Summary of Husbandry Guidelines for

North American (aka Nearctic) River Otters (*Lontra canadensis*) in Captivity

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Photograph taken at the North Carolina Aquarium at Pine Knoll Shores by Julie Powers

Objective

This manual has been prepared by zoo and aquarium professionals to help institutions identify and adhere to the basic minimum standards of care recommended for keeping the North American river otter (NARO, also known as the Nearctic otter) in wildlife facilities. These recommendations have a sound scientific basis or are the result of experience gained over many years of working with this species. For more complete information, readers should consult relevant World Zoo and Aquarium Association documents, available on the OCT website.

Natural History Overview

Members of the Mustelidae family, NARO are one of thirteen species of otters worldwide, and one of only five New World otter species. They are currently listed on CITIES Appendix II (www.cities.org) and listed as a species of Least Concern by the World Conservation Organization (IUCN/SSC) (IUCN 2004).

Built for swimming, these animals have an elongated body, short legs, fully webbed toes, and a long, tapered tail equaling about 1/3 of their total body length. Their dense water resistant coat is generally dark brown to black with a paler chin and throat. Adult weights vary between 12-30 pounds; most subspecies exhibit sexual dimorphism with males as much as 17% larger and heavier than females. Typically they live 8-10 years in the wild and may reach 20+ years in captivity.

The semi-aquatic NARO occupies a wide range of fresh water and marine habitats such as streams, rivers, lakes, ponds, marshes, and some coastal shorelines. The aquatic portion of their habitat provides the majority of foraging opportunities, escape from predators and convenient travel corridors. The habitat land component, where the majority of their time is spent, is important for giving birth, resting, playing, denning, grooming, foraging, and travel between water systems.

Historically found throughout most of the U.S. and Canada (except for very arid regions), they were extirpated from large portions of their range, especially in the mid-west U.S. This was

due primarily to habitat loss, fur trapping, and pollution. Many states and provinces, through aggressive conservation efforts, have successfully reintroduced otters back into some of these areas; others are actively engaged in monitoring or conducting NARO reintroductions.

Social Groupings

NARO are considered to be a social species when compared to other mustelids; however their sociality is not as strong as that seen in some otter species. A number of social groupings have been documented in the wild, but the following groupings are the most common: A female and offspring; solitary males; groups of males; solitary females; groups of males with sub-adult females; male/female pair (during mating season); or two females and offspring. These social groupings are not necessarily found wherever there are otters. Group structure and social tendencies appear to be influenced by and vary with the habitat quality in which the otters are found. In habitats where there is an abundance of resources otters tend to be more social.

Captive environments, such as zoos and aquariums, would qualify as habitats rich in resources (otters have their daily needs met in terms of food, shelter, and stimulation), providing the opportunity to keep different NARO social groupings. However, certain groupings in a captive social situation are recommended. These recommendations are as follow:

- All males - All male groups can do very well together and are recommended for non-breeding situations.
- A male and female pair (1.1)
- One male with multiple females (1.2)
- Equal opposite-sex pairings (2.2, 3.3, etc.)

When determining what NARO social grouping to hold in captivity the facility size, exhibit/holding features and physical set-up, species-appropriate husbandry practices, and available institutional resources all should be considered. Furthermore, breeding pairs of this otter species will most often require separation during the late stages of pregnancy and early stages of pup rearing. An exhibit that allows for physical and visual separation of the male and female is essential.

The following social groupings with this otter species are not recommended.

- All female groupings or pairs (unless they are sisters, mother/daughter, and introduced at a very young age).

It is not impossible to introduce or house adult females (related or unrelated) but it is often difficult and unsuccessful. Furthermore, if one female must be removed from a stable group or separated for whatever reason, even for short periods, it can be difficult or at times impossible to reintroduce them successfully.

- Multiple males with one female.

Although this social grouping is not recommended it can be maintained if monitored closely, having a mix of ages, and/or separation of males during the breeding season (to prevent males from fighting over females, or harming the females with too much attention).

NARO have been successfully exhibited with a few other species, e.g. beaver, but any mixed species exhibit attempts should take into account the appropriate recommendations for housing this species, their curious and semi-aquatic nature, their habit of digging and climbing, and their carnivorous nature.

Diet and Feeding

In the wild, the NARO is primarily piscivorous, feeding on slow-moving, most easily caught fish. Their diet may also include crayfish, amphibians, turtles, as well as some small mammals and birds. Up to 60% of an otter's time may be spent hunting and foraging for food. Due to a high metabolic rate and the rapid progression of digestion, an otter may process its food in as little as one to four hours. This means that an otter may consume up to 20% of its body weight per day.

Captive otters do not expend as much energy. Regular weights should be obtained and used to design diets that maintain a healthy weight and body condition for each individual. Research has shown that captive otters fed about 10% of their body weight typically maintain a healthy weight. However, all diets should take each individual otter's activity level, physical condition, health, and personal preferences into consideration. Due to an otter's high

metabolic rate, they should be fed at least two times daily, but preferably three to four. Additional feeds may be part of an enrichment session, encouraging activity and natural behaviors such as hunting and foraging. Clean, fresh drinking water (separate from the swimming pool) also should be available at all times.

A captive diet plan should replicate their natural food sources while also including adequate supportive foods (e.g. nutritionally balanced commercially prepared products or additional vitamins and minerals) in order to ensure all nutritional needs are being met. Captive otter diets should focus more on protein and fat sources and less on carbohydrates. Because NAROs are primarily piscivorous, fish should make up an important part of their captive diet. However, frozen fish can be high in thiaminase, which may decrease an otter's ability to absorb thiamine, a nutrient important for metabolism. Therefore, the diet should be supplemented with 25-30mg thiamin per kg of fish fed. Vitamin E also is extremely important to maintain a healthy coat and should be supplemented at a rate of 100IU per kg of fish fed. Many other nutrients are essential to an otter's diet and can be supplemented using commercial vitamins such as Mazuri® marine mammal vitamins or over-the-counter multi-vitamins.

In addition to fish, captive diet protein sources can include the use of chicken, mice, ground horse meat, ox tails, boiled eggs, and crayfish. A prepared feline commercial diet (e.g. Science Diet® Feline Chow, Toronto Zoo® Feline Diet, Iams® feline diet) also is a recommended part of a base diet. The addition of fruits and vegetables (e.g. carrots, apples, broccoli, cauliflower, peaches, pears, melon, etc.) to the diet can help increase the bulk of the diet, helping an otter feel full without adding extra fat into the diet. This is particularly helpful in the preparation of diets for weight-control issues. All foods should be introduced to otters at an early age, if possible, to increase the likelihood of acceptance of a variety of foods.

In addition to the base diet, enrichment feed items can be scatter-fed throughout the day in order to encourage activity. Foods may be buried under clean straw, hidden throughout an exhibit, placed into puzzle feeders, released live into pools, etc. in order to promote foraging and hunting skills. Examples of good foraging items include fruits and vegetables, mushrooms,

boiled eggs, shellfish and nuts. Live foods such as goldfish, crayfish, crabs and crickets encourage hunting activities. These foods should be fed in modest amounts and modified accordingly to control otter weight. All feeding times should be randomized to minimize stereotypies associated with routine feeding schedules.

- **Sample diet** (per otter, per day, split into 2-4 feedings):
    - 16 oz (454g) fish (lake smelt, capelin, sardines, herring etc.)
    - 2 oz (57g) chicken or mice
    - ¼ cup Science Diet Feline Chow
    - 1 cup assorted fruits and vegetables
    - 1 Mazuri® marine mammal vitamin every other day
    - Additional enrichment items, scatter fed 1-2x per day

Base diets may need to be modified for otters with a change in physical condition (i.e. age, pregnancy, lactating females, overweight, etc.) Younger otters will need more food daily than adults. Generally, pregnant or lactating females should be offered as much food as they want to consume. Sick or injured otters may need to be offered smaller meals more often throughout the day. Weight reduction can be obtained by reducing calorie intake while adding more bulk and water to the diet. Decreasing the diet can cause aggression between exhibit mates, so adding foods like fruits and vegetables can help an otter feel full without increasing caloric intake.

Separating individual otters during base diet feedings will help reduce aggression and help keepers monitor how well and how much each otter is eating. Otters can be fed using bowls or fed directly by keepers during training sessions. More information on training is available in the OCT Otter Training document on the OCT website. Any uneaten food should be removed within one hour to prevent the consumption of spoiled food.

Introductions

Introductions of NARO can be attempted at any age and with a variety of social groupings. Typically introductions are more successful with young animals or when attempted with the recommended age/sex mix. Introductions can take anywhere from a few days to months; in some cases they are never successful. Success may depend on the individual animals involved, every individual responds uniquely to new or frightening situations. An animal's cues, reactions and body language will be key indicators in determining the comfort level between individuals. Many unsuccessful introductions involve multiple females or females and immature males (especially if the female is in estrus). Introduction of hand-reared animals to mother-reared animals are often successful but may require extra keeper time to reassure the hand-reared animal.

NARO introductions should follow the standard practice of captive animal introductions. The progression of the introduction should follow the following steps; progression from one step to the next should be dictated by the behavior and body language of the otters involved. Progress to the next step should not be attempted until the previous step has been successfully completed.

1. Auditory and olfactory introductions

Auditory introductions take place naturally when the animals are housed in the same building but cannot see each other. Playing recorded otter calls may help hand-reared animals become familiar at least with their sound. Olfactory introductions also occur naturally when otters are housed in one building. Familiarizing animals with their new exhibit mate's scent also should involve the transfer of bedding, feces, etc. between the stalls of the animals involved. This sharing of scent should not start if any of the otters are still under medical quarantine.

2. Visual introductions

Visual introductions should begin in the night quarters if possible. Animals should originally be placed with at least one empty stall between them. Once animals appear comfortable they should be moved to adjacent stalls. At this stage a protective barrier, such as

plexiglass or fine mesh is necessary to prevent biting of tails, paws, and noses. These barriers should be installed before Stage 1 introductions begin.

3. Shared space with limited tactile contact (including howdy sites)

Shared space introductions are an important step in familiarizing all the animals involved with the layout of the entire exhibit and should occur prior to full physical introduction. This knowledge is especially important during any chases, fights, and separations that may occur during the physical introduction that follows. Shared space introductions can be facilitated by rotating animals through their holding areas and the public exhibit. An example would be to lock one otter on public exhibit while giving the other full access to the holding quarters. After a few hours, individuals should be switched. Shared space introductions also can be used to introduce howdy sites. Howdy sites are areas where the otters can have limited tactile interaction through barriers such as fencing, plexiglass, or windows prior to a physical introduction. Howdy spaces are very effective at advancing the introduction process. If howdy spaces are not available two options are: 1) place one otter in a kennel and place this in the other otter's space, or 2) Remove plexiglass, fine-mesh wire, etc. from adjoining doors allowing the animals the ability to touch one another.

Positive reinforcement using operant conditioning training can be another effective tool during visual and shared space introduction phases. Station and cooperative feeding training while in adjacent stalls can help the otters have a positive association with close proximity and help them learn they can eat without competition. This process can continue into physical introductions.

Auditory, olfactory, visual, and shared space introductions should be successfully completed before attempting to move on to any physical introduction. Look for affiliative behaviors such as chuckling, rubbing, grunting, "friendly" pawing and rolling before progressing.

4. Physical introductions

Physical introductions should be conducted in the most spacious, neutral, and well-known territory for all otters involved. This can be either the holding quarters or the exhibit. The space should have options for otters to hide, escape, and get distance from one another. If

shared space introductions have been successful all otters involved should know the space, site, and scents of the others. If possible, operant conditioning training such as cooperative feeding and stationing should be incorporated into the physical introduction phase.

Most physical introductions involve some aggression, screaming, lunging, fighting, and stand-offs where the otters stay away from one another. This will minimize with time, however it is important to keep a close eye on the otters during this time as one sign of an unsuccessful introduction is the inability of the otters to move beyond these behaviors. Furthermore, it is important that each facility come up with its own guidelines on what is considered unsafe levels of aggression, when to separate the animals involved, or when to put a stop to a physical introduction if it is not going well. If there are problems or injuries one can always back up a few steps and then proceed forward when ready.

Hand-reared NARO may require some extra time and care to be successfully introduced to other otters due to the bond they may have developed with their caregiver. It is important to involve the caregiver, if possible, in the introductions and stay with the hand reared individual until it is comfortable and their attention has turned to the other otter.

It is important that no tranquilizers or medications are used on the otters for the introduction process due to the dangers associated with this (attempting to swim while drug-influenced, confusion from due to drug, unable to properly behave, defend, or escape, due to drug confusion/lethargy, and/or agitation from the other otter, etc.) Let the otters be themselves for best results.

Exhibit design

- **Land**

NARO are semi-aquatic; they are land mammals that use the water for foraging and transportation. Therefore, the land area of enclosures is very important. All exhibits should offer a minimum of 150 m^2 of usable land/water surface (for two animals) with a 4:1 land/water ratio (NAROs spend roughly 60% of their time on land playing, resting, grooming, drying off, and denning). Multiple on exhibit sleeping and hiding places should be provided

offering respite from excessive sun/rain and security when frightened; at least some of these should be located away from the public offering the animals the ability to rest or sleep away from close proximity to the visitors. All den boxes and sleeping areas should be provided with a dry base. This is best accomplished by placing them away from water and/or providing them with replaceable bedding material such as grass, leaves, straw, wood-wool, hay, etc. This material can be placed in the exhibit for the otters to carry into their sleeping/resting sites. Furthermore, plants, trees, hollow logs, stumps, shrubs, rocks, and various substrates (the majority of which should be soft options such as soil, grass, mulch or sand) offer opportunities and structures for otters to dry themselves off, maintain good coat condition, provide enrichment opportunities, provide natural behavior opportunities, and create an aesthetically pleasing visual presentation for visitors. Hard surface substrates such as concrete or gunnite are not recommended as these can lead to skeletal trauma from falls and health issues due to the animals' inability to sufficiently dry their coats and feet. Complex exhibits with varied shorelines, varied water levels, multiple land surface levels, multiple substrates, numerous vegetative plantings, floating rafts/logs (anchored so they do not drift) in the pool, and several climbing structures (boulder piles, deadfall, tree stumps, etc.) are all important. These provide hiding places for shy animals, provide protection from weather extremes, and provide opportunities for NARO to exercise natural behaviors.

The modification of old otter exhibits to comply with these recommendations can be easily accomplished with the addition of a 10 to 20cm deep layer of natural substrate over the concrete; tree bark mulch or sand will allow for drainage and surface drying. The placement of flat stones around pool edges will serve as a buffer keeping the new substrate from running off into the pool. Natural furnishings, rocks, boulders, and deadfall are then easily added and maintained helping to create an inexpensively refurbished and improved environment for the otters.

- **Water**

Exhibit water features should have varying depths and easy entry/exit areas for young, injured and/or older animals. Animals will spend a lot of time on the banks of the pool.

Therefore plenty of flat rocks and bank areas should be available for sunning or resting. Running, shallow streams are popular foraging and play areas. If using chlorinated water, be sure to monitor chlorine levels (animals should not be allowed access if levels are higher than 0.5ppm). PH and Coliform levels also should be monitored (pH for system performance; total coliform counts should not exceed 500ppm, or a MPN of 1000 coliform bacteria per 100ml water. Fecal coliform count should not exceed 400ppm). Water quality is important with this species as they frequently defecate and pull food and debris into their water. Frequent water changes are necessary. Because of their in-and-out of the water behavior, some sort of mechanical filtration system is strongly recommended for closed systems. Water temperature is less of a concern for this species. Water systems should be kept open during the winter in temperate climates. This can be done with the use of an air bubbler hose placed in the water to prevent freezing. Separate fresh drinking water sources should also be provided and cleaned daily.

- **Barriers/Containment**

NAROs are excellent diggers and climbers. Exhibit fencing should be sunk 2.6 feet (80cm) into the ground (and angled inward if possible). Fences should be non-climbable and at least 6 feet (180cm) high. If using chain-link or other climbable material, it should be topped with a 90-degree non-climbable overhang. Glass, plexiglass and acrylic panels make great walls or fences. Hotwire can be used, but should never be accessible to an animal in the water. Trees and rocks should be located away from exhibit perimeters. Any trees close to the perimeter or with accessible overhanging branches should have aluminum flashing on them about 3-4 feet up the trunk to prevent climbing. Perimeter fence should be checked daily.

- **Dens/Nest Boxes:**

While on exhibit, animals should have access to temporary shelter from the weather. These might include, but are not limited to, nest boxes, hollow logs, tree roots, deadfall, shrubs, tubes, etc. More than one nest box/den/protected sleeping area should be provided, allowing one per animal and at least one large enough to accommodate all otters in the enclosure. Individual nest boxes/dens should be large enough, at a minimum, for an adult animal to turn

around in and curl up comfortably. Communal nest boxes/dens must be large enough to allow room for sleeping mother and pups or several adults. Nest boxes/dens should have good ventilation to avoid accumulation of excess moisture. Dry bedding needs to be available year round. This may include, but is not limited to, grass, leaves, hay, straw, or wood wool, Heat lamps can be added during the cooler seasons to add warmth and to aid in drying-off.

- **Off-exhibit Holding:**

A holding area connected to the exhibit is recommended. Holding areas may vary in size but attention should be given to the possibility that a sick or new animal may need to be housed there for extended periods of time. There should be an area of land space where dry bedding can be offered and maintained, a small pool the animal can get into, and a separate fresh drinking water source. If animals are not given access to natural sunlight, their holding area should offer full spectrum lighting on a varying photoperiod. At least one of these holding dens should have a door system that will accommodate a squeeze cage or transport cage being placed securely inside or in front of them to facilitate handling them for medical treatment.

- **Cleaning**

Exhibits and holding facilities should be cleaned daily and disinfected regularly. Drinking water should be changed daily and food pans and water bowls disinfected every day. Dens/boxes should be checked daily and dry and unsoiled bedding maintained. Exhibit furniture should be cleaned on a rotating basis allowing the animals' scent to remain in the exhibit.

- **Miscellaneous Considerations**

Other considerations when designing an exhibit include: 1) Incorporation of built-in enrichment areas or devices. 2) Specialized areas for training sessions and keeper presentations. 3) Space or features required for particular social groupings (e.g. multiple females giving birth at the same time). 4) Other items/features such as; built-in scales, squeeze cages, climbing structures, slides, infrared cameras positioned over birthing dens, and bubbler systems to prevent pool freezing.

Enrichment

Naturally highly active and energetic NAROs should be encouraged to maintain these activity levels in captivity. Due to their typically nocturnal activity budget, enrichment sessions and a varied enrichment program may help to increase activity levels during the day. Normal activities include playing, sliding, wrestling, grooming, foraging, climbing, swimming, digging and nesting. Both natural and non-natural items can be added to the otter habitat in order to promote these activities. Non-natural items should be inspected before use, with any removable or edible parts removed. Habitat changes, such as the movement or addition of resident furniture (trees, logs, stumps, rocks, plants, waterfalls, etc.) also help create a complex environment and help stimulate natural behaviors. The addition of scatter- or live-feed items will encourage foraging and hunting behaviors. Below is a list of sample enrichment ideas:

Natural Items	**Non-natural Items**
Ice blocks/cubes with frozen fish, etc	Balls (with/without holes and food placed inside
Logs, branches, driftwood, stumps	Jugs (may have live fish/crayfish inside)
Live foods (goldfish, crayfish, shellfish, crabs, crickets, etc.)	Puzzle feeders (can be made out of PVC)
Bedding (pine straw, wood wool, hay, etc.)	Floating dock
Scents (animal urine, herbs, catnip, etc)	Play slide
Rocks, varying sizes	Sheets, towels, blankets (secured so that cannot be dragged into pools)
Snow, ice piles	Hammocks
Leaf piles	Broom heads, natural grass, astroturf for grooming stations
Pine cones (may have food	Buckets

stuffed inside)	
Vines	Burlap
Clamshells	Buckets, tubs of water
Showers, waterfalls	Heavy duty dog toys such as kongs
Sand box	Tires
Tunnels	
Hollowed out coconuts, melons, etc. with food placed inside	
Ledges, climbing areas	
Substrate (bark, sand, dirt, straw, etc.)	

Training sessions can be another important part of enrichment. Husbandry training is beneficial both to the animal and the keeper, reducing stress from routine/non-routine animal care activities and facilitating medical treatments when required. Important husbandry and veterinary behaviors that can be taught include: separating from enclosure mates, standing on a scale, entering a crate or squeeze cage for transport, visual inspection of coat, paws, tail, and teeth, and entrance/exit of exhibit on command. See the OCT website for more detailed information.

Catching Up

There are numerous methods of catching up and handling otters, but crate and squeeze training is the most effective and least stressful method. Other methods of capturing and restraining otters include the use of nets, push boards, and blow darts. These methods create higher stress levels and chance of injury to both otters and keepers and should be used only with otters that have not yet been trained to voluntarily enter a crate/squeeze cage or in medical emergencies. Appropriate protective gear for keepers should always be available

(gloves and rubber boots) as well as a well thought-out plan (minimizing stress to the animal(s) and staff) before any of the non-preferred methods (nets, push boards, blow darts) are used. Otters are ideal candidates for behavioral modification through operant conditioning; for this reason crate and/or squeeze cage training is encouraged as this is the safest and least stressful method of catching an otter for any reason. The use of some basic training techniques, establishing a bridge, and easily trained behaviors such as targeting and stationing, are the foundation of crate/squeeze cage training.

Establishing a bridge is the process of creating a link between a sound (whistle, word, or click) and a positive reward (e.g. small amount of favored food item). Once the bridge is established the animals associated the bridge with a reward and work to receive it.

Target is a basic behavior that can easily be taught to otters. Teaching of this behavior allows keepers to lead the animal around their holding areas and exhibit. It also aids a trainer in shaping future behaviors. With targeting, the otter is given the command "target" and is expected to touch its nose to a ball which is positioned on the end of a stick. The animal is then quickly rewarded with a small treat (e.g. piece of favorite food) which reinforces the behavior.

Stationing is a basic behavior that has the otter stop and stay in place at a designated position.

Basic Crate and Squeeze Training

- Desensitize the otter to the crate/squeeze by making it accessible to the otters on a regular basis and routinely asking them to move in an out. This can be accomplished by baiting it with food or making it a transfer point from one location to another. The goal is to get the otter comfortable with its presence while making this item fun and interesting.
- Once the otter is regularly going in and out of the crate/squeeze of their own free will, it is now time to ask the animal to start entering on command. Using a target, the otter should be brought to the entrance to the crate/squeeze, stationed and rewarded. This should be repeated routinely and over time, using the target to lead them, the otter can

be led by small steps into the squeeze and stationed inside. Animals should be rewarded for following the target and entering the crate.

- Once the otters are comfortable entering the squeeze/crate keepers may begin training them to stay on station inside. Using the target, station the otter inside the squeeze/crate. Have the otter stay at the station for a brief amount of time and then reward. Over time, increase the length of station time before initiating reward.

- Once the animal is comfortable staying in the squeeze/chute, desensitize the otter to having the door(s) being closed. While having the otter on station inside the squeeze/crate slowly move the door in small increments, then reward. Over time, ask the otter to station while closing the door further and further until closed. Once the otter has accepted the door being closed, again increase the length of successful stationary time before initiating reward.

It is important to maintain a calm atmosphere and demeanor whenever trying to capture and restrain an otter. Once an otter is suspicious or stressed, postpone catching up the animal until another time. In the case of using a crate or squeeze cage, one can leave them open in the pen so the otter can continue to become more familiar with the apparatus. In some cases, facilities allow crates and squeezes to be part of the daily furniture for the otters to use as den sites and training locations.

Reproduction and Breeding

- **Age of Sexual Maturity**

Generally, males and female NARO reach sexual maturity at 24 months of age, though they may be sexually mature by 15 months. Males are in their prime at 3 to 14 years. Females are in their prime at 2 to 10 years.

- **Male Sexual Characteristics**

The NARO male's testes begin to distend and increase in volume soon after sperm production begins, coinciding with elevating testosterone levels (Bateman personal

communication). At more northern latitudes this begins sometime in October or November and may begin as early as September in southern portions of the NARO range. On average, the testosterone level remains elevated for three months of the year and testes may appear distended for roughly four months (Bateman personal communication). This period begins before and ends after female estrus coinciding with the latitudinal breeding season. The production of mature spermatozoa begins usually by 24 months.

- **Female Sexual Characteristics**

The ovaries and uterus continue to grow until about 2 years of age. The uterus is bicornate (two horned). The NARO female has two pair of inguinal mammae. Females are known to be induced ovulators, may experience facultative (spontaneous) ovulation, and experience delayed implantation.

- **Signs of Estrus**

NARO females may show any, all, or occasionally none, of the following signs of estrus: vulvular swelling, a slight pinking of the vulva area, increased rubbing, rolling and allo-grooming, increased interest in the male or the male's quarters, increased interaction between the female and the male to include chasing, tumbling, mutual grooming, sleeping together, chuckling to the male, genital sniffing of the male by the female and vice versa, blood spotting, and of course, copulation.

- **Estrus Cycle and Length**

A NARO female may be in estrus 35 to 46 days with receptive peaks every 6 days or so. There may be intervals of only mild receptivity during which the female may completely reject the male. If the female is not receptive, or interested, she may roll on her back and paw at the male, nip and scream at him, or bite him and run away.

- **Breeding Season**

NARO females are monestruos, with breeding season ranging from November to June. Breeding season will vary according to geographic location. In general, breeding occurs in late March through early June at northern latitudes and during late November through February at more southern latitudes.

- **Copulation Strategies**

While most facilities leave their NARO together year round in hopes of seeing successful breeding, it may also help to look at the animals' surroundings. An enriching environment can greatly improve reproductive success.

In the wild, males and females meet only during the breeding season, spending the remainder of the year alone, in single sex groups, or in family groups (females and pups). For this reason it may help stimulate breeding by separating the male/female pair seasonally. This can be accomplished by separating the male/female pair for 2 months prior to their typical breeding season. Animals should be rotated through the exhibit daily; this will allow them to smell the scent of the other individual. At the onset of breeding season/female's estrus, begin introducing the pair to exhibit. Animals should be separated if breeding is not observed within the first hour. Introduction should be repeated every 3rd day until breeding is observed. Once breeding behavior is seen, the animals should be left together. A good copulatory bout should last 15 minutes or more, and should be repeated several times over several days.

- **Copulation Characteristics**

Breeding pairs must establish a good bond for successful reproduction. NARO females are induced ovulators and require not only stimulation from the male but also may require it from changing environmental stimuli such as day length. Although copulation generally takes place in the water, it can take place on land. The copulatory act is vigorous, noisy and can be lengthy, with breeding lasting 15 minutes to 1 hour. Copulation generally occurs several times over successive days. Normally the male will approach the female from the rear, hold the female by the scruff of the neck with his teeth and bend the posterior part of his body around and below the tail of the female.

- **Delayed Implantation**

NARO females experience delayed implantation. The fertilized egg stops developing at the blastyocyst stage and floats freely in the uterus for a number of months before implanting in the uterine wall. The exact duration of implantation varies between females. Generally the delay will last 7 to 10 months. Actual gestation is 68 to 72 days. Some examples of total

gestation times include 345 days, 340 days, 347 days, 354 days, and 362 days. Pseudo pregnancies are known in this species and have been reported in females housed only with other females. Symptoms are similar to pregnancy but birth never occurs. Typically, females return to normal once the breeding/birthing season is past.

- **Pre-partum Weight Gain**

The NARO female will usually gain 2-3 pounds, but a weight gain of up to 5-6 pounds is not uncommon.

- **Birth Season**

Parturition typically occurs for NARO from November through May. There are always exceptions to when birth may occur. The peak time appears to be March or April in northern latitudes and January or February in the southern latitudes.

- **Birth Management Strategies**

For primaparous females with no birth history to go on, it is best to eliminate all possible stress factors approximately 3-4 weeks before the expected birth. This allows the female ample time to adjust to any environmental, enclosure mate, or cleaning/feeding routine changes. The male should be removed, or separated, at this time and not reintroduced until the pups are weaned and/or swimming well. This removal is for his safety as well as reducing stress on the female (generally females do not tolerate the presence of the male as parturition nears and while pups are very young). The den and nest boxes should be stocked full of bedding; built-in indoor pools should be drained and stocked full of bedding. The female will move the pups around so two or more denning options need to be available to her. The female should have 24-hour access to her den and nest boxes at this time. Keepers should maintain normal routines however, nervous or primaparous females may necessitate changes in routines. These changes may include: reduction of cleaning, stopping the use of disinfectants, limiting time in the building, limiting people allowed in the building to veterinarian and primary keepers, reducing ambient noise, and reducing handling/opening of nest boxes. If the female is normally fed inside the den, the food should be placed just outside the den. Furthermore, the female's diet should be switched to free choice, as her energy requirements are 17% to 32% higher than a

non-reproducing female. If possible, live fish for her should always be available in her outside pool.

- **Signs of Imminent Birth**

The NARO female may exhibit a number of different signs of imminent birth. They may include increased "nest" building, abdominal distension, swollen mammae, aggression toward exhibit mates or keepers, depressed appetite, frequent floating in the pool, refusal to leave the nest box or den, restlessness and lethargy.

- **Parturition**

NARO births can take 3- 8 hours for all pups to be born.

A female's behavior after giving birth and what she will tolerate is different in every female. A female's behavior may change with each litter. Females, who early-on and/or regularly easily shifted to another den allowing visual inspection of the pups for their first litter, may refuse to cooperate or leave the natal den with subsequent litters. Other females may exhibit the opposite behavior.

Great care should be taken to prevent stressing the female. This is particularly true for primaparous females and just prior to and after birth for all females. Staff familiar with the female's normal behavior should watch her for signs of stress due to staff presence in the building, normal routines, or any disturbances such as attempts to shift her over and visually check the pups. Typically, with experienced females, there is no need to handle neonates or pups less than one week of age unless signs of stress are noted (excessive chirping by pups, agitation in the female, or any other behaviors that are concern to staff). In some cases it is better to "observe from a distance" and let the mother handle things.

A certain percentage of females, primarily primaparous females, do not produce milk. In these cases the pups nurse but do not receive milk. For this reason, it is recommended that a 'well-pup' check be conducted within the first 24 to 48 hours if possible. Only the primary keeper and veterinarian should be present during this check. It should be conducted quickly and carried out only if the female is not unduly stressed by being separated from the pups. If

the female is reluctant to leave her pups or becomes highly agitated at this, an early check of pup condition is not recommended.

In some cases the female may rarely be seen until she starts to bring the pups out for swimming lessons, around day 57. In other cases, the female will be seen regularly.

- **Pseudo Pregnancies**

NARO females can experience pseudo pregnancies. They will show all the signs of pregnancy, including weight gain, increased appetite, nipple distension, and behavioral changes. However, no offspring are produced.

- **Litter Size**

Typically a NARO litter consists of 2 or 3 pups, however the range is 1 to 6. Some females tend to produce large litters, others small ones.

- **Inter-Birth Interval/Post-partum Estrus**

Due to delayed implantation, there is at least a one-year interval between NARO litters. Most zoos are breeding their females every other year; this is due to management practices and no observable signs of post-partum estrus in many captive females. If pairs are kept together throughout pregnancy, parturition, and pup rearing there is a higher likelihood the pairs will reproduce annually. A post-partum estrus occurs soon after parturition lasting the same, 35-46 days of a typical estrous. Most zoos that have observed post-partum estrus see behavioral signs 1-2 weeks after birth.

- **Neonate Condition**

Otter pups are born completely dependent on the female. Pups are born fully furred, generally a silky dark brown to grayish black in color. Eyes and ears are closed but the auditory canals are open at birth. Pups are toothless at birth. Young otters are capable of making a chirping contact call from day one.

- **Pup Developmental Stages**
    - Birth weight ~ 110-170 grams, pups gain weight quickly on mother's milk.
    - Eyes open ~ 21 – 40 days
    - Eyes focus ~ 50 days

- Milk teeth eruption ~ 24 – 39 days
- First walk ~ 36 days
- Pelt changes ~ 26 – 46 days
- Leave the nest box ~ 38 – 70 days
- First play ~ 25 – 49 days
- First swim ~ 28 – 58 days
- Localized latrine use ~ 49 days
- First solid foods ~ 54 – 66 days
- Total nursing time ~ 3 – 4 months
- Remain with mother ~10 – 12 months

- **First Swim**

Otter pups must be taught to swim. Females will decide when it is time to teach the pups to swim. Young pups are extremely buoyant so water depth does not seem to matter but provisions should be made to ensure it is possible for the pups to pull themselves out of the water. Young animals seem to enjoy playing in shallow water, so if possible, this should be provided.

- **Male Reintroduction**

Depending on enclosure design, males should be moved to another location, rotated on and off exhibit alone, or in some cases, all animals can be left as is.

Males moved to another location: This should be done if there is no way to adequately handle the male and female separately, if the male must pass the female's den to enter or exit holding, or if it is believed the male's presence in the building will be stressful on the female.

It is generally best to bring the male back to exhibit for reintroductions when the pups are ~3 months old, feeding on their own, and swimming well. Bringing the male back too soon may cause undue stress to all involved. Reintroductions should follow the same recommendations in the Introduction section above. The female may vocalize at the male or briefly go after the male, only to let him know she is in charge and for him to keep his distance. Generally, the male will respect this and keep his distance and it will be the pups and female

who approach him when they are ready. This may take several days. The male should not be left overnight with the female and pups until staff is confident all animals are getting along.

Males separated but housed within the exhibit: This option can be used in cases where the exhibit allows for management of two separate groups and the female is not disturbed by the scent of the male in the holding building/exhibit. The male should be able to enter/exit the exhibit without passing in visual range of the female. The reintroduction time frame and process is the same as above.

Animals managed as is: In some large, complex, naturalistic exhibits it is possible to leave the female and male in the same exhibit. In these cases animals should never be locked into holding together but instead allowed 24-hour access to the exhibit. Animals should never be allowed access into holding buildings if one animal can be trapped inside by the presence of another. Males should only be allowed to stay in the exhibit with a female close to or just after birth if he can stay out of her sight. This option has worked in some cases but in general is not recommended unless the institution has experience with breeding NARO.

- **Pup Dispersal**

Young NARO are self-sufficient by 5 – 6 months, but the family remains intact for at least 7 – 8 months or just prior to the birth of a new litter. In general, it is believed that young animals leave the female by 12 – 13 months of age. When possible it is preferable to leave pups with their mother for one year before moving them to another institution.

Hand-Rearing Otter Pups

The hand-rearing of otter pups may be necessary if a female has rejected her pups, the pups are not feeding successfully naturally, pups require supplemental feeding, or orphaned rescue pups are brought to the establishment. Hand-rearing neonates or very young pups (up to six weeks of age) can be difficult and should only be done by experienced, trained staff. Pups should be kept in a dry, warm place, should be fed every 2-3 hours round the clock, and need to be stimulated to urinate and defecate. Record keeping is extremely important – accepted food amounts should be recorded after each feeding, along with defecation and urination events

and pups should be weighed daily, just prior to feeding. If possible, pups should be raised in a group to help maintain natural social skills.

Many commercially prepared milk formulas may be used to hand-rear, including Esbilac®, KMR®, and Zoologic® Multi-Milk. Formula should always be warmed to body temperature before feeding and the pup should be placed on its stomach, never on its back. Otter pups are estimated to consume 20-40% of the body weight daily, with a general target of 30% accepted. It may be difficult to acclimate pups to the use of a bottle. In this case, stimulation of the mouth, face or throat with a warm, moist finger or piece of cotton may help begin a suckling response. Pups should appear pot-bellied, not lean. As the pup ages, feeding amounts can be increased with number of daily feedings being reduced to every 4-6 hours.

Pups may begin to be weaned as early as six weeks or as late as ten weeks. Rice cereal may be added to formula to increase viscosity, preparing pups for more solid foods. Commercially prepared baby foods (chicken and turkey varieties) or wet cat foods mixed with formula can also help the transition to solid foods. Alternately, small amounts of fish can be blended with formula. Gradually, formula amounts should be decreased over time as long as the pups are maintaining a healthy weight and growth rate. Once a pup is able to successfully consume fish, additional base diet items can be introduced, including chow, chicken, mice, fruits and vegetables. Generally, the more variety of foods introduced at an early age, the wider variety diet may be used throughout the life of the animal.

Behaviors such as swimming, hunting and foraging will need to be introduced to otter pups as these lessons would normally come from a mother otter starting at the age of about two months. Swimming lessons should begin in a few inches of lukewarm water, increasing size and depth of the pool as swimming ability builds. Clean, dry towels should be provided to help the pup dry its coat following swimming lessons. Foraging may be taught by scattering parts of the diet around the pup's enclosure, still ensuring that all pups are obtaining an appropriate amount of food. Again, rearing pups in groups will help stimulate normal play and social activities and will help when it comes time to introduce pups to current adult exhibit residents.

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