual effect is the reduction of the testicles. The method is fully reversible. Some institutions have used Suprelorin[®] implants in females to inhibit reproduction with some success in reducing aggression. At this time this is the suggested form of contraception for small carnivores. However, before use veterinarians and curators should consult with other institutions for additional information on efficacy and potential side-effects (41).

Information on these implants is available at:

<http://www.stlzoo.org/animals/scienceresearch/contraceptioncenter/contraceptionrecommendatio/contraceptionmethods/suprelorin-deslorelin/>

Crating or Catching For Moves or Transports

Listed below are some standard recommendations for transporting any giant otters.

- Giant otters should never be sedated for transport. Ideally an otter should be acclimated to transport crates and trained to enter them willingly.
- Sykes-Gatz (9) states that giant otter should not be transported in hard plastic containers in situations other than within an institution.
- Airlines and IATA regulations should be consulted for appropriate transport containers for this species when moving them by air.
- It is very important that the relevant IATA and airline regulations be checked prior to constructing all shipping containers and complied with to ensure acceptance by the transport carrier.
- It is advisable to ship this species without a wire mesh lining inside the crate, as it could be harmful to their exceptionally sensitive footpads and webbing between the toes. Lining of this type has not been proven necessary for safety when transporting this species in appropriately constructed crates (9).
- One experienced institution utilizes the ZooPro[®] crate (Knapp Manufacturing - <http://knappmanufacturing.com/Zoo%20Pro/Zoo%20Pro.htm>); this crate is all metal with appropriate ventilation and built in water bowl, typical size is 51'x36'x33'.
- It is recommended that this species should not be transported in temperatures below 10° C (50° F) or above roughly 15.5° C (60 °F). Otters are very susceptible to over-heating.
- As far as possible, noise should be kept to a minimum (including sudden loud noises, constant high-pitch noises, or anything considered uncomfortable to people), and the animal kept in low light conditions.
- Otters should not be maintained in shipping containers for longer than 24 hours without food and water. Directions on what should be done in the case of an emergency that necessitates animal treatment should accompany all animal shipments. If access to an animal is required due to illness or extended shipment delays, the shipping/receiving institutions should be notified.
- Upon arrival at their destination, shipping crates should be placed inside the quarantine holding pen, the door opened, and the animal left to exit at will. All holding pens should be provided with food, water, alternate hiding places, appropriate bedding, and enrichment structures.

Health Issues

This list of common health issue symptoms and solutions has been taken from multiple sources including citations 9, 29, 40, and 41.

Feet

Symptoms include lameness; feet, webs or toes changing to pink or showing red sores/lesions; excessively dry feet, or swelling of the feet. This can be caused by substrates that are too rough, hard, are poorly drained so remain too wet, and/or poor water quality.

Solutions: Improve substrate, provide dry areas and appropriate pool areas. Monitor feet daily. Monitor water quality daily/weekly.

Coat Quality

Symptoms include hair loss, patchy fur, unkempt coat, matted coat, tail and chin lesions, pneumonia, and in extreme cases death. These issues can be caused by: prolonged exposure to damp/wet surfaces, inadequate grooming spaces, and poor water quality are all frequent causes. Also to be considered are ecto-parasites, internal parasites, allergies, and numerous other conditions which can also lead to poor coat quality.

Solutions: In the case of environmental causes - balance dry and damp spaces, provide appropriate dry areas and grooming spaces, monitor the coat daily. Add brushes to the sides of nestboxes or entry/exit doors along with large diameter logs, bread crates or other similar items to provide ample ‘drying off’ opportunity areas. Monitor water quality daily/weekly.

NOTE

“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...” (11). 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 if water does not form droplets and cannot be easily groomed off (11, 12).

Obstructions by foreign objects:

Symptoms include distress from lodged item in throat, roof of mouth, teeth, eyes, or feet. This can be caused by chewing on foreign bodies like sticks, rocks, mulch, substrates or fish bones and scales.

Solutions: Monitor inside and outside enrichment, substrates and the entire environment daily for hazards. Monitor any inappropriate or potentially dangerous interaction with items in their environment.

Emergency Situations: If an otter gets an item stuck in roof of mouth, teeth, eye, or any other body part try to shift animal inside. If animal is trained through operant conditioning see if animal will allow keeper in a protected contact (do not go in with animal) situation to remove foreign body. If this procedure cannot be done because the otter is not trained, or is uncooperative, call veterinary staff immediately for chemical immobilization to remove the item.

Example: It was recorded that one female giant otter on three occasions had a twig stuck across the roof of her mouth in the soft palate area. On two occasions this had to be removed under general anesthesia and on one occasion it was resolved by giving her a salmon head to dislodge the stick.

Stress:

Symptoms include “swim pacing” (repetitive swimming back and forth), repetitive diving, land pacing, lack of appetite, lack of normal play or grooming behavior, single animal off alone, overly aggressive towards conspecifics, or lethargy. Stress has many causes, including: unidentified illness (seek veterinary advice/exam), lack of proper social interaction with conspecifics, changes to their surroundings, or loud noises. Other stressors include substandard living conditions in the enclosure such as inappropriate land/water ratio, pool depth, or water quality, lack of digging opportunities, overly wet environment, lack of visual barriers for hiding behind and privacy, or boredom due to a lack of scheduled enrichment and stimulation of the senses and natural activities.

Solutions: Veterinary attention if warranted, evaluate the enclosure, enhanced enrichment program, and changing/improving the social dynamic of the group. Additionally, time should be spent observing the animal to determine other symptomatic behaviors that could lead to identifying potential stressors.

Spinal Concerns:

Symptoms are typically lameness, dragging of hind legs, lack of activity, increasing paralysis along spinal column (hunched back), lack of activity, and/or appetite. Potential causes include: age; physical injury - which may be due to inappropriate exhibit design, specifically poor substrate quality/quantity and water depth; or behavioral issues within the group that may have led to fall, etc.

Solutions: Evaluate and improve exhibit design, substrate quality/quantity, evaluate entry/exit points to pools and “jump off points” that may have led to a fall. Evaluate group interactions and monitor otter’s behavior. Veterinary exam and radiographs should be performed.

NOTE

As giant otters age they tend to begin exhibiting a “slowing down in activity” and an eventual, possible spinal, hind end paralysis (as observed in a 19 year old male otter). Making adjustments to the exhibit and holding spaces like ramps and additional haul out areas within the pools are recommended.

Eye Concerns:

Symptoms are typically watery eyes, bulging eyes, reddened eyes, drooping eye lid, or swelling around the eyes. These conditions may be caused by vitamin deficiencies, poor water quality, excessive substrate dryness, stressful situations, or other unidentified medical issues.

Solutions: Monitor eyes daily but seek veterinary advice for possible medical causes immediately. Veterinary and nutritional staff should also evaluate the diet and vitamin supplementation, as well as potential substrate and environmental causes. If an environmental cause is suspected it should be rectified immediately and the otter monitored for improvement. Giant otter eyes may appear watery as a normal occurrence.

Geriatric Care:

Symptoms consist of signs of aging (cloudy eyes/cataracts, decreased activity level, slower to eat or poor appetite, lameness, spinal deficiencies, graying facial hair, unkempt coat, separation from its family members).

Solutions: Seek veterinary advice and monitoring; adjust keeper routine to add time for geriatric animal management, and cutting fish if larger pieces are harder for the animal to manage. Pain management for arthritis and other geriatric ailments may be required. Adjusting exhibit and holding spaces to add ramps, extra bedding and alternate areas of entry/exit points for the geriatric animal. Offer choice to animal to not shift outside on occasion. Have your institution draw up a decision tree plan for quality of life and end of life decisions.

Enrichment and Operant Conditioning (training)

Enrichment

Giant otters are naturally active, vocal, and energetic throughout the day. It is important to encourage and maintain these natural behaviors in captivity. Normally, daily activities include swimming, playing in the water, digging, feeding, grooming, mutual grooming, and resting. The enclosure design must provide opportunities to enjoy these activities but all animals in captivity require some extra stimulation to prevent boredom or stereotypic behavior developing.

All enrichment devices must be checked to ensure the otters cannot trap paws or body parts and all edible parts such as loose string, rope, sharp plastic edges or anything that can cause harm should be removed. Enrichment items should not be used when worn out or damaged and all items should have manager and veterinary approval. Otters should always be monitored when new items are introduced to ensure they do not eat non-edible parts. A record should be kept of what they do and do not use, how they use it, and for how long; this will allow staff to eliminate unused items from the rotation. Staff should provide enrichment at least once a day, preferably two or more times from a list of approved items extensive enough to allow for selection of novel items daily for a month. These should include scents, approved edibles, environmental changes, manipulable items, etc. The following list offers suggestions of items that have been used successfully however; each institution must make their own decision as to safety and appropriateness for their animals and situation.

- Change in the habitat - moving enclosure “furniture” (logs, rock piles, leaf mounds, etc.) to different sites in enclosure
- New enclosure “furniture”
- Items floating in the pool (balls, logs)
- Scatter feeding in the pool
- Ice blocks of frozen fish, fish juices.
- Ice blocks of different fruits - they may not eat the fruit but they enjoy playing with it.
- Large fish heads - one per otter
- Feed balls stuffed with fish
- Water melons, melons, pumpkins
- Hollowed out coconuts

- Indestructible heavy duty toys - Kong[®] Toys (<http://www.kongcompany.com/>), Otto Environmental[®] (<http://www.ottoenvironmental.com/>), Wildlife Toys (<https://www.wildlifetoybox.com/>), or similar
- Straw bales in the water - but these will need collecting and may affect water filters
- Hanging vegetation - clumps of bamboo hanging from the roof on a bungee
- Old rubber boots - to throw around in the water
- Cardboard boxes, rolls of paper towels - in dens only not in pool area
- PVC tubes of various sizes for throwing or rolling on etc.
- Husbandry training
- Offering live fish (if legal and approved by veterinary staff)
- New logs, boulders, substrates and non-toxic planting
- Scents - perfumes, herbs, extracts, spices and mists
- Hard plastic milk crates, bread crates, heavy duty children's play items
- Visual- ever changing items hanging in keeper areas, holiday lights in keeper area

Special Note: If cubs are present all enrichment toys must be removed from the enclosure or only cub-proof items allowed.

Operant Conditioning (Training)

Otters are excellent candidates for behavioral training programs focusing on routine and non-routine husbandry tasks, such as shifting, weighing, entering squeeze cages or crates, stationing for close visual inspections or injections, etc. Standard positive reinforcement behavioral training techniques are used successfully on giant otters at numerous facilities. As much as possible, all animals should routinely shift into a holding area and readily separate into specific holding areas on cue. Animals should be trained to come to the keeper when called for daily health checks, and remain calm and not aggressive during these checks.

Keepers should avoid use of aversive stimuli in the daily management of otters. Profound aversive stimuli such as squirting with hoses, loud noises, harsh words, and long-term withholding of food are inappropriate unless serious injury of keeper or animal is imminent (e.g., serious fight). In general, otters respond to profound aversive stimuli with fear and/or aggression. It is best to maintain positive and pleasant keeper/animal interactions. Assessing the animal's motivation, (e.g. Why should it "want" to come in? Why does it "want" to stay outside? What is the animal's motivation, and how does it relate to the animal's behavior in the wild?), is a useful exercise when training problems occur. Patience and planning are keys to success (21).

It is helpful to have areas available where husbandry training can take place. If the only place that training can be done is indoors that one room should have a wire mesh front (i.e. used as a containment barrier for one side of the den), with mesh large enough to permit the passage of human hands, training targets, fish, otter foot, and ultrasound wand. Fence mesh, with 5cm x 20cm mesh works well for husbandry training, although caution must be taken as otters can climb this fence thus this training area must have a roof. As usual a deep, soft substrate should cover the floor for all husbandry training.

An operant conditioning program should not be initiated without consulting a professional with experience and some of the documents listed at the end of this section. However, following is a sample training plan excerpted from McKay (44).

Sample Training Plan: Target

Goal of behavior: To have otters go to a target object and hold its position at the target until bridged

- 1. Introduce the target at the side of the mesh door while you feed the otters through the mesh.*
- 2. Approximate (slowly move) the target closer to the otters. Once they are comfortable with the target, place target in front of them and cue "target".*
- 3. Reward the otters for touching the target.*
- 4. Approximate that one paw touches the target.*
- 5. Approximate that both paws touch the target.*
- 6. Work on shaping step 5 so that the otters hold their paws to the target for short periods of time.*
- 7. Lengthen the holding time and then vary it. When bridged, they should release the target.*
- 8. Move target a short distance away and bridge when otter goes to the target.*
- 9. Move target a greater distance away. Have otter go to target and hold until bridged.*

Target training and holding an otter's attention in one spot are key tools to facilitate stress reduction during routine and important health-check procedures such as ultra-sounding to test for pregnancy.

Priority Training Behaviors required for proactive care are:

- Target
- Station
- Crate Training
- Scale Training
- Open Mouth
- Present foot (feet) for inspection
- Present ear
- Voluntary hand injection
- Voluntary blood draw from webbing between toes

The OZ Task Force document Basics of Otter Training (44) is available at www.otterspecialistgroup.org/...Otter_Training_Doc_OCT_08May2009.pdf. This and many other resources can provide an introduction to the operant conditioning/training process. For additional detailed information on giant otter training consult Sykes-Gatz (9) http://www.otterspecialistgroup.org/Library/TaskForces/OCT/International_Giant_Otter_Studentbook_Husbandry_and_Management_Information_and_Guidelines_2005.pdf.

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Contact Information

IUCN/SSC Otter Specialist Group (OSG) – otterspecialistgroup.org; lc.wright@rl.ac.uk
OSG OZ Task Force (Otters in Zoos, Aquariums, Rehabilitation, and Wildlife Sanctuaries - <http://www.otterspecialistgroup.org/Library/TaskForces/OCT.html>)
Nicole Duplaix (OSG Chair) – Nicole.Duplaix@oregonstate.edu
Carol J. Heap – (New Forest Wildlife Park & Chestnut Centre England) carol@chestnutcentre.co.uk
Jan Reed-Smith (OZ Task Force Chair) – jrsotter@gmail.com
Tim Schikora (Director Zoo Schwerin, works with EEP G.O. Coordinator Dr. Frank Brandstätter – Zoo Dortmund) - EEP-GiantOtter@hotmail.com
Tammy Schmidt – (AZA Otter Keeper Workshop, G.O. Instructor; Assistant Mammal Curator Zoo Atlanta) tschmidt@zooatlanta.org
Helen Bateman (reproduction) - helen.bateman@cincinnati-zoo.org
Barbara Toddes (nutrition) - Toddes.barbara@phillyzoo.org
Barbara Henry (nutrition) - barbara.henry@cincinnati-zoo.org
Dr. Donna Ialeggio (veterinarian) - ialeggio.donna@phillyzoo.org
Dr. Sam Rivera (veterinarian) - srivera@zooatlanta.org
Kim Lengel (General Curator) – GO AZA Coordinator - Lengel.Kimberly@phillyzoo.org
Dr. Ivan Rubiano - zoovet@yahoo.com

Appendix 1: Sexing Cubs

Male



Female

