



NORTH AMERICAN RIVER OTTER

Husbandry Notebook, 3rd Edition

NORTH AMERICAN RIVER OTTER

(Lontra canadensis)

Edited by:

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"Alacris ad ludos est."

"It is quick to play"

(Albertus Magnus, 13th Century teacher and naturalist)

North American River Otter Husbandry Notebook

3rd Edition

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In the days when the earth was new and there were no men but only animals the sun was far away in the sky. It was so far away that there was no summer. It was so far away that the trees and the grasses did not grow as they should.

He-Who-Made-the-Animals saw how it was that there was not enough sun to heat the earth, and so he fashioned a snare. The Sun did not see the snare in his path, walked into the snare and the snare held him fast.

The sun was close to the earth. In fact, the snare held the sun so close to the earth that there was no night. Day after day the sun shown and the earth dried and the grasses withered. There was not enough food or water for the animals and they desperately called a council. "Sun," the animals said, "You give too much heat to the earth."

"Set me free from this snare" the Sun said, "and I will go away."

"But if you go away, then there will not be enough heat." "Set me free," the Sun said, "and I will come to the edge of the earth in the morning and in the evening; then at noon-time I will stand straight above the earth and warm it then."

The animals sat around the council fire and they said, "Who is going to set the sun free?"

"I shall not do it," Wildcat said. "Whoever sets the sun free must go so close to the sun that he will be burned to death." Lynx said, "Whoever sets the sun free must chew the leather thong that holds him; the sun will burn him to death before he can do it." "I shall not do it," said the deer, the wolf and the raccoon.

"I shall do it," Otter said. "How can you do it?" said the animals. "You are too small, your teeth are for fish, and your fur has already burned away." None of the other animals liked the otter because he played too much. They did not think he was brave.

"Let him try," Bear said. "He will burn to death, but we will not miss him. He is of no use to us. He looks silly now that his fur is gone." The animals laughed.

Ignoring the taunts, the otter set off to the place in the sky above the earth where the sun was held by the snare. Otter took many days to get to the sun. The sun burned him. The sun was so bright, Otter had to close his eyes. When he reached the sun, Otter began to chew on the leather thong that held the sun. His skin was burning and blistering, his eyes were hot stones. But, Otter did not stop chewing.

Suddenly he chewed through the leather. The animals saw the sun rise into the sky. The animals felt the cool winds begin to blow on the earth. Otter had freed the sun from the snare.

Time passed. Otter lay in the center of the council ring. There was no fur at all left on his body. His skin was burned and scorched and his flesh was falling off his bones. His teeth were only blackened stumps.

He-Who-Made-the-Animals also stood in the center of the council ring. "Otter," he said, "the animals will not forget what you have done for them. I will see that they do not forget," and he gave Otter new strong teeth, tireless muscles, keen eyesight, and a powerful tail to help him in his hunting and in his play. He did not have to give him bravery. But he gave him new fine fur that was like down on his skin, and a second coat of fur to guard the first so that he would not get cold in water or in winter. Then he gave him joy so that he would always be happy in his otter's life, and Otter has so remained until this day.

An Otter Legend derived from the Cree Indians
Contributed by John Mulvihill
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1st Edition

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USE GUIDE

INTRODUCTION

As soon as the first edition of the North American River Otter Husbandry Notebook was completed additional information became available – that is the way projects of this nature all work. I have no doubt it also will be true for this edition. Thus, use this 2nd edition as a beginning point when looking for an answer to a particular otter problem or question, not as a definitive authority. Our approach to captive husbandry should be as dynamic as the animals in our care. **This 3rd edition includes some additional information as well as correction of typographical errors. Since publication of the 2nd edition significant work has been done on otter reproductive physiology, contraceptive recommendations have changed, and there have been some changes made to recommended routine veterinary care. These changes as well as additional training and enrichment information have been included in this digital update of the NARO husbandry manual.**

Where possible, all measurements and weights have been put into the English and metric systems. This is not true for the weights tables, however. There is some duplication from one chapter to another; some information on a given topic may only appear in one location. This is inconsistent but an attempt was made to at least provide some basic information on pertinent topics where appropriate so a reader would not have to go to all of the sections. For example: there is pup development information in the Reproduction section and Hand Rearing.

Many thanks go out to all of the people who have shared ideas with me over the years, too many of you to name here however, your contributions have all been helpful and have been incorporated in some way in this manual.

I encourage everyone working with otters in captivity to join the Otter Keeper list serve. Improved communication between everyone working with this species will increase our chances of solving unusual problems as they arise. The list serve can be joined by contacting jrsotter@iserv.net

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CHAPTER 1

TAXONOMY

INTRODUCTION

The scientific name for the North American otter was *Lutra canadensis*; it is now *Lontra canadensis*.

*“The generic name **Lutra**, proposed by Brisson in 1762, is the Latin name for otter. The specific name **canadensis**, proposed by Schreber in 1776, refers to Canada, with the Latin suffix, *ensis*, meaning ‘belonging to’ because the species was first described from Canada. The common name otter has a northern European origin; in Old English, *otor*; in Middle English, *oter*; in Swedish, *utter*; in Danish, *odder*; in German, *otter*.”* (Baker, 1983)

The ongoing discussion regarding the generic status of the New World otters appears to have been settled, at this point, in favor of *Lontra* as proposed by van Zyll de Jong in 1972. This is largely due to increased acceptance of van Zyll de Jong’s analysis and the recent work of Klaus Koepfli and Robert K. Wayne at U.C.L.A.

In accordance with the use of *Lontra* by van Zyll de Jong (1972, 1987), Wozencraft (1993), and the work of Koepfli and Wayne (unpublished thesis, 1998) *Lontra* will be used in this manual. (See Taxonomic Overview)

CURRENT OTTER TAXONOMY AND COMMON NAMES

ORDER	Carnivora
FAMILY	Mustelidae
SUBFAMILY	Lutrinae
GENUS	<i>Lontra</i> (Gray, 1843)
SPECIES	<i>canadensis</i> (Schreber, 1776)
SUBSPECIES	<i>L. c. canadensis</i> , <i>L. c. kodiacensis</i> , <i>L. c. lataxina</i> , <i>L. c. mira</i> <i>L. c. pacifica</i> , <i>L. c. periclyzomae</i> <i>L. c. sonora</i>

The generic designation of *Lontra* instead of *Lutra* was widely adopted in the late 1990’s. *Lontra* is now accepted for all of the new world river otter species (which includes the N. A. otter, Neotropical otter, Southern otter, and Marine otter), by ISIS, the IUCN/SSC Otter Specialist Group, The Wildlife Society, Society of Mammalogists and other recognized organizations.

Common Names

Otter, common otter, North American river otter, land otter, Fischotter (German), Fisher (this usage most likely started as a deliberate falsification), river otter, water dog, Ku-tet-tahx (Potawatomi), loutre (French-Canadian), Neeg-keek (Chippewa), *nutria norteamericana* (Spanish), *lontra canadese* (Italian)

HISTORICAL OTTER TAXONOMY

Lontra (Lutra) canadensis, Schreber 1776 Synonyms:

Mustela hudsonica, Desmarest 1803

Mustela canadensis, Turton 1806

Lutra hudsonica, Cuvier 1823 and many others

Lutra brasiliensis, Harlan 1825 & Godman 1826*

Lutra vulgaris variety *canadensis*, Wagner 1841

Lutra brasiliensis, De Kay 1842

Latax lataxina, Gray 1843

Latax canadensis Gray 1865

Lontra canadensis Flower 1929*

* Harris (1968) indicates these terms were used improperly by the individuals indicated, when doing further research, be alert to this kind of incorrect usage.

Subspecies

Harris (1968) listed 20 subspecies:

Lutra canadensis

canadensis

L.c. nexa

L.c. brevipilosus

L.c. optiva

L.c. chimo

L.c. pacifica

L.c. degener

L.c. perichlyzomae

L.c. evexa

L.c. preblei

L.c. extera

L.c. sonora

L.c. interior

L.c. texensis

L.c. kodiacensis

L.c. vaga

L.c. lataxina

L.c. vancouverensis

L.c. mira

L.c. yukonensis

Toweill & Tabor (1982) and Hall & Kelson (1959) list 19 subspecies, leaving out *Lutra canadensis mira*, which they list as *Lutra mira* (the Prince of Wales Island otter).

In the 1981 edition of *The Mammals of North America*, Hall revises the 1959 (Hall & Kelson) listing of 19 subspecies as follows:

1959 EDITION	1981 EDITION
<i>Lutra canadensis canadensis</i>	<i>Lutra canadensis canadensis</i>
<i>L. c. degener</i>	Schreber 1776
<i>L. c. kodiacensis</i>	<i>L. c. kodiacensis</i> Goldman 1935
<i>L. c. interior</i>	<i>L. c. lataxina</i> Cuvier 1823
<i>L. c. lataxina</i>	
<i>L. c. texensis</i>	
<i>L. c. vaga</i>	
<i>L. c. mira</i>	<i>L. c. mira</i> Goldman 1935
<i>L. c. vancouverensis</i>	
<i>L. c. brevipilosus</i>	<i>L. c. pacifica</i> Rhoads 1898
<i>L. c. evexa</i>	
<i>L. c. extera</i>	
<i>L. c. nexa</i>	
<i>L. c. optiva</i>	
<i>L. c. pacifica</i>	
<i>L. c. preblei</i>	
<i>L. c. yukonensis</i>	
<i>L. c. perichlyzomae</i>	<i>L. c. perichlyzomae</i> Elliot 1905
<i>L. c. sonora</i>	<i>L. c. sonora</i> Rhoads 1898

Van Zyll de Jong's 1972 suggested subspecies revision agreed with Hall's 1981 revision with one difference; van Zyll de Jong incorporated the 20th subspecies listed by Harris (1968), *L. c. chimo* in *L. c. canadensis*.

Mammal Species of the World, A Taxonomic and Geographic Reference (1993) edited by Wilson & Reeder lists the North American river otter as *Lontra canadensis*. Twenty-two subspecies synonyms given are: *americana* Wyman 1847; *atterima* Elliot 1901; *brevipilosus* Grinnell 1914; *californica* Baird 1857; *chimo* Anderson 1945; *degener* Bangs 1898; *destructor* Barnston 1863; *evexa* Goldman 1935; *hudsonica* Merriam 1899; *interior* Swenk 1920; *kodiacensis* Goldman 1935; *lataxina* Cuvier 1823; *mira* Goldman 1935; *mollis* Gray 1843; *nexa* Goldman 1935; *optiva* Goldman 1935; *pacifica* Grinnell 1933; *paranensis* Elliot 1901; *preblei* Goldman 1935; *vaga* Bangs 1898; *vancouverensis* Goldman 1935; *yukonensis* Goldman 1935

TAXONOMIC OVERVIEW – A SUMMARY

The following overview of the taxonomic treatment of North American river otters (*Lontra* [*Lutra*] *canadensis*) is not exhaustive, but should be viewed as an historical introduction to otter systematics.

*“The subfamily (Lutrinae) comprises 13 extant species for which four to eight different genera have been recognized and variously divided into two or three tribes. The oldest fossil otters are found in early Miocene deposits, represented by the genus **Mionictis**, dating approximately to 20 million years ago, ...*

“ Previous systematic studies have relied primarily on the overall similarity of cranial and dental characters to infer relationships of otters. However, despite using similar morphological characters, different methods of systematic analysis have led to a number of taxonomic revisions of the Lutrinae during this century. Studies based on classical systematic approaches (Pohl, 1919; Pocock, 1921), evolutionary systematics (Simpson, 1945; Sokolov, 1973; Davis, 1978; Willemsen, 1992), phenetics (van Zyll de Jong, 1972, 1987), and cladistics (van Zyll de Jong, 1987) have reached different conclusions regarding relationships.”

Koepfli & Wayne, 1998

The evolutionary approach: Davis' treatment.

In 1978 J. Davis reviewed the previous taxonomic treatment of the *Lutrinae* and published his work utilizing behavioral characteristics and baculum type as key indicators of Lutrine taxonomic standing.

Due to the “*plasticity*” of otter behavior, behaviorally based taxonomic criteria are not regarded as reliable. However, Davis proposed that the use of otter vocalizations was dependable because, “...*the plasticity of behavior is far less evident in the vocalizations of otters*”. Some calls are common to all species (warning growl) but others, such as the contact and affectional calls, “...*appear to be peculiar to each of the monotypic genera, and closely similar among the species within each of the polytypic genera Aonyx and Lutra.*”

Characteristics of the Tribes of Lutrinae (Davis, 1978)

Lutrini

Morphological – Penis completely internal, no preputial button. Baculum slightly curved, not tapered markedly, with a sharp distal bend, like a hockey stick. Bend is dorsal in New World species, ventral in Old World species. All digits are strongly clawed. Webbing between digits extensive.

Behavioral – Sociable; pairing more or less casual and limited to breeding season; male not permitted near cubs. Anxiety call an aspired H!. An affectional call a low, staccato, usually monotoned guttural or nasal chuckle Hunh-hunh-hunh-hunh. Contact call a monosyllabic, uninflected chirp.”

Aonychini

Morphological – Penis tip protrudes beyond abdominal wall as a preputial button, except in Enhydra. Baculum moderately curved, shaped like a baseball bat, heavy at proximal end, tapering distally with a grooved distal knob. Digits may be heavily clawed (Pteronura, Lutrogale, Enhydra), weakly clawed (A. cinerea), or clawless (A. capensis) except for digits 2, 3, and 4 of hind paws, which bear small grooming claws. Interdigital webbing variable in extent, least in clawless, greatest in clawed species.

Behavioral – Social; pairing is more or less permanent; male participates in rearing young from early age with the exception of Enhydra where pairing is casual with no male parental role. Anxiety call an aspired H!. Contact call a rising and falling circumflex chirp. No chuckle; affectional call is circumflex in at least some species.”

Hydricini

Morphological – Penis completely internal, no preputial button. Baculum slightly curved, shaped like a baseball bat in general outline, heavy at proximal end, tapering distally, with a grooved distal knob. Fore and hind digits strongly clawed. Webbing between digits extensive.

Behavioral – Sociable; pairing is more or less casual; male not permitted near young cubs. Anxiety call as aspired F!. Affectional call a burbling series of metallic chirps, reminiscent of the Lutra chuckle but inflected and not nasal or guttural. Contact call mono- or di-syllabic but not inflected.”

The phenetic approach: van Zyll de Jong's treatment.

At one time, phylogenetic relationships were difficult to study in the *Lutrinae* due to the limited number of useful characteristics. As van Zyll de Jong put it: “*The only characters readily available for a study of all species of otters are those that may be derived from traditional museum specimens, which consist of skulls and skins. Postcranial elements have a less than complete representation in collections. As many species of otters are now rare or endangered, the possibility of obtaining additional material is poor.*” (van Zyll de Jong, 1987)

To conduct his phenetic analysis of 12 otter species from seven genera, van Zyll de Jong analyzed a large number of skulls, a limited number of skins, and a limited number of postcranial specimens. A variety of “...bivariate relationships of the skull and dentition were analyzed allometrically and the overall similarities of nearly all species of *Lutrinae* were estimated using taxonomic distance.” In addition, he made a number of “...other qualitative and descriptive comparisons”. On the basis of all these comparisons, he concluded that, “...there are probably four recent species of river otter in the Western Hemisphere, corresponding to the North American *Lutra canadensis*, the Neotropical *Lutra annectens*-

enudris-platensis group (***Lutra longicaudis***), the Chilean ***Lutra provocax*** and the southern Pacific coastal form ***Lutra felina***.” “Evidence further suggests that the relationship of the American river otters with ***Lutra lutra*** and other Old World species of that genus is not as close as was formerly assumed. Aside from differences in skull and dentition, the marked differences in the known bacula may be regarded as significant evidence of their distinctness.” (van Zyll de Jong, 1972)

In 1987, van Zyll de Jong again addressed the *Lutrinae* concluding, “...the New World river otters (***Lontra***), is a monophyletic group phylogenetically linked to the African and Asian clawless otters (***Aonyx*** and ***Amblonyx***). The other group, their Old World ecological counterparts (***Lutra***), constitutes a different clade. ***Enhydra*** and ***Pteronura*** are the most divergent of the living otters, the former being closer to the clawless otters and the latter to the smooth-coated otter (***Lutrogale***), which in turn is phylogenetically close to the Old World river otters (***Lutra***).”

Wilson and Reeder (1993) published these comments on van Zyll de Jong’s treatment of otter taxonomy: “van Zyll de Jong argued that the New World otters represent a single radiation and questioned whether ***Lutra*** (*sensu stricto*) or ***Aonyx*** was the closest sister group. There has been no published work to refute his hypothesis, although it has not received general acceptance. Hall (1981) chose not to question the monophyletic nature of the group, but to lower it to the subgeneric rank, feeling that the characters were not sufficient enough to warrant generic distinction. Regardless of the ‘morphological gap’ between the monophyletic New World otters and the Old World otters, if ***Lutra*** (*sensu stricto*) is the closest sister group, then inclusion within ***Lutra*** could be maintained. However, if, as van Zyll de Jong (1987) suggested, ***Aonyx*** is the closest outgroup, then recognition at the generic level is necessary.”

Analyses of otter phylogenetic relationships using mitochondrial DNA sequences: Koepfli and Wayne approach.

“Mitochondrial DNA sequences provide independent information that can be used to corroborate or falsify phylogenetic hypotheses derived from morphological data.” Koepfli and Wayne, “obtained the complete nucleotide sequence of the cytochrome **b** (**cyt b**) gene to investigate the following phylogenetic” controversy: “monophyly or diphyly of the river otters classified in the genera ***Lutra*** and ***Lontra***...”

“Phylogenetic analyses consistently recovered the same clades but the hierarchical relationships among these clades varied depending on how the data matrix was weighted. The trees based on maximum parsimony and maximum-likelihood indicate that...the otters are divided into three clades, one containing the North American river, neotropical and marine otters; another containing the sea, Eurasian, spotted-necked, cape clawless and small-clawed otters; and one containing the giant otter.” (Koepfli & Wayne, 1998)

The work of Koepfli and Wayne further showed that the North American and Eurasian otter lineages diverged approximately eleven to fourteen million years ago, sometime during the middle Miocene. In addition, the three *Lontra* species, only the North American, Neotropical and Marine otters were studied, no samples from the southern river otter were available, were shown to form a “well supported monophyletic grouping in all of the phylogenetic analyses.”

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CHAPTER 2

DISTRIBUTION

Originally, the North American river otter could be found in a wide range of aquatic habitats; rivers, lakes, freshwater marshes, estuaries, and rocky sea coasts extending from 25° to 70° N latitude and 53° to 166° longitude. "...virtually every major drainage basin and wetland habitat north of the Rio Grande and Colorado River drainages..." had significant otter populations. (Foster-Turley et al. 1990)

▶ *Lontra canadensis canadensis* is found in: Newfoundland (some recognize these otters as the subspecies *L.c. degener*; the animals found here are the smallest form), Illinois, Wisconsin, Michigan, Minnesota (northeastern corner), the eastern seaboard states, Ontario, Quebec, New Brunswick, and Nova Scotia.

▶ *Lontra canadensis kodiacensis* is a smallish subspecies found on Kodiak and Afognak islands, Alaska.

▶ *Lontra canadensis lataxina* is found in the southeastern U.S., central plains and Gulf of Mexico states. In recent times this subspecies has been used for reintroduction and restocking projects in some states where it is believed not to have been found historically.

▶ *Lontra canadensis mira* is found in the Alexander Archipelago, Alaska (including the Prince of Wales' Island). This subspecies is the largest form.

▶ *Lontra canadensis pacifica* is found throughout Alaska, Yukon and Northwest Territories, British Columbia, Alberta, Saskatchewan, Manitoba, and parts of Ontario. In the U.S. it is found in northern California, Oregon, Washington, Idaho, Montana, Wyoming, North Dakota, South Dakota, most of Minnesota, parts of Colorado, northern Utah, and northern Nevada.

▶ *Lontra canadensis periclyzomae* is found on the Queen Charlotte Islands, Windfall Harbor, Admiralty Island, and Savok Bay area in Alaska. This form is significantly smaller than *L.c. mira* which is the largest North American river otter form.

▶ *Lontra canadensis sonora* is found in parts of Arizona, Nevada, southeastern California, southern Utah, and New Mexico. This subspecies has nearly disappeared. (Nowak 1991) Fish and Wildlife experts in New Mexico and Colorado believe it to be extirpated in their states.

LONTRA CANADENSIS – SUBSPECIES MAP



Lontra canadensis Subspecies

- | | |
|----------------------------|------------------------------|
| 1. <i>L. c. canadensis</i> | 5. <i>L. c. mira</i> |
| 2. <i>L. c. latrixina</i> | 6. <i>L. c. periclyzomae</i> |
| 3. <i>L. c. pacifica</i> | 7. <i>L. c. kodiacensis</i> |
| 4. <i>L. c. sonora</i> | |

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CHAPTER 3

STATUS

“During the late 1800’s and early 1900’s, the synergistic effect of wetland destruction, pollution, and overexploitation for furs was devastating to North American river otter populations. Additional otter losses were due to road kills, accidental drowning in fishing nets and ‘incidental take during beaver trapping’.” (Foster-Turley et al. 1990)

The beginning of the 20th century saw the introduction of conservation measures that prompted the initial recovery of the river otter in some areas. These were, restricted trapping and hunting seasons, increased public awareness and education, and, the preservation of wetlands. These early efforts have been aided in the latter half of the 20th century by habitat restoration in some areas and re-stocking/translocation projects.

“The reintroduction and restocking of beavers from the 1920’s to the 1950’s also had a positive influence on otter populations.” Because beaver dams increase wetland area and otters frequently use beaver lodges as denning sites, the otters benefit from a , *“..facultative commensalism with beavers.”* (Foster-Turley 1990)

In the 1970’s, Nilsson & Vaughn (1978) estimated that the river otter was found in only 33% of its former range. The causes of this were listed as: intensive trapping, pollution, destruction of habitat by clearing land, draining marshes, and channelizing streams.

In 1971 Ed Park published these results from a survey he conducted of all the U. S. states and Canadian provinces where otters had historically occurred:

“Otters are evidently still plentiful enough in the East to warrant a trapping season in most of the Atlantic Coast states from Maine to Florida, and in the Gulf Coast states, including Texas, which also admits “no large population present in the state.” The three Great Lakes states of Michigan, Minnesota, and Wisconsin have adequate otter populations, as do the northwestern states of Washington, Oregon, Nevada, Idaho, Montana, and Wyoming.”

“...From Colorado: “No otter have been observed in Colorado for many years.” Indiana: “The last authentic record of the presence of otter in the state was of one shot by a hunter in Posey County on December 7, 1942.” Oklahoma: “There are no otters in Oklahoma.” South Dakota: “No otter or otter literature.” West Virginia: “West Virginia sustained a small population of otter until approximately 15 years ago.”

“Many other states report the otter as rare. A report from North Dakota said, “Two reports of otters in North Dakota in recent years indicate that this valuable furbearer may not be entirely extinct within the state.” A report from Iowa read, “Otter is a pretty rare item in Iowa in recent decades. Occasional one turns up in nets of commercial fishermen in Mississippi river along NE border.”

“So, while many states still claim to have a few otters, they are almost gone from the vast central part of our country – from North Dakota to Texas and from West Virginia to Utah.”

“Canada and Alaska, of course, still have many otters, with trapping seasons in Alaska and all the Canadian provinces.”

(Park 1971)

Jenkins (1983) adds: *“Today the otter is essentially absent from the interior of the U.S. and the arid southwest where it was always rare. There can be little doubt that habitat destruction, unregulated trapping, and water pollution eliminated otters over wide areas of the interior of the country and in the more industrialized parts of North America.”*

Although in the 1990 Otter Action Plan the IUCN Otter Specialist Group considered the North American river otter as a species receiving adequate protection, they made several suggestions for areas needing study, these suggestions included: *“Critical evaluations of current status determinations are of highest priority for this species, especially in states and provinces where harvest is permitted.”*

A telephone survey of the Fish and Wildlife Agencies of Canada and the 49 U.S. states with historic otter populations was conducted by Reed-Smith in 1994. At that time much of the status data was anecdotal or based on experience and “gut feeling” versus definitive status surveys.

In 1994 many of the states that allowed trapping had very small harvest limits; the bag limit was essentially set to cover incidental trapping of otter by beaver trappers. (This was not universally true, some states and Canada reported heavier trapping of otter.) Due to the decline of the fur market over the last decade or two, several states indicated that interest in otter trapping was minimal. Because of this lack of interest in fur trapping in general, some states had seen a dramatic increase in beaver populations. The increase in beaver numbers had often resulted in a concomitant increase in the otter population due to the improved river otter habitat created by the beaver.

The 1994 survey results showed the beginning of a reversal in the decline of the fur market. Many states and all of the Canadian provinces reported a rise in otter pelt value, in some cases tripling, at least doubling, over the previous two to three years (1992 – 1994). To a large extent, the price jump was believed to be due to an increased interest in otter pelts in the world fur market, particularly in Asia.

As of 1995 most states were still reporting limited intentional trapping of otter however, Canada reported more active otter trapping.

N. A. River Otter (*Lontra canadensis*) – U. S. Wild Population Status - Table
(IUCN/SSC Otter Action Plan 1990, Reed-Smith 1994/95, IUCN/SSC Otter Action Plan 2000)

STATE	IUCN OAP 1990	REED-SMITH 1994	SERFASS (UNPUBL. 2000)
Alabama	HP, SP	HP, SP	HP, IP
Alaska	HP, SP	HP, SP	HP, SP
Arizona *	HNP, SP	HNP, SP, T	HNP, SM-RE, SS
Arkansas	HP, IP	HP, IP	HP, IP
California	HNP, SP	HNP, SP, SS locally,	HNP, SP
Colorado *	HNP, DP	HNP, US, E	HNP, E,
Connecticut	HP, SP	HP, IP	HP, IP
Delaware	HP, SP	HP, SP	HP, SP
Florida	HP, SP	HP, SP	HP, SP
Georgia	HP, IP	HP, IP	HP, IP
Idaho	HNP, SP	HNP, IP	HNP, SP-IP
Illinois *	HNP, US	HNP, IP, E	HNP, T,
Indiana *	Extirpated, US	HNP, E	HNP, E
Iowa*	HNP, IP	HNP, SP, SM, T	HNP, IP, T
Kansas *	HNP, IP	HNP, IP, SM	HNP, IP
Kentucky *	HNP, IP	HNP, IP, PM	HNP, IP, PM
Louisiana	HP, SP	HP, SP	HP, SP
Maine	HP, SP	HP, SP to IP	HP, SP
Maryland *	HP, IP	HP, IP	HP, IP
Massachusetts	HP, SP	HP, IP	HP, SP
Michigan	HP, SP	HP, SP	HP, IP
Minnesota*	HP, SP	HP, IP	HP, SP
Mississippi	HP, SP	HP, SP to IP	HP, IP
Missouri *	HNP, IP	WL	HP, IP
Montana	HP, SP	HP	HP, IP
Nebraska *	HNP, IP	HNP, IP, E	HNP, E
Nevada	HP, SP	HP & HNP (county dependent), SP	HP, SP
New Hampshire	HP, IP	HP, SP, U to C	HP, SP
New Jersey	HP, SP	HP, SP to IP	HP, SP
New Mexico	HNP, US	extirpated	extirpated
New York *	HP, IP	HP, IP	HP, SP
North Carolina *	HP, IP	HP, SP to IP	HP, IP
North Dakota	HNP, IP	HNP, regarded as extirpated	HNP, regarded as extirpated
Ohio *	HNP, SP	HNP, IP, E	HNP, IP, E ***
Oklahoma *	HNP, IP	HNP, IP	HNP, IP
Oregon *	HP, SP	HP, IP	HP, SP
Pennsylvania *	HNP, SP	SS, IP	HNP, SS, IP
Rhode Island	HNP, IP	HNP, IP, PM	HNP, IP
South Carolina	HP, SP	HP, SP	HP, IP
South Dakota*	HNP, US	HNP, US, T	HNP, T
Tennessee *	HNP, IP	HP & HNP, T in part, SP to IP	HP, IP, T
Texas	HP, IP	HP, SP	HP, IP
Utah *	HNP, US	HNP, US, SM, SS, SM	HNP,SP, SS
Vermont	HP, IP	HP, SP, C	HP, SP
Virginia*	HP, SP	HP, IP to DP dependent on area,	HP, SP-IP
Washington	HP, SP	HP, IP to SP dependent on area	HP, IP
West Virginia *	HNP, IP	HNP, PM	HNP, PM
Wisconsin	HP, IP	HP, SP to IP, C	HP, IP
Wyoming	HNP, IS	HNP, US to DP, PS, SM	HNP, PM

LEGEND: HNP – Harvest Not Permitted; HP – Harvest Permitted; SP – Stable Population; DP – Declining Population; US – Unknown Status; IP – Increasing Population; E – State Endangered Species List; T – Threatened; SS – Species of Special Concern/Risk; PM - Protected Mammal.; WL – Watch Listed; SM – Small Population; U - Uncommon; C – Common; RE – Reintroduced * Restocking or translocation projects have taken/are taking place.

2000 Status, State comments:

Alaska – There is no limit during the open season which extends from 01 December to 15 February in Units 1 – 4 and from 10 November to 15 February in Unit 5. The Alaska Fish and Wildlife web site (www.state.ak.us/akpages/FISH.GAME/notebook/furbearer/rvrotter.htm) states that 1,200 to 2,400 pelts are harvested annually in Alaska.

California – Numbers in Northern California are increasing, “...I do know from studies done in '94 - '96 that otters are adapting well to suburban and even urban habitats in some areas of Northern California. This includes resident otters in tertiary treatment marshes next to an extraordinarily busy freeway, suburban transients in swimming pools thriving on cat food, and migrating otters moving through the delta among industrial marshes (loaded with toxics by the way). (M. Graham, pers. comm.)

Florida - <http://www.riverotter.org/> This is a web site dedicated to river otters in Florida. It contains a page where otter sightings can be posted.

Illinois – 346 (192.154) otters were released in Illinois between 1994 and 1997. Their web site is at www.inhs.uiuc.edu/dnr/fur/index.html.

Michigan – DNR figures from the state of Michigan show that since 1992-1992 when 887 otters were trapped the pelt take has increased. 1993-1994 N/A; 1994-1995: 1,521; 1995-1996: 1,115; 1996-1997: 1,416. (Cooley, T. et al. 1993, 1995, 1997, 1997)

Ohio - *** The state endangered status will probably be reviewed and changed in the near future. The state otter population was estimated to be about 1,700 and increasing in 2000. (Dwyer per. com.)

N. A. River Otter (<i>Lontra canadensis</i>) – Canadian Wild Population Status - Table (IUCN/SSC Otter Action Plan 1990, Reed-Smith 1994/95, IUCN/SSC Otter Action Plan 2000)			
PROVINCE	IUCN OAP 1990	REED-SMITH 1994	REED-SMITH 2001
Alberta *	HP, SP	HP to HNP dependent on area, SP to IP dependent on area.	HP, to HNP dependent on area, SP to IP.
British Columbia	HP, SP	HP, SP	HP, SP
Manitoba	HP, SP	HP to HNP dependent on area, SP, U to C	HP, SP, C
New Brunswick	HP, SP	HP, SP	HP, SP
Newfoundland	HP, SP	HP, SP, C	HP, SP
Northwest Territories	HP, SP	HP, SP(?)	HP, SP
Nova Scotia	HP, SP	HP, SP	HP, SP
Ontario	HP, SP	HP, SP	HP, SP
Prince Edward Island		extirpated	extirpated
Quebec	HP, SP	HP, SP	HP, SP
Saskatchewan	HP, SP	HP, SP, C	HP, SP
Yukon	HP, SP	HP, SP	HP, SP

LEGEND: HNP – Harvest Not Permitted; HP – Harvest Permitted; SP – Stable Population; DP – Declining Population; US – Unknown Status; IP – Increasing Population; E – State Endangered Species List; T – Threatened; SS – Species of Special Concern; PM - Protected Mammal; WL – Watch Listed; SM – Small Population; U - Uncommon; C – Common;

*- Restocking or translocation projects have taken/are taking place.

Alberta – There are about 2000 trappers registered in Alberta and 1700 registered fur management areas. Between 1990 and 2000 332 otter pelts were harvested selling for a mean price of \$112.63 (Canadian). Otters are trapped under a quota system; listed as a “green list” species.

Manitoba – The number of otters taken per year period in Manitoba were: 1983 – 1988: average of 2,290; 1988 – 1993: average of 1,219; 1993 – 1998: average of 1,904; 1997 – 1998: 2,021; 1998 – 1999: 1,690. The average auction value of the pelts was: 1983 – 1988: \$41.60; 1988 – 1993: \$44.74; 1993 – 1998: \$83.71; 1997 – 1998: \$79.54; 1998 – 1999: \$60.48 (Canadian dollars) The pelt is considered to be in its prime from mid-November to the end of December. Ranked as S5 = secure, widespread and abundant.

New Brunswick – The total number of otter pelts exported in 1998/99 was 433 in 1999/2000 it was 410. The per pelt value in the 1998/99 season was roughly \$46.63 (Canadian), in 1999/2000 it was \$82.45 (Canadian). Trapping is permitted in zones 1 to 11 from October 13 to January 27; zones 13 to 27 the season extends from November 4 to January 27; zone 12 the season opens October 21 and ends January 27.

Yukon - Because otter are not generally targeted by Yukon trappers fewer than 50 are usually taken each winter and just 12 otters were trapped in the 1998-99 fur harvest season, the average pelt price was \$60.00 (Canadian).

In 1994, all Canadian provinces reported an increased interest in trapping otters due to an increased interest in otter pelts from Europe and Asia. At that time it was believed that what in recent years had predominantly been incidental trapping of otter, would switch to an intentional annual otter take as a result of the increase in price. For that reason, every province reported that bag limits, or the use of no bag limit for otter, would be reviewed annually.

In summary, “...North American river otters are most abundant in wetland areas of the Mississippi river delta and adjacent Gulf Coast (east Texas to Florida), the Atlantic Coast (Florida to Newfoundland, excluding large metropolitan areas such as New York City, Washington D. C., and Philadelphia), the Great Lakes region, the southern Hudson Bay region, and the Pacific Coast (northern California to Alaska).”

(Foster-Turley et al. 1990)

CITES LISTING

In 1977 N. A. river otters were listed as an Appendix II species by CITES (Convention on International Trade in Endangered Species of Wild Fauna and Flora).

“Appendix II: Species are not presently threatened with extinction, but may become so unless their trade is regulated. Import permits are not required, but an export permit or re-export certificate must accompany each shipment. Export permits can be issued as long as the export will not be detrimental to the survival of the species. Re-export certificates are required for species previously imported.

“■ All CITES wildlife shipments must enter and leave the U.S. through customs ports designated by FWS, unless an exception is obtained. Shipments must comply with the International Air Transport Association Live Animal Regulations (IATA) and CITES Transport Guidelines.

“■ CITES establishes procedures to regulate the import and export of species threatened by trade. The treaty covers animals and plants, whether dead or alive, or any readily recognizable part or derivative of that animal or plant.

“■ The ESA (Endangered Species Act) designated the Interior Department both the management and scientific authority for CITES in the U.S. The FWS/Office of Management Authority reviews the effects of wildlife and plant trade and issues or denies permits. The FWS/Office Scientific Authority determines whether the issuance of the permit will not be “detrimental” to the survival of the species.” (AZA 1994)

IUCN RED LIST – IUCN/SSC OTTER SPECIALIST GROUP SUGGESTED LISTING

The N. A. river otter (*Lontra canadensis*) was not listed on the 1994 IUCN (International Union for the Conservation of Nature) Red List. In 1999 the IUCN/SSC Otter Specialist Group reviewed the Red Book listings of all 13 extant otter species and recommended that *L. canadensis* be listed as Lower Risk. It is unknown at the time of publication if their recommendation will be adopted. (Reuther 2000)

OTTER/HUMAN RELATIONSHIP

First and foremost, river otters are frequently confused with sea otters. Stand at any otter exhibit in any zoo or aquarium and you will soon hear comments similar to these: "I love otters." "It is so much fun to watch them float on their back and use a rock to break open a clam then run and slide in the snow or mud!" Confusion like this is not the fault of the zoo visitor. It comes from the high profile of the sea otter, a focus only on the word otter, and a basic unfamiliarity with wildlife. It is the job of zoos and aquariums to change this.

Otters in the wild are appreciated, tolerated, persecuted or trapped; it all depends on where the otters are and who you are talking to. Otters can be viewed as pests by home owners, boat owners and anglers. They can have serious economic impact on fish ponds, they are not looked on kindly by some beaver trappers, and of course, they are trapped themselves for their beautiful fur. Thus far, with some sound conservation measures passed in the late 1960's and 1970's the river otter has been a true conservation success story despite all the previous mentioned people who may not be too happy to have an otter visit their stream, river, or lake. However, this could change quickly, especially if pollution continues to go unchecked. (See also Native American Tales and Legends)

OTTERS IN CAPTIVITY

ISIS Zoological Institution Census – Table (As of June 2000)	
<i>Lontra canadensis</i> (no subspecies)	1994: 83.69.3 = 155 @ 67 institutions 2000: 92.99.5 = 196 @ 87 institutions
<i>Lontra canadensis</i> (hybrid) *possible <i>L.c.canadensis/L.c.lataxina</i> hybrid; true status unknown	1994: ---- none identified 2000: 0.3.0 = 3 @ 2 institutions
<i>Lontra canadensis canadensis</i>	1994: 20.17.0 = 33 @ 19 institutions 2000: 20.16.2 = 38 @ 21 institutions
<i>Lontra canadensis degener</i>	1994: ---- none identified 2000: 1.1.0 = 2 @ 1 institution
<i>Lontra canadensis lataxina</i>	1994: 15.18.0 = 33 @ 17 institutions 2000: 18.14.2 = 34 @ 22 institutions
<i>Lontra canadensis pacifica</i>	1994: 6.4.0 = 10 @ 5 institutions 2000: 4.3.0 = 7 @ 5 institutions
Total # of animals in ISIS institutions (1994)	124.104.3 = 231
Total # of animals in ISIS institutions (2000)	125.146.9 = 280 total (120.140.6 = 266**)
Total # ISIS institutions in 1994 with <i>L. canadensis</i>	95**
Total # ISIS institutions in 2000 with <i>L. canadensis</i>	114 (99**)

ISIS = International Species Information System. This is a member computerized database, not all institutions/facilities/rehab centers, etc. holding this species participate. It can be assumed that there are at least half again the total number of river otter listed here in captivity, if not more. ISIS is located at: <http://www.worldzoo.org/> 12101 Johnny Cake Ridge Road, Bldg. A, Rm. 6, Apple Valley, MN 55124-8151. 952-997-9500. Fax: 952-432-2757. isis@isis.org.

** North American institutions

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CHAPTER 4

IDENTIFICATION and DESCRIPTION

Historically otters, as a group, are old; their body shape has remained relatively unchanged for 30 million years. They have not undergone any drastic evolutionary changes, but instead show a number of subtle modifications on the basic carnivore body form.

PHYSICAL DESCRIPTION

“In general body conformation, the northern river otter resembles a long cylinder that reaches its greatest diameter in the thoracic region. The head is rather blunt, small, and somewhat flattened. It is characterized by a bulbous nose on the end of a short muzzle, small rounded ears set well back, and eyes set high on the head and closer to the nose than to the ears. The neck is thick and cylindrical. Legs are short and stocky, and the feet are pentadactyl and plantigrade, with interdigital webs. The tail is relatively long, thick, and pointed.” (Toweill & Tabor, 1982)

Coat

The otter's fur is held in high regard in the fur trade and is considered a standard by which durability and quality are judged. (Obbard 1987) Only the sea otter's pelt is considered to exceed the river otter's in luster, durability, hair density, and softness. The fur consists of long, lustrous guard hairs and short, dense, wool-like hairs which trap air and act as insulation. The guard hair is thick at 17 – 20mm (.6693 - .7874 inches); the under-fur is 8 – 9mm (.315 - .3543 inches). The insulative and waterproof qualities of the coat are maintained by frequent grooming. Water adhering to the tips of the guard hair beads off and causes the coat to form spikes upon leaving the water.

Although there is a great deal of color variation, in general, the back is a rich dark brown, the under parts somewhat paler with lips, chin, and throat area paler still.

Molt

Many observers have noted that there are normally two molts a year; spring and fall; however, others report only one molt, in the spring. Because the spring molt, or shed, can extend over a long period of time it is possible that the fall shed is actually the completion of the earlier spring molt. (Jackson 1961 & personal observation)

Harris (1968) describes the molts in this fashion: *“...there is a very quick and almost imperceptible moult in September, preceded by a slightly singed appearance. The spring moult, however, is a more elaborate affair, starting at the end of March with a paling of the hair tips on the head and shoulders. This is accompanied by a ravenous appetite. The first fur to be shed seems to be that along the upper center line of the tail, the side edges of the tail shedding next. At about the same time or very shortly afterwards the area immediately behind the shoulder-blades starts, as does the face. Here it begins immediately above the eyes, in more or less circular patches, and temporarily gives the animal a very curious piebald appearance. Moult of the throat, chest and stomach soon follows. By this time the guard hairs on the body have paled almost exactly to the colour of the underfur...Once the shedding starts it proceeds fairly rapidly...”* (Harris 1968)

“Differences in length and density of the fur are related to climate, with northern forms having the longest and most dense pelage. Similarly, western and southern forms tend to be lighter in color than northern and eastern forms.” (Toweill & Tabor 1982)

Ben-David et al. (2000) & Blundell et al. (in press) found that river otters involved in a captive study in Alaska shed their under fur from May to August and their guard hair is shed between August and November.

“White, albino, black, silverfish, slate, grizzled, and mottled variations have been reported.” (Jackson 1961)

The otter’s coat as insulation

Tarasoff (1974) and Kruuk (1995) discussed the relative merits of fur versus blubber as an insulator in cold waters. Although blubber is far more efficient as an insulator, its low specific weight would cause a problem for the small otter trying to swim submerged. Also, the added weight would prove a serious impediment to an animal like the otter that spends so much of its time traveling over land. Thus, the otter has solved the insulation problem with a thick coat of fur. A layer of air is trapped within the dense under-fur and the guard hairs; these air pockets are maintained by the otter’s frequent grooming.

It has been shown that the *“...thermal conductivity of fur is 20 to 50 times greater when wet than when dry...(and that) it is therefore vital for otters to maintain the air holding capacity of fur, even at the cost of considerable effort...”* (Kruuk 1995)

Fur density

“...the under-fur gives the impression almost of being the skin itself, so dense is the hair.” This statement made by Hans Kruuk in his 1995 book *Wild Otters Predation and Populations* is as true for *L. canadensis* as it is for *L. lutra*. Addy de Jongh (Kruuk 1995) calculated 50,000 hairs per cm² for *L. lutra*. Tarasoff et al. (1972) give a figure of 57,833 hairs/cm² for the midback area of *L. canadensis*. Harris (1968) cites Schreber (1776) as describing the difference between the European and North American otters in part as: *“Over and above their [larger]size, pelts from American otters are distinguished by the greater fineness of the hairs, the greater amount of the undercoat, and the colour...”*

Size

Head and Body Length (Head to rump)

661mm – 1270mm (26in. to over 50in.) (Harris 1968)

22 to 31 inches (Walker et al. 1964) (55.88 to 78.74 cm)

26 to 30 inches (Burt & Grossenheider 1952) (66.04 – 76.2 cm)

23 to 36 inches (Wilson 1959) (58.42 – 91.44 cm)

Tail Length

305mm – 457mm (12in. – 17in.) (Harris 1968)

The tail comprises roughly 40% of the total body length. (Melquist & Hornocker 1983) Toweill & Tabor (1982) put the tail length at about one third of the total length.

14 – 19.5 inches (Park 1971 citing Wilson 1954, 1959, 1961) (35.56 – 49.53cm)

12 to 20 inches (Hall & Kelson 1959) (30.48 – 50.8cm)

Total Length

35 – 54 inches (Park 1971) (88.9 cm – 1.3716 m)

1000mm – 1530mm (Foster-Turley 1991) (3.28 – 5.02 ft.)

1100mm – 1525mm (Harris 1968) (3.61 – 5 ft.)

35 to 51 inches (Hall & Kelson 1959) (88.9 cm – 1.295 m)

42 to 54 inches (Cahalane 1947) (1.067 – 1.3716 m)

Maximum length reached at about two years of age.

Weight

4.5 – 11.3 kg. (Harris 1968) (10 lbs. – 25 lbs.)

5 – 15 kg. (Hall 1981) (11 lbs. – 33 lbs.)

8 kg (mean) for females; 9.8 kg. (mean) for males in Alaska (Bowyer in press)

The ideal weight for all animals will vary and should be established on an individual basis.

Below is a table listing body mass and total length by sex and age classes of river otters captured in non-oiled areas of Prince William Sound, Alaska, USA, 1996-1998 (Ben-David et al. personal communication).

Sex and Age Classes	Body Mass (kg)			Total Length (mm)	
	<i>n</i>	\bar{x}	SE	\bar{x}	SE
Males					
Yearlings	6	7.3	0.6	1171.0	27.9
Adults	34	9.8	0.2	1287.0	8.7
Females					
Yearlings	0	—	—	—	—
Adults	17	8.0	0.2	1232.0	13.7

Sexual Dimorphism

All subspecies are somewhat sexually dimorphic with the males generally larger than the females. Melquist & Hornocker (1983) found that adult males, on average, were 17% heavier than adult females. They cite an average weight of 7.9kg. (17.4 lb.) for females. Keep in mind that not all males are larger than females and, as stated above, target weights for all animals should be based on their size, activity level, age, and individual characteristics – not on any of the published norms or mean weights.

Length and weight vary a great deal between some subspecies.

Regional Differences

There appears to be a clinal decrease in size from north to south, but this does not appear to be so going from west to east. (Toweill & Tabor 1982) “*Differences in length and density of the fur are related to climate, with northern forms having the longest and most dense pelage. Similarly, western and southern forms tend to be lighter in color than northern and eastern forms.*” (Toweill & Tabor 1982)

Dentition

3/3 Incisors 1/1 Canines 4/3 Premolars 1/2 Molars x 2 = 36 Total

The teeth are adapted for crushing; the upper fourth premolar and lower first molar, the carnassials, are adapted for shearing. (Toweill & Tabor 1982)

Supernumerary premolars have been reported. (Toweill & Tabor 1982)

Layering in the cementum of the teeth and tooth wear can be used to age animals.

Skeletal Adaptations

In addition to adaptations mentioned elsewhere (See Aquatic Adaptations), river otters have the following characteristics:

The fore limbs are highly mobile on the chest wall because they do not have a clavicle.

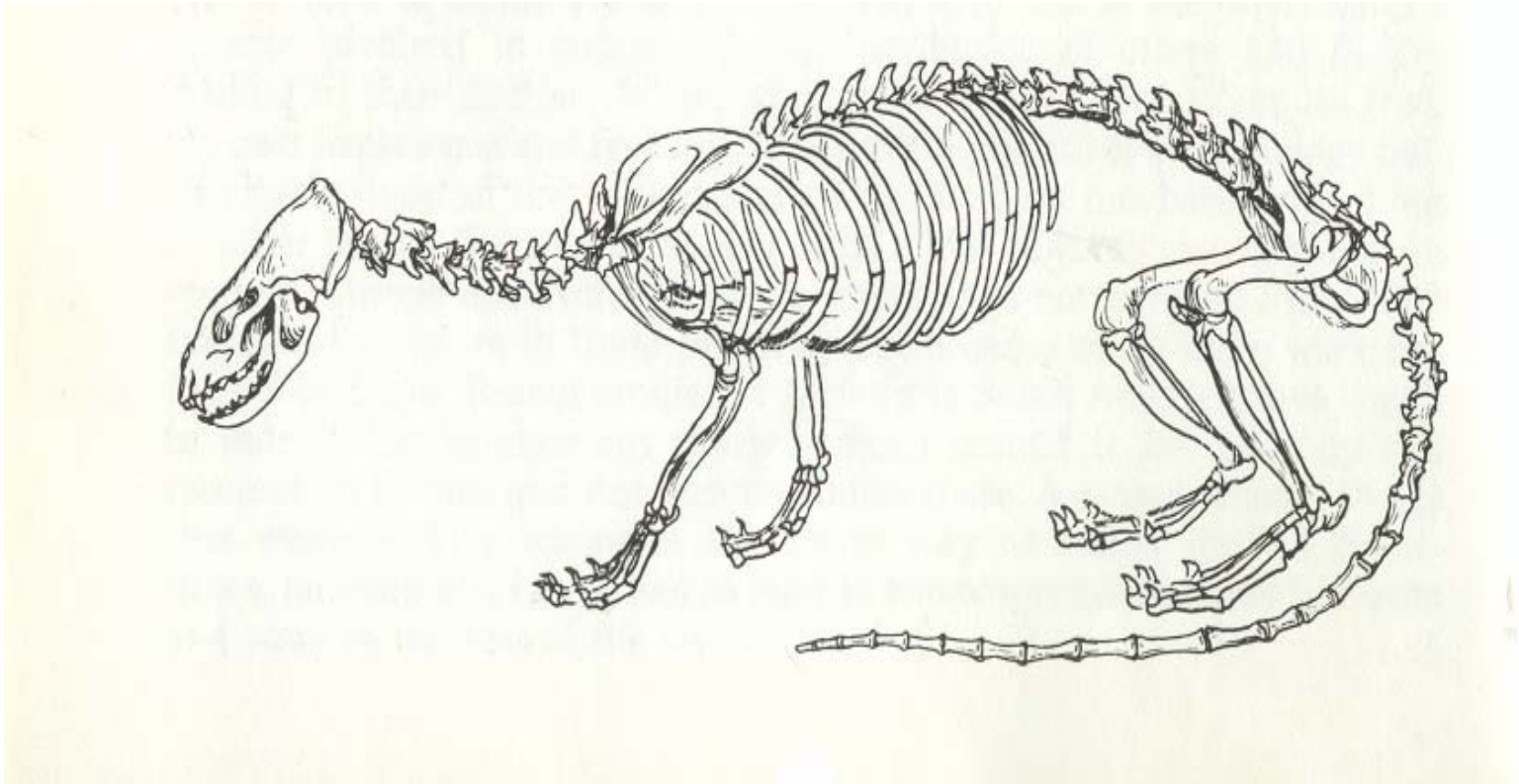
“Both the metatarsals and phalanges are elongated, and a generous web of skin exists between the digits of the hind feet, so that the foot becomes twice as wide when the digits are spread. The length of the individual digits of the river otter are $IV=III>V=II>I$.” (Taylor, 1989)

Vertebrae

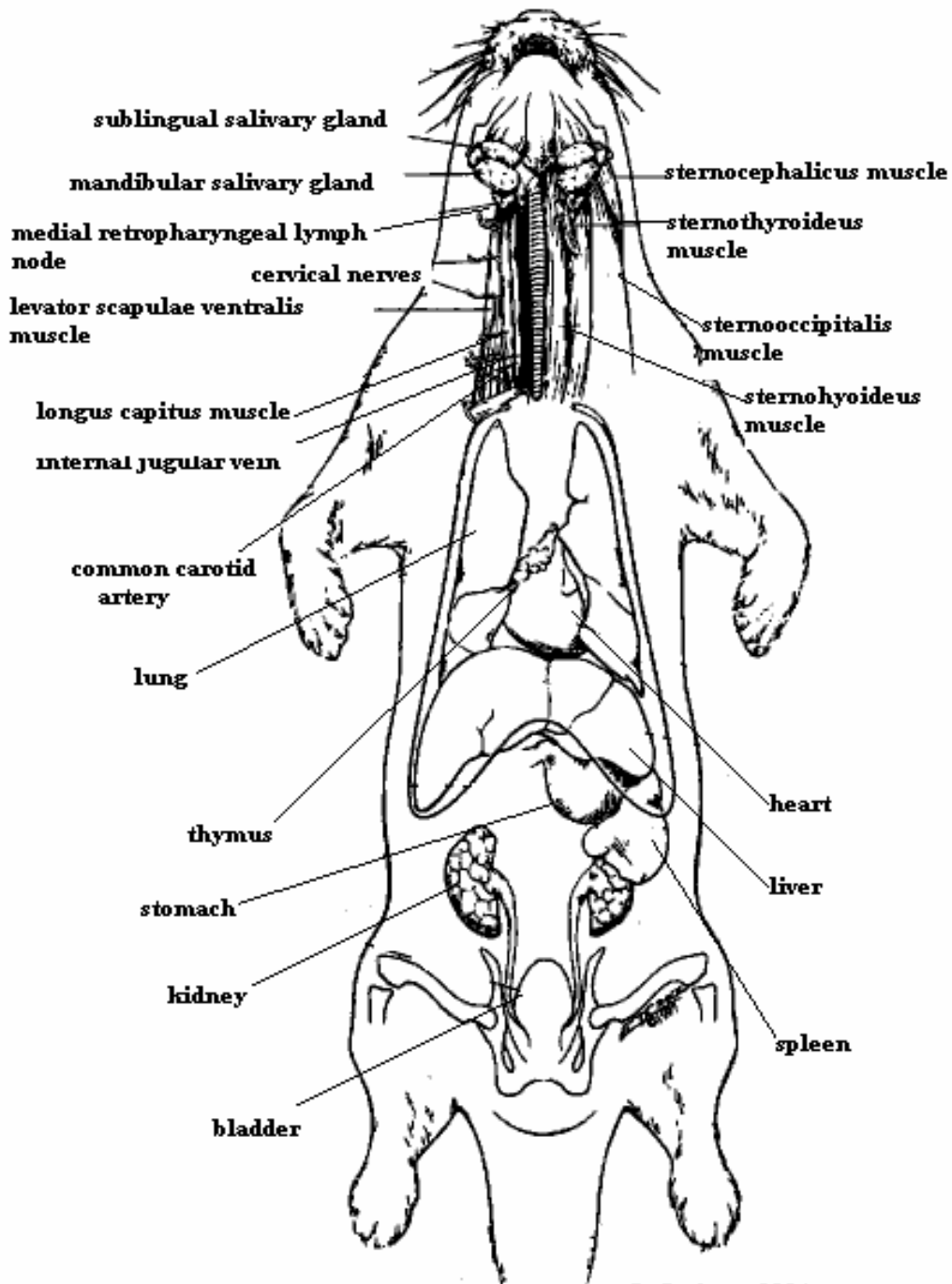
14 rib-bearing; 7 cervical; 14 thoracic; 6 lumbar; 3 sacral; 22 caudal. The normal total is 52. (Toweill & Tabor 1982)

Chevron bones, which are found from the fourth caudal vertebra posteriorly are associated with greater vascularization of the river otter's tail.

River Otter Skeleton



Illustrations by Michael Clark
From: Chanin 1985, The Natural History of Otters, page 4.
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Digestive Tract

The intestines are lined with a mucoid substance which is believed to help protect them from sharp edged foods, i.e. fish spines, etc. This mucous is frequently passed with the feces. (Harris 1968) This could be the same as the jelly-like secretion mentioned below.

In addition to scats, otters produce a 'jelly-like' secretion which varies in color from white to yellow to green, brown and black.

Davis et. al. (1992) and Spelman et al. (1997) report that gastrointestinal transit time for a fish meal took anywhere from 2 to 4 hours with a mean of 202 minutes. In 1951, Liers tested otters previously fed a bland diet and found that the exoskeletal remains of crayfish were passed about one hour after consumption.

Otter Scat

Otter feces can be varied in color, dependent on what they have been eating, particularly in captivity. In the wild the otters' scat is generally dark in color with identifiable bits of fish scale or the exoskeleton of insects, etc. Scat are frequently deposited as scent marks in prominent locations throughout an otters home range. It is frequently accompanied by a jelly-like or mucoid substance that can vary in color from yellow-green-brownish to quite dark. Ormseth & Ben-David (2000) found that on average, otter scat weighed 39.5 g (± 2.1 SE; n = 99 scats)

"Fresh dropping were black with a strong characteristic odor....heavy mucous was mixed throughout..." (Greer 1955)

"The average (scat) is approximately $\frac{3}{4}$ " in diameter and characteristically in 2, 3, or 4 curved segments each about $1\frac{1}{2}$ to 3" long..." (Greer 1955) (3.81 – 7.62 cm)

"Otter intestines (are) lined with about $\frac{1}{4}$ " (6.35 mm) of mucous for protection from fish spines and other sharp edged foods..." (Wilson 1954)

Scent Glands

Anal glands release a strong smelling, creamy, substance when an otter is sprainting (defecating), scent marking, frightened, or angry. This anal secretion is whitish when from young animals and darkens a bit as the animal ages.

Facial Characteristics

Eyes

Directed forward allowing for binocular vision

Vibrissae

Numerous, long, thick vibrissae on the face, used for locating prey in dark, murky waters.

Rhinarium

The nose pad is naked and black. The shape, something resembling the ace of spades, or inverted triangle, is characteristic of this species. (Harris 1968, Coues 1877))

Mustache Spots

Scott Shannon (personal communication) refers to these unique marks as "*mustachial maculations*". These spots which appear after about one year of age are unique to each individual, although, not all individuals develop these spots. Generally they are dark in color but S. Shannon has seen "*orange colored markings*" on several individuals in his study population in Northern California. (personal communication). Once an animal has reached adulthood these mustache spots can be useful as visual identifiers. However, an

individual's spots can change over time so this method should only be used for identifying animals in which these changes can be monitored and traced.

Feet

Webbing between all digits but, more extensive on the hind feet. The claws are sharp and probably aid in gripping. The hind feet are generally larger than the fore and the hind legs are longer leading to the typical hump-backed gait when traveling across land. The soles of the feet have tufts of hair under the toes (in some subspecies). Plantar pads are found on the soles of the hind feet. "*Moustachial pads well developed.*" (Harris 1968) Pentadactyl and plantigrade. Also see skeletal adaptations.

Physiological Values

Normal Heart Rate

137 – 170 beats/minute (Grassmere Wildlife Park now Nashville Zoo @ Grassmere, TN)
130 – 178 beats/minute; baseline = 152 beats/minute (Spelman 1999)
120 – 160 beats/minute (Hoover 1985)

Normal Body Temperature

A range of 37.5° to 40°C or 99.5° to 104°F, for otters involved in a translocation project, was given by Serfass (1994). (The upper end of this spectrum should be considered pathologic if it continues very long. An animal's normal temperature may reach this height after the exertion and stress associated with being caught.)

Rectal Temperature Range: 38.1 – 38.7°C; baseline = 38.4°C (100.58 – 101.66°F) (Spelman 1999); 35.28°C – 38.89°C (95.5°F - 102°F) n=8 (Ben-David unpublished information)

A core body temperature range of 35.86°C to 40.37°C (96.55 – 104.66°F) was recorded by Kruuk et. al. (Kruuk 1995) for *Lutra lutra*. The mean for inactive otters was 38.14°C (100.65°F).

Basal Metabolic Rate

Toweill and Tabor (1982) cite work done by Iversen in which he reported that the BMR of mustelids over 1kg. can be expressed by the equation: $M = 84.6W^{0.78} (+0.15)$. M = basal metabolic rate in kcal/day and W = body weight in kg. "*This is about 20% higher than expected from the mammalian standard curve described by $M = 70 W^{0.75}$.*" Although Iversen's study used *Lutra lutra* (the Eurasian otter), it is assumed the data is valid for *L. canadensis* as well.

"...mustelids typically have basal metabolic rates about 20% above the standard curve." (Estes 1989)

Social System

More social than some of the other otter species (*L. lutra*) and less than others (*A. cinereus*, *P. brasiliensis*). Animals inhabiting marine ecosystems appear to form groups (mostly males but some females do join) to take advantage of seasonally schooling pelagic fish. (Blundell in press & pers. com.). Adult females in marine systems are less likely to be social. Males inhabiting fresh water systems also may form groups but are generally considered to be solitary (Melquist & Hornocker 1983); females found with family groups. (See Natural History)

Karyotype

"*The diploid (2n) number of chromosomes is 38. Thirteen pairs of autosomes are metacentric or submetacentric, while six pairs are acrocentric or subacrocentric.*" (Toweill & Tabor 1982)

Aquatic Adaptations

Respiratory System

See Coat and Maximum Dive Time

“River otters appear to undergo bradycardia while submerged. Despite this ability to conserve oxygen, the maximum time an otter can remain submerged is approximately 4 minutes.” (Melquist & Dronkert)

According to Dunstone (1998) the early studies on the physiology of diving involved “forced submersion”. They also discuss studies conducted on mink by Stephenson et al (1988) in which they found that mink diving in familiar tanks did not exhibit bradycardia. *“However, when the animals encountered a novel situation, or were diving in an unfamiliar environment, they showed a reduction in heart rate that may therefore be associated with a fear response. The possibility cannot be excluded that the animals are consciously able to initiate the development of a bradycardia if the situation – for example, sustained pursuit of a fish or escape from a predator – requires it.”* (Dunstone 1998)

In short, it is likely that otters undoubtedly store enough oxygen in the lungs, blood and muscles for a typical dive but experience bradycardia when pushed as a result of fear or necessity.

Lungs

An increase in relative lung size as an adaptation for aquatic life has been described by investigators. (Toweill & Tabor 1982)

“Aquatic mammals possess structural modifications in their lungs and bronchial trees, which vary according to dive depth and duration. The tracheal length-width ratio decreases from river otters to sea otters to phocid seals, presumably permitting more rapid and complete air exchange with the lungs before and after diving in the more highly adapted aquatic forms. The tracheal rings of river otters and sea otters are partially calcified, whereas those of phocid seals are entirely cartilaginous, thus permitting flexibility under the pressure of deep diving.”

Lungs are triangular in shape; the right lung which is 19.3% larger than the left, has four lobes versus two lobes for the left. This reduction in lung lobulation is theorized to be an adaptation to aquatic life. (Tarasoff & Kooyman 1973)

Trachea

The otter’s short trachea (about midway in length between that of terrestrial and marine mammals; mean length is 23.2% of body length), is believed to possibly aid air exchange and increase ventilation of the lungs. (Tarasoff & Kooyman 1973a)

Dive Information

Maximum Dive Time

There are a number of varying opinions as to how long river otters can stay submerged. At the short end, the IUCN/SSC Otter Specialist Group lists 30 – 40 seconds (IUCN 1992). The longest dive time of 6 to 8 minutes are listed in Grzimek (1975) and the Smithsonian Book of North American Mammals (1999). (These times are most likely unsubstantiated observations, which have been repeated throughout the literature, of animals that went under water and found air pockets.) Field (1970) timed dives for periods ranging from 68 to 263 seconds. Kruuk (1995) lists dive times for *L. lutra* of 96 seconds, but says it was, *“...quite rare to see dives lasting longer than 50 s (seconds).”*

“Dive duration for otters chasing fast schooling-fish was significantly lower (14.2 ± 2.3 seconds; $n = 10$) than when they were chasing slow nonschooling-fish (16.3 ± 1.6 seconds; $n = 12$) suggesting higher levels of oxygen consumption during these chases. The aerobic dive limit for otters would be 54.1 seconds for animals with normal hemoglobin contents.” (Ben-David per. com. from Ben-David et al. 2000)

The longest dive recorded during recent studies in Prince William Sound, Alaska was 88 sec. but dives of this length occurred in only 0.3% of 2,293 dives; of 441 closely observed dives, the duration was recorded as 21 ± 1 sec., mean \pm SE. (Ben-David unpublished data).

Dive Depth

There is more information available on *L. lutra* than *L. canadensis* due to the work of H. Kruuk and his students in Scotland. Kruuk (1995) states that the Eurasian otter generally doesn't dive deeper than 3 meters (9.84 ft.) but has been known to dive as deep as 14 meters (45.93 ft.).

There is at least anecdotal information that N. A. otters prefer to fish at shallower depths as well.

Heat Conservation

River otters rely on their fur and the layer of air trapped by the undercoat to conserve body heat. This layer of air prevents penetration of cold water to the skin and may secondarily serve to aid in floatation. (Estes 1989) It is unclear if *arrector pili muscles*, which serve to "...increase the insulative thickness of fur by holding the air shaft vertical to the skin..." in other mammals, are present in the lutrinae. (Estes 1989)

Locomotion

Hump-backed gait when traveling overland. A dog paddle with the head above water is typical when the animal is swimming slowly. Paddling modes include forelimb, hindlimb, and all limb paddling.

Underwater swimming is accomplished by pulling the front legs next to the torso then undulating the body and tail; the hind legs are used to steer and help propel them during this type of swimming. On snow or muddy banks, otters will frequently slide on their stomachs. Often seen as play behavior, it is primarily an efficient means of transportation. (Fish 1994)

In snow, they have been reported to fold back their front legs and push themselves up a 20 to 25° grade using only their hind legs. (Field 1970)

Otters in captivity have been known to climb trees and there is at least one report of an otter found high up a cliff face (stuck) in a river canyon. (pers. com. anon.)

Reuther (1989) discusses two studies done on the jumping ability of *Lutra lutra* in Germany. It was determined that an otter could jump from the ground to a platform 130 cm (4.26 ft.) high, leap from the water onto a platform 90 cm (2.95 ft.) high and cover a distance of 160cm (5.24 ft.) when jumping from one platform to another.

Top Speed on Land

Up to about 18mph (29kph). (Nowak 1992)

Severinghaus & Tanck (1948) determined a top land speed for the otter of 15 to 18mph (24 – 29 kph) using a combination of gliding and running.

Top Speed in water

Six to 7mph (10 to 12kph). (Harris 1968)

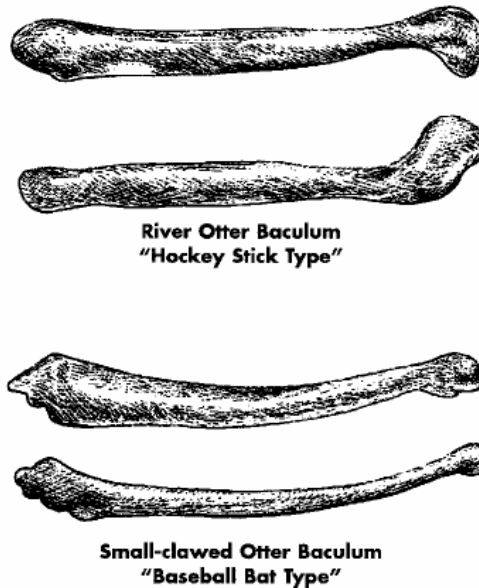
Male Characteristics

Males begin producing viable spermatozoa at about two years of age when they mature sexually. However, in the wild, it is believed they are not successful breeders until they are about five years of age. The males baculum increases in length until age three and weight until age six. It has been postulated that the baculum may not be developed enough to induce ovulation until the male reaches this older age. (Melquist & Dronkert 1987)

Data collected from captive breedings over the last decade contradict this hypothesis, at least for the captive population; there have been a number of successful births sired by two year old males. It could be that in the wild these young males cannot successfully compete against older, more experienced males. It also is possible that due to the smaller size of their baculums, these young males require a longer period of intromission to successfully stimulate ovulation which, due to their inexperience, subordinate role or position as a territorial interloper, they are not able to realize in the wild. In captivity, there is no competition, generally, thus an inexperienced animal can take as long as he needs to get it figured out!

The males testes fluctuate seasonally in size. (Toweill & Tabor 1982, personal observation)

Otter Baculums



Illustrations by Michael Clark
From: Chanin 1985, The Natural History of Otters, page 8
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Female Characteristics

Females are also sexually mature at about two years of age. Liers (1951) did report one female who bred at 15 months.

The ovaries and uterus continue to grow until about 2 years old. The uterus is bicornate. *“Adult females...may develop an os clitoridis, the female counterpart to the male os baculum. The os clitoridis is a cartilaginous structure in females less than two years old, but may ossify in older individuals.”* (Toweill & Tabor 1982)

Induced ovulators, *L. canadensis* experiences delayed implantation. *“The exact duration of neither the inactive (unimplanted) nor the active (implanted) stage of pregnancy is known.”* (Toweill & Tabor 1982) (See Gestation)

Mammae

Four total, two pairs; inguinal.

Estrous

November to June; in general, estrous appears to be dependent on latitude. The estrous period lasts roughly 42 to 46 days with peaks of receptivity every six days or so. (See Reproduction)

The post-partum estrous is said to begin immediately after parturition and last the same 42 to 46 days. (Melquist & Hornocker 1983 citing Liers 1951; Hamilton & Eadie 1964; Lauhachinda 1978) In captivity behavioral signs of this estrous seem to appear two to four weeks after parturition, if they manifest themselves at all.

In the wild some females give birth annually, others every other year. See Reproduction. In captivity whether or not a female breeds annually depends on a number of management factors and appearance of a behavioral post-partum estrous.

Florida – Estrous is usually observed in November or December. (Unpublished captive data.)

N. California - S. Shannon reports estrous may begin at the end of March but that he never sees it later than the third week of April. (Personal communication.)

Michigan – Estrous is usually seen in April or May, more rarely in June. (Personal observation)

Prince William Sound, Alaska – G. Blundell reports: *“The earliest estrus I've seen in south-central Alaska (Prince William Sound) was on April 24, all the other estrous females that I've handled have been in May -- latest estrus May 26. Dates are consistent for three years of handling wild otters in that area.”* (Personal communication.)

Delayed Implantation

It is unclear precisely why female North American river otters experience delayed implantation. A variety of theories have been formulated, generally dealing with the synchronization of breeding and parturition to make it easier for males to locate estrous females, or, a neutral hold-over of a previously useful evolutionary adaptation.

Robbins (1993) explains why delayed implantation: *“The energy requirements and food intake of pregnant females are from 17 to 32% higher than nonreproducing females. However, only 10 to 20% of this additional energy is retained as new tissue by the developing uterus with the rest of the energy lost as heat. Because most of the energy metabolized by the gravid uterus is lost as heat, lengthening the gestation period by slowing the growth rate will disproportionately increase the total energy cost per unit of fetus production, which may explain why most delays during pregnancy are not via a reduced growth rate but occur prior to the initiation of growth (i.e., delayed fertilization or implantation).”*

Total Gestation

290 – 380 days (Liers 1951); 240 – 360 days (Duplax-Hall 1975); 309 – 355 days (Reed-Smith, this volume)

Actual Gestation

60 – 63 days (Lancia & Hair 1983); 50 days (Toweill & Tabor 1982)

Parturition

November to May with a peak in March or April at northern latitudes and December or January at more southern latitudes. However, January births in New York can be found in the historic captive record. (ISIS N. A. River Otter data base) Although not always true, multiparous females generally have their litters clustered around the same date, i.e. April 20, April 24, April 22, April 12th; April 10, 1993 and April 10 1997.

Otter Milk

Water – 62%, Fat – 24%, Protein – 11%, Carbohydrates – 0.1%, Ash – 0.75%. (Toweill & Tabor 1982)

*No indication was given by the authors at what point in the lactation cycle the milk was tested. (See Hand-rearing)

Litter Size

One to six pups have been reported, generally two to three. An interesting anecdotal observation is that there appears to be females that tend to produce large litters habitually, and others that routinely produce small ones.

Daily Activity Cycle

Generally crepuscular or nocturnal. Some investigators report dawn/morning hours as their most active. (Melquist & Hornocker 1979; Toweill & Tabor 1982) In their 1983 publication Melquist and Hornocker reported that the otters in their Idaho study area were more diurnal in winter and tended to be nocturnal the rest of the year. Personal observations of otters in Yellowstone National Park indicated that morning hours until about 10:00 or 11:00 am and late afternoons were active times for otters, at least those animals whose home ranges included areas characterized by some human disturbance (winter snow mobilers). See also Activity Cycle under Behavior.

Feeding Style

Predominantly piscivorous or ichthyophagous; their diet of fish is supplemented with crustaceans, birds, small mammals, amphibians, and invertebrates. Otters are considered “*single-prey loader*”. (Houston & McNamara 1985) This means they must bring each prey item to the surface to consume it. There is a report of otters eating blueberries in Alaska (Merilees 1981) but consumption of fruits, etc in the wild is probably rare.

Otters prey on a wide range of species however, Toweill and Tabor (1982) concluded after reviewing a number of field studies that there are, “...*certain patterns of fish vulnerability to otter predation... The most important is that fish are preyed on in direct proportion to their availability (i.e., occurrence and density) and in inverse proportion to their swimming ability.*” They propose three concepts central to otter predation: “(1) *otters do not select a particular species of fish when hunting, (2) slow-swimming species of fish are more vulnerable than fast-swimming species, and (3) injured or weakened fish are more vulnerable to otter predation than healthy, vigorous fish. In practical terms, these patterns imply that abundant, slow-swimming fish species will be selected more often...*” These species include: suckers (*Catostomus sp.*), redhorses (*Moxostoma sp.*), carp (*Cyprinus sp.*), chubs (*Semotilus sp.*), daces (*Rhinichthys sp.*), shiners (*Notropis sp.*), squawfish (*Ptychocheilus sp.*), bullheads and catfishes (*Ictalurus sp.*), sunfishes (*Lepomis sp.*), darters (*Etheostoma sp.*), mudminnows (*Umbra limi*), and sculpins (*Cottus sp.*).

The faster swimming species such as, trout and pike, are not caught as often as their numbers in the water would suggest. (Toweill & Tabor 1982)

The N. A. river otter is mouth oriented, i.e. prey is caught with the mouth. Generally, food items are taken to shore to be consumed. Some observers report that the otter eats its fish head first, others tail first. My personal observations have been that small to medium sized fish are eaten tail-end first most frequently but can be eaten in either direction. Generally, food items are taken to shore to be consumed, especially large prey.

They have a high metabolic rate for land mammals and are considered to have an efficient digestive system. (Toweill & Tabor 1982) BMR (Basal Metabolic Rate) for many mammals equals 70 x Body mass in kg to 0.75 power however, Iversen determined that the BMR of otters can be expressed by the equation: $M = 84.6W^{0.78} (+0.15)$. M = basal metabolic rate in kcal/day and W = body weight in kg. “*This is about 20% higher than expected from the mammalian standard curve described by $M = 70 W^{0.75}$.*” (Iversen 1972; Toweill & Tabor 1982; Kruuk 1995; Estes 1989)

Due to this high metabolic rate, food passes through their digestive tract quickly, within one to three hours. Davis et. al. (1992) and Spelman et al. (1997) report that gastrointestinal transit time for a fish meal took anywhere from 2 to 4 hours with a mean of 202 minutes. In 1951, Liers tested otters previously fed a bland diet and found that the exoskeletal remains of crayfish were passed about one hour after consumption.

Most feeding activity seems to occur between dawn and midmorning. (Toweill & Tabor 1982) Hoover & Tyler (1986) report that the N. A. river otter spends 41 – 62% of their time engaged in foraging and feeding activities.

Longevity

In the wild about 10 to 13 years. Mortality rates for wild otters increase at three to five years, the reasons for this are unknown. (Polechla 1989) Longevity in captivity is given as 25 years (Melquist & Dronkert 1987), and 23 years (Park 1971, Nowak 1991)

SENSES

Auditory

Well developed. Toweill & Tabor (1982) suggest the variety of sounds used for communication further support this. (See Communication)

Vocalizations

Everyone has their own way of characterizing vocalizations; you may not agree with the labeling of a particular call, listed below are those calls found in the literature and heard by the author.

Call	Usual context/meaning
savage, snarling growl explosive snort	angry or disturbed alarm call, similar to cough, made by expelling air through the nostrils (Park 1971)
scream low growl bird-like chirp	frightened, uneasy, threat threat call note, contact call between dam and pups; may be made by injured animals calling group mem. (Ben-David per. com.)
grunt or cough	startled, feel threatened, response to pups chirp
whoop	contact call made by dam to pups, made by dam when searching for pups
un-huh, un-huh caterwaul grunts or chuckles	could be same as grunts or chuckles used by female during mating pups soliciting dam; animals soliciting food from keepers, general contact call or greeting (huh, huh, huh) 'hm! hm! hm! as deep as possible (Harris 1968)
chuckle	low-keyed, used above and below water to communicate good feelings. <i>"To imitate it, close the lips & utter huh! huh! huh! as deeply as possible in rapid groups of several sounds at a time."</i> (Park 1971)

The ears are small and protected by a valve, comprised of anterior and posterior ridges, which can be closed under water.

Olfactory

Little is known, but it is believed to be acute due to the extensive use of scent markings, or spraints for communication. There is speculation that an animal may be able to determine the identity and sex of the individual who left the spraint simply by smelling it. (Estes 1989)

“All otter species have large nasal fossae and well-developed turbinates, suggesting a keen sense of olfaction; however, the otters’ olfactory lobes are small relative to other mustelids.” (Estes 1989)
(See Scent Glands under Identification/Description & Communication)

Tactile

Highly developed. Researchers have found the coronal gyrus of the brain to be enlarged, *“...suggesting highly developed receptor fields in the head, probably associated with the numerous and stout facial vibrissae.”* (Toweill & Tabor 1982) These characteristically long vibrissae are believed to be very sensitive and may aid in locating prey in murky water.

Manual dexterity also is highly refined but not relied on as heavily as is seen in some of the other otter species, i.e. Asian small clawed otter. Park (1971) recounted a case of an otter manipulating *“a small lead pellet underwater...”* which lead him to conclude they are highly dexterous. For the most part, N. A. river otters use their face and facial vibrissae to locate food. (Park 1971)

Taste

Little is known.

Visual

“Visual senses are not acute in the otter. Otters are nearsighted, an adaptation for underwater vision, but apparently can detect movement at considerable distances.” (Toweill & Tabor 1982)

The following information comes from Estes (1989):

Underwater vision presents three basic problems; *“...the need for increased light-gathering capacity; ...need to accommodate the spectral shift in light quality toward the blue-green wavelengths (found particularly in scopic, low light conditions); ...need to modify the eyes’ light-focusing capacity underwater because of refractive differences that occur at the water-corneal compared with the air-corneal interface.”* These are problems faced by the otter that could be accommodated structurally in three different ways: 1) an increase in corneal convexity, 2) increase in the focusing capacity of the lens, and, 3) increase the length of the eye.

Estes refers to work done on the Oriental small-clawed otter (*Aonyx cinerea*, now *Amblonyx cinereus*) which indicates a high degree of flexibility in their focusing ability in air and water with a slight selection for high visual acuity on land. It is theorized that the *Lontra (Lutra)* species require more visual acuity underwater because they capture their prey with their mouths versus the *Amblonyx (Aonyx)* pattern of using the forelimbs to feel for invertebrate prey. Further, he states that the underwater focusing mechanism of *Lontra* species is achieved by the distortion of the lens due to well-developed sphincter and ciliary muscles.

“The optical difficulty of focusing in both air and water is considered to be one of the primary environmental influences on the adaptive radiation of the vertebrate eye. (Walls 1942). Vision underwater is confounded by the similar refractive indices of the cornea and water. As a result the cornea can no longer contribute to the focusing power of the eye. Since, in terrestrial animals, the cornea is the principal refracting surface of the eye, underwater such an eye would focus the image behind the retina, resulting in

blurred vision. Submergence thus causes longsightedness (hypermetropia). To maintain its acuity in water, the eye of an amphibious mammal must have greater focusing or dioptric power. In optical terms this means a higher lens curvature." (Dunstone 1998)

Dunstone (1998) cites work by Walls (1942) indicating that the otter has adapted to this need for greater focusing power by evolving "*well developed sphincter iridis muscle(s)*" which serve to compress the outer edge of the lens thereby producing, "*an area of high curvature and hence powerful focusing ability.*" The work of Ballard et al. (1989) has shown that the N. A. river otter eye is capable of roughly 54 diopters of accommodation. To put this in perspective they point out that young primates, "*which are acknowledged to have the greatest accommodative ability of any terrestrial mammals, could only produce 10 diopters.*" (Dunstone 1998) Based on these findings they determined that the otter has equivalent visual acuity on land and in the water in bright light conditions.

Park (1971) decided that the otter's sight on land was not that good with motion needed to attract the animal's attention. However, he believed their short-range vision was excellent. He based this on the ability of an animal he observed to find a shot gun pellet hidden in the pebbles on a pool floor.

Mortality

There is no question that the future of river otter populations is dependent on man. In addition to the of pollution and loss of habitat (see general bibliography), trapping, domestic dogs, roads, and railroad tracks that run through otter habitat are known hazards. To date there is not enough known about what kind of impact the last three have on otter populations.

There are few natural enemies of the river otter; most of these dangers, such as coyotes, are encountered when traveling overland.

There seems to be a peak in otter deaths at about three to five years with nine to ten years considered a good longevity for wild otters. Otters in captivity can live to 20+ years but this is not typical.

SUB-SPECIES DISTINCTIONS

Anyone interested in the specific distinctions between subspecies should consult the literature cited in the bibliography. However, some authors refer to a few physical characteristics that are regarded as indicative of a certain subspecies, these are given below.

Lontra canadensis canadensis: Type subspecies. "*Rhinarium naked, broad, with a large ascendant central point above, a very small descendant central point below; the hind feet with four small, calloused, circular rugosities on the sole near the heel; the soles with tufts of hair beneath the toes; moustachial pads well developed; skull flattened dorsally; rostrum wider, premaxillary area shorter, than in L. lutra.*" (Harris 1968)

Lontra canadensis kodiacensis: The subspecific distinction is based on a combination of cranial details. (Harris 1968)

Lontra canadensis lataxina: Total weight ranges from 7.25kg. to 10.4 kg. (16 to 23 lbs.). Total length ranges from 1130 – 1270mm (44 to 50 in.) "*Usually smaller and lighter in colour, than the typical form; soles of its feet less hairy; skull small, teeth relatively massive.*" The tail may be proportionally longer than in other forms. "*Southern specimens may be lighter than northern ones.*" (Harris 1968)

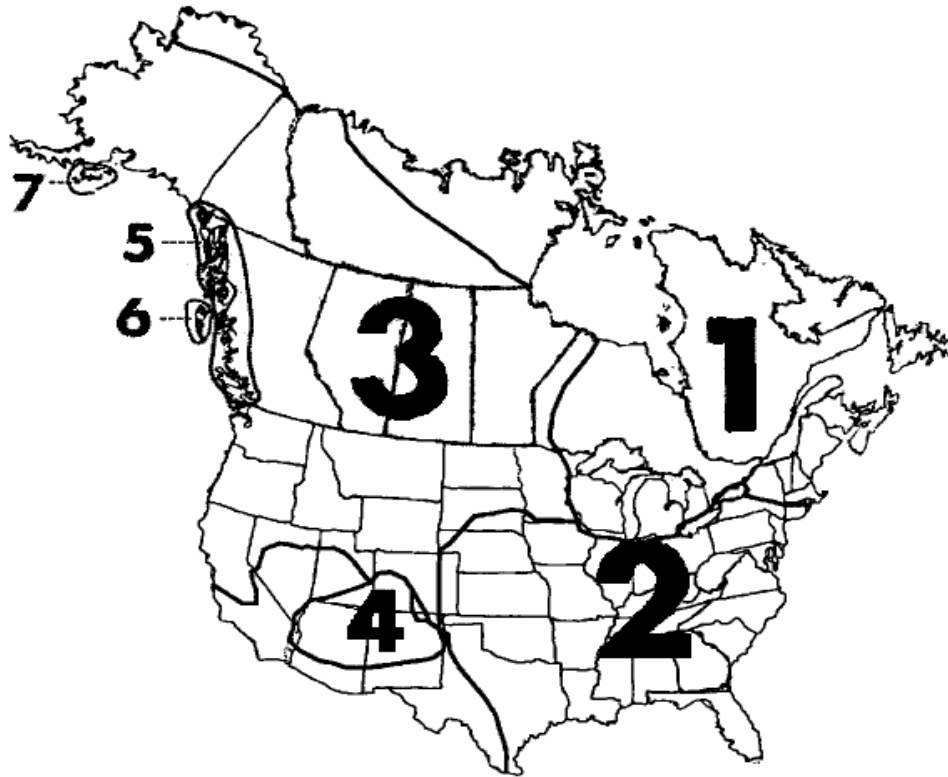
Lontra canadensis mira: Largest of the subspecies with a massive, broad and somewhat angular skull. (Harris 1968)

Lontra canadensis pacifica: Usually lighter in color than the other forms. The inferior surface of the feet and webs are generally almost naked. (Harris 1968)

Lontra canadensis sonora: A large subspecies. Weight ranges from about 8.8kg. to 11.3kg. (19 lbs. to 25 lbs.). Total length up to about 1348mm (53 in.). This form has a very long hind foot. (Harris 1968)

Lontra canadensis perichlyzomae: Found in a small area encompassing islands off the western coast of Alaska.

Subspecies Range Map



1 *Lontra canadensis canadensis*

2 *Lontra canadensis lataxina*

3 *Lontra canadensis pacifica*

4 *Lontra canadensis sonora*

5 *Lontra canadensis mira*

6 *Lontra canadensis periclyzomae*

7 *Lontra canadensis kodiacensis*

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CHAPTER 5

BEHAVIOR, SOCIAL ORGANIZATION, NATURAL HISTORY

NATURAL HISTORY

Habitat

“Otters are found in both marine and freshwater environments ranging from coastal to high mountainous elevations. Density appears greatest in the least disturbed food-rich coastal regions, including estuaries, the lower portions of streams, and coastal marshes...and inland where lowland marshes and swamps interconnect with meandering streams and small lakes.

“The availability of certain key components (including shelter, food, and water) determine the duration and intensity of habitat use. Riparian vegetation adjacent to lakes, streams, and other wetland areas is a key component of otter habitat. It may attract beavers, which in turn create ponds, bank dens, and lodges that are later used by river otters. Melquist and Hornocker (1983) documented the importance of beavers in creating foraging and denning sites for otters, and several states have correlated good river otter habitat with the activities of beavers.

“Fallen or partly submerged trees and logjams created during the spring runoff provide shelter and foraging areas for both the river otter and its prey. Cavities among tree roots, dense shrubs, and tall grass provide escape cover and temporary resting sites. The conditions created by adequate riparian habitat probably increase the likelihood that an area will be used.

“In coastal areas, rugged, rocky, indented shorelines associated with short intertidal lengths provide favorable foraging, feeding, and resting sites. However, river otters tend to avoid extensive shorelines that have long intertidal lengths and are devoid of large trees and other riparian vegetation. Otters in coastal southeastern Alaska avoided 5- to 20-year-old clear-cut areas.

“In the temperate regions of North America where winters are severe (i.e. lakes and streams freeze over and snow accumulates to considerable depths), certain habitats are used only seasonally. In mountainous areas, river otters vacate high elevation streams and lakes during winter and move into the valleys.”

(Melquist & Dronkert 1987)

In summary, the availability of temporary dens, resting sites, key activity areas, suitable vegetation cover and adequate food influences otter habitat use considerably. Sometimes this leads to conflict with man, particularly since areas otters find attractive such as lake shores, streams, and river banks also are highly

desirable locations for human development. In the future, this conflict could be prove to be the most severe threat to the continued survival of river otters.

Human/Otter Habitat Conflict

There is no easy answer to the questions: *“How do I get otters to leave my fish pond or boat dock alone?”*

Generally, otters will leave an area in a few days time; if food is prevalent, or if the area provides good denning/resting sites, the animals may incorporate your location into their home range. The best response is to sit back and enjoy the rare pleasure of the otters’ visit. If this is not an option you can try: getting a dog; putting a radio on a timer; removing the attraction for the otters, at least temporarily; erect an electric fence otter high until they are dissuaded from visiting. The latter is being tried in S. Africa around sport-fishing lakes where it has met with some success; on a small scale this could be accomplished with a typical battery run farm Fencer unit.

Fish in man-made ponds can be given some protection by providing them with cover in the pond. This can be accomplished by placing dead-fall into the pond which offers hiding spots for the fish. Some small commercial fish ponds have tried constructing “otter barriers” down the middle of the pond. These are made from palm fronds, bamboo, or anything similar that will allow the fish to swim through but prevent the otters from pushing through. The otter is forced to go up and over or get out of the pond and go around. This provides the fish enough time to hide, or allows them to swim back to the other side while the otter is maneuvering the barrier.

Unfortunately, otters fall victim to road accidents because of our mutual attraction to these water environments. The extent of otter road kill/injury is not known at this time and should be studied in the future.

Activity Cycle

Generally crepuscular or nocturnal. Some researchers have reported observing active otters during daylight hours in areas remote from human interference. In 1983 Melquist and Hornocker reported that their Idaho study animals were more diurnal during the winter, while confining most of their activity to crepuscular and/or nocturnal hours the remainder of the year.

“Although northern river otters may be active at any time of day, most activity occurs from dawn to midmorning and during the evening. (Melquist & Hornocker 1979) “The peak of feeding activity apparently occurs from dawn to midmorning.” (Toweill & Tabor 1982)

During his fifteen plus years of observing five generations of otters living on the northern California coast, Scott Shannon has found them to be diurnal and undisturbed by the nearby harbor and presence of man. (Personal Communication)

Seasonal activity patterns are not well understood beyond the fact that otters are active year around. Females with young pups are less active than they are the rest of the year when the pups are older or they are without young.

Melquist & Hornocker (1983) documented the daily movements of a number of individual otters in Idaho through the use of biotelemetry. Their study produced the following information:

“The most notable conclusion is that there was considerable variation in the mean distance between consecutive-day locations for individuals from each class and between classes (these were age/sex classes). There was no apparent seasonal trend in the extent of movement for any of the age classes except that independent juvenile males and family groups moved significantly less during the winter.”

A dispersing yearling male traveled the maximum distance recorded, 42km (26.1 miles), in one day. (Melquist & Hornocker 1983)

Yearling males and females travel further on a daily basis in summer and fall than adult females (which would coincide somewhat with the period of dispersal). It is likely that adult males range over areas at least as large as the yearly males. (Melquist & Hornocker 1983)

Finally, they concluded that: "*Nulliparous females and parous females without young would likely travel more extensively with a male during the breeding season than would a lactating female.*" (Melquist & Hornocker 1983)

(See also Daily Activity Cycle under Identification)

Daily Movements

Melquist & Hornocker (1983) reported daily moves for individual otters ranging from 2.4 km (1.49 miles) (average for family groups in winter) to 42 km (26.1 miles). See also Home Ranges & Daily Activity Cycle.

Feeding Behavior

Otters are predominantly piscivorous or ichthyophagous (fish eating). However, there is seasonal variation and otters inhabiting areas with an abundance of crustaceans may rely heavily on them at times.

"Foraging otters investigate the hiding places of potential prey, capture slow-swimming species by direct pursuit, and probe muddy and weedy substrate for aquatic insects. Otters tend to forage for themselves, although apparent cooperative fishing has been noted..." (Beckel 1982)

A. Beckel (1982) also states that the animals she observed "...usually remained near each other while foraging, but did not dive together or appear to coordinate their hunting efforts." Her data suggested that although animals frequently remained near each other while foraging, animals hunting alone generally had higher success rates.

Beckel did not observe any sharing of food or any fighting over food.

More recent studies of river otters inhabiting marine ecosystems in Alaska have shown that groups of animals, (generally males but a few females without young join in) forage together for pelagic fish. (Blundell in press)

"Catchability is a key factor in the prey consumed; slow-swimming fish and any prey unable to escape detection will be selected first. Numerous other factors influencing the diet include season, time of day, prey abundance and behavior, competition for the resource (by both conspecifics and other species), water characteristics such as flow and temperature, and size and relative proportions of prey. River otters normally avoid carrion." (Melquist & Dronkert 1987)

Contrary to the fears of many fishermen, otters can be beneficial to game fisheries due to their tendency to take the less desirable and competing species. As a rule, "...fish are preyed on in direct proportion to their availability (i.e. occurrence and density) and in inverse proportion to their swimming ability." (Toweill & Tabor 1982)

Crustaceans, primarily crayfish and crab, are important food sources in areas where they occur. At certain times of the year it has been found they can constitute 100% of the otters' diet. (Melquist & Dronkert 1987)

“Reptiles and amphibians, particularly frogs (Rana sp.), are commonly eaten by otters.” (Toweill & Tabor 1982)

Melquist & Hornocker (1983) commonly found insects in otter scats.

Small birds, i.e. fledglings, ducks, and young mammals also are taken occasionally.

“The importance of avian prey varies...frequency of occurrence was greatest during summer (when waterfowl broods are vulnerable) and autumn (when waterfowl crippled by hunters are likely to be scavenged). Predation on ground-nesting colonial birds along the Pacific coast and on coastal islands may be substantial and can be a major cause of nesting failure.” (Melquist & Dronkert 1987)

The river otter will generally take its prey to land to be consumed. It will emerge entirely from the water, or simply rest the front half of its body on the bank, log, rocks, etc. Prey, such as fish, is caught with the mouth then held in the front feet while being eaten. Crustaceans may be routed out with the front feet, but more often the muzzle is used.

Signs of otter in the wild

Signs of otter in the wild have been described by numerous authors, including: Mowbray et al. 1977, Polechla 1987, Liers 1951 and others. This list is taken from Polechla's (1987) glossary of otter sign.

Haul outs – *“Worn trail from the water's edge...usually scattered with fish scales, bones and scats.”*

Bedding sites – *“Concentric impressions on the ground left by sleeping otters.”*

Rolling sites – Areas flattened out by “frolicking” otters.

Scrapes – *“Areas scraped bare by otter usually used more than once...Food remains and scats are absent.”*

Dens – *“Holes in bank,” beaver lodges, or natural or artificial cavities used by otters.”*

Tracks – Footprints, generally 8.255cm (3.25 inches) wide showing five distinct claw-toed marks with webbing.

Single scat – *“Not associated with haul outs or obvious feeding sites...”*

Scent posts – *“A site about five feet square with several digging and scratching sites located within it.”* As a rule no evidence of bedding sites, food remains or scats are found at scent posts.

Slides – The trough created by the otters body when sliding through mud or snow. Accompanied by otter tracks.

SOCIAL ORGANIZATION

Social System

River otters are believed to be more social than most mustelids based on the findings of a number of different researchers. (Shannon per. com., Beckel 1982, Ben-David per. com., Blundell 1999, Blundell et. al. 2000, Landis (1997 film), Rock et. al. 1994, Reid et. al. 1994, Johnson & Berkley 1999)

Although, few behavioral studies of free-ranging otters have been carried out (there are studies in progress that should produce additional ethological information), those researchers that have studied them document a variety of social groupings (13 combinations by Melquist & Hornocker 1983, Blundell et. al. 2000, S. Shannon per. com.). In general, *“...the basic social group (family) consists of an adult female and her juvenile offspring.”* (Melquist & Dronkert 1987)

“Most studies have concluded that adult male river otters do not function as part of a family group; however instrumented males have been observed in groups of up to seven unidentified, adult-sized otters.”

(Beckel 1982) Beckel concluded, based on observations of unmarked otters, that the adult male is readily accepted into the family. She does not clarify how she determined this.

“Bachelor groups of adult males have been observed outside of the breeding season...as have unidentified groups of river otters ranging from 9 to 30 individuals.” (Beckel 1982)

Home (1982) described family groups as being led by adult males although the method of determining sex and group composition was unspecified.

Due to the illusive nature of this species it is difficult to definitively answer the question of the male's participation in family life. A number of recent researchers (Blundell, pers. com.; Shannon, pers. com., Rock et al. 1994) and members of the general public, report seeing groups of adult sized otters, sometimes accompanied by what are believed to be sub-adult animals. Whether these are single sex male groups, females and offspring, or actual family groupings is not always determined. Generally, the conclusion has been that they are single sex groupings (males), or females traveling with sub-adult offspring. It is generally accepted that the adult male has little to do with rearing the pups in the wild. However, in captivity, males have proven to be very attentive and gentle with pups once the dam allows him near the young.

Based on data collected from 55 radio-tracked otters during a study which included social organization of coastal otters, Blundell et. al. (2000) reported that, *“Approximately 44% of females were asocial, whereas only 24% of males were not social. Males were social 45% of the year and 65% of that time were found in all-male groups, whereas females were only social 25% of the year and were in mixed-gender groups 85% of that time.”* Blundell believes these groups of males are taking advantage of the seasonal occurrence of schools of pelagic fish. Females unaccompanied by young have been seen to join these foraging groups. (Blundell in press)

Reid et. al. (1994) reported that in their study *“...adult females with juveniles, and adult males together, were the two most frequently documented groupings.”*

“River otters exhibit considerable plasticity in their social behavior. Flexibility may permit otters to exploit variable habitats with diverse seasonal and spatial patterns of resource availability. Otters reintroduced into vacant habitat exhibit a variety of group associations.” (Melquist & Dronkert 1987. This information, cited by these authors, originally comes from a variety of sources.) As Melquist and Hornocker stated in 1983, *“...river otters appear to be far more sociable and tolerant of conspecifics than previously thought.”*

Mr. Noel Kindler, of the Louisiana Fish and Wildlife Department, reports that groups of two or more otter families (i.e. dam and her pups) have been seen not infrequently. These groups have been seen to travel and forage together. (pers. com. 1994)

Scott Shannon, who has studied five generations of otters living on the northern California coast, has observed as many as eight non-related males living and fishing together. He also reports a strict segregation of adults along sexual lines (except during breeding season or before a female is sexually mature), and social groupings (matriarchal clan) not observed by other researchers. (pers. com.)

In captivity, care needs to be taken when introducing a new animal into a group, especially with females. (See Captive Management.)

Most common social groupings

In short, the most commonly seen groups of otters in the wild are females with pups and all male groups. Also seen but, less frequently are two females traveling, or foraging with associated pups, and a male/female pair (generally during estrous).

Home Ranges

“A river otter’s home range includes the area in which the animal lives, reproduces, and generally satisfies its life requirements. The shape of a home range will vary because it is determined primarily by drainage patterns.

“...prey availability, habitat, weather conditions, topography, the reproductive cycle, and conspecifics influence home range use and size. However, all portions of the home range are not equally used. Strong site attachment for activity centers, which often determines seasonal home range limits, may be the primary reason for the existence of river otter home ranges.

“River otter home ranges vary considerably between the sexes and among the different age classes. Adult males probably have the largest home ranges, especially during the spring breeding season. Lactating females have the most restricted home ranges during spring”
(Melquist & Dronkert 1987)

“Otters exhibit different spacing mechanisms, degrees of sociality, and habitat selection in different portions of their range. In mountain streams and lakes of Idaho, home ranges were defined largely by local topography and overlapped extensively within and among sexes. Otters exhibited varying degrees of mutual avoidance and tolerance depending on the seasonal dispersion and availability of food and shelter (Hornocker et. al. 1983; Melquist & Hornocker 1983). Family groups of otters in coastal southeastern Alaska used adjacent but generally non-overlapping lengths of shoreline (Woolington 1984), but males in a similar coastal environment exhibited larger and partially overlapping ranges (Larsen 1983).” (Reid et. al. 1994)

Researchers have reported other seasonal variations in the size of home ranges, i.e. an increase in size from autumn to winter in Idaho. (Melquist & Hornocker 1983)

(Home range) *“...spacing is variable and might be related to physiological and environmental factors. Intra- and intersexual home range overlap was extensive in Idaho, where potential confrontations appeared to be resolved through mutual avoidance. The concept of territory as ‘any defended area’ may not apply to river otters because in Idaho they defended their own personal space without reference to fixed spatial boundaries. Considerable mixing and extensive home range overlap were documented in Louisiana and for reintroduced otters in Missouri.”* (Melquist & Dronkert 1987)

In southeastern Alaska Woolington (1984) and Larsen (1983) found that family groups of otters, *“...used adjacent but generally non-overlapping lengths of shoreline...”* (Woolington 1984) but that males occupying similar types of shorelines utilized, *“...larger and partially overlapping ranges.”* (Larsen 1983)

In Alberta, Canada, annual home ranges varied in size from 15.8km² (6.1 miles²) (adult female with young) to 271.9km² (105miles²) (an adult male). (Reid et. al. 1994) They also found that annual home range overlaps were more extensive for males than for females and that the males’ ranges overlapped those of both females and other males. They also found: *“Groupings appeared to be more common during the open-water season and early winter. By midwinter and through the breeding season, otters seemed to move and den more often alone.”*

In Alaska, Bowyer et al. (1995) found that otters inhabiting coastal environments had home ranges along the shoreline varying from 20 to 40 km (12.5 to 25 miles long).

In general, wherever otters are found, activity centers are important. Because the land/water interface is important home ranges frequently assume a linear shape to incorporate shorelines and activity centers.

Activity Centers

“Activity centers were areas where an otter had been located at least 10% of the time during a specific season. Activity centers were considered preferred locations within the home range.” (Melquist & Hornocker 1983)

In captivity as well as the wild otters show a tendency to use certain areas for specific activities. These activity centers include:

Pulling out places, Landings or Haul-outs – Locations where otters leave the water to rub and groom themselves. These areas are frequently the site of scent markings using urine or feces. (Liers 1951, Melquist & Hornocker 1983)

Holt – Denning locations, generally opportunistically use dens dug by other species, beaver dams, root systems, natural hollows, etc. The otter will enlarge a previously dug den or hole. (Liers 1951)

Slides – A bank or hill area otters use frequently for sliding, especially into the water.

Latrines – Sprainting sites where feces and urine are deposited by more than one otter. Because otters do not appear to defend a physical territory in the classic case but, instead defend personal space, it is speculated that latrines may serve to announce an animal’s presence in an area.

“As part of their social behavior, river otters mark specific locations along the coast, known as latrine sites (Testa et al. 1994, Bowyer et al. 1995, Kruuk 1996. In these sites, which can be 5 - 20 m (16.4 – 65.6 ft) in radius and are typically 25 – 300 m (82 – 984 ft) apart ([approximately] 160 latrines/100 km [62.13 miles] of shoreline), river otters deposit feces and urine, as well as excretions from their anal glands. Although the social function of these latrine sites is not clearly understood (i.e., marking to establish social dominance, marking of feeding sites, etc.; Kruuk 1996), direct observations and removal of feces suggest that the visitation rate to latrine sites is high (Testa et al. 1994, Bowyer et al. 1995; M. Ben-David, personal observation). The distribution of latrine sites along the coast is dependent on several habitat variables. Otters show preference (in Alaska) for sites that have shallow, tidal slopes with large rocks and shallow, vegetated slopes with high overstory cover (Bowyer et al. 1995).

Scent posts – Similar to latrines. Often located near den entrances, slides, runways or other frequently used places. Most frequently seen on elevated sites like fallen logs, rocks, or small mounds. (Park 1971)

NATURAL HISTORY and OTTER BEHAVIOR

General Behavior

These behaviors have been described by a number of authors; all of them have been observed by this author in captive animals and I have seen most of them in wild otters.

Wrestling

Beckel (1982) observed wrestling in the captive groups and the free-ranging otters she studied. In fact, it was the most commonly observed social behavior between free-ranging otters. This behavior has the appearance of play but, more likely, serves to establish the involved animals relative strength.

Muzzle-Touching

Seen in captive and free-ranging otters. (Beckel 1982) There appears to be a significant increase in the frequency of this activity during the breeding season. A gesture of reassurance or friendly intentions.

Social Grooming (Allo-grooming; Mutual grooming)

Social grooming is seen in free-ranging as well as captive otters, however, it probably occurs more frequently in captive animals. Male-male, female-female, and male-female pairings are all observed to groom one another. Beckel (1982) reports that 86% of all social grooming is directed to the head and neck area, so it may also play a role in hygiene (this is the hardest area for an otter to groom itself). It is theorized that social grooming may play a role in “...*establishing and maintaining social relationships among all group members, possibly making the animals more familiar with each other.*” (Beckel 1982)

Face-Pawing

“*This behavior...appears to communicate a readiness to engage in affiliative interactions.*” (Beckel 1982) Further, Beckel reports that rolling onto their back and pawing at another otter’s face frequently resulted in social grooming; if this face-pawing behavior was carried out more vigorously, wrestling usually ensued. When face-pawing or muzzle-touching is done gently by the initiator while lying on the back the behavior may help inhibit aggression.

Roll-Over

A submissive animal may roll onto its side or back when approached by a more dominant animal.

Step-On

A dominant animal places its front feet on a submissive animal while it is lying on its back or side. Not infrequently the submissive animal is screaming. Dominant animal follows up this behavior with a nuzzle or quick bite.

Nuzzle

One animal rubs its face on another.

Mounting

This refers to mounting occurring outside of the breeding season. It has been observed as male-male, female-male, and male-female mounting. Male-male mounts are an expression of dominance; this also may be true of female-male mounts.

Anal-Anogenital Sniffing

The frequency of this behavior may increase during breeding season. Beckel (1982) did not observe this behavior in the free-ranging groups she studied.

Foraging

This is not truly a social behavior however, Beckel (1982) reports observing animals frequently foraging in the same area. They do not appear to be cooperating, and although they seem to be less successful, they seem to capture larger fish when there is more than one otter hunting in the same general area.

Resting

Otters are frequently seen sleeping, or resting, in physical contact with other conspecifics.

Fighting

This is generally noisy, accompanied by a lot of screaming. In the wild, otters do not frequently fight, more commonly they exercise avoidance of other individuals.

Communication

River otters are less vocal than other *Lutrinae*, however, they do communicate via some auditory as well as olfactory and tactile signals. Visual signals are thought to be of minor importance. (See Senses for additional communication information.)

Auditory

Shrill chirp, soft chuckle, scream, and a caterwaul (from females only during copulation) were reported by Liers (1951a) A low grunting noise was added by Harris (1968). Melquist references, "...a 'grunt'" (See Senses for additional vocalizations.)

Olfactory

"Olfaction apparently plays a major role in otter communication. Northern river otters possess anal scent glands, and scent may be released from these glands in times of fear or rage. Otters also maintain 'scent posts' throughout their territory." (Toweill & Tabor 1982)

Scent posts have been described as "...sites 1 to 2m (3.28 – 6.56 ft.) with digging and scratching sites but no food remains, scats, or beds." (Toweill & Tabor citing Mowbray 1979)

"Marking by defecation, urination, and possibly anal sac secretion was observed primarily at activity centers and foraging sites. Otters marked sites at various times during foraging sessions and generally just before leaving a site." (Melquist & Hornocker 1983)

Melquist and Hornocker (1983) also reported that scent marking was probably the most important mode of inter-group communication.

Any site can be used for the deposition of scent but, it is believed the natal den area is not marked to prevent its discovery by adult males.

In captivity, females have been known to defecate in the water while pups are very young and at least one male defecated in the water during times of the year he was avoiding the female or when she was being particularly "cranky".

Tactile

The facial vibrissae are known to be important in detecting prey in murky water. It has been proposed that the frequent muzzle-touching and mutual grooming seen, at least in captive animals, may serve a social function. (Beckel 1982) Also, "...wrestling, a behavior often characterized as play, may be a means of assessing relative strength and dominance." (Melquist & Dronkert 1987)

L. canadensis is a 'contact species' ...; group members maintain no individual distance and are not only tolerant of physical contact, but also seek it. Group members sit and sleep together, often piled one on top of the other, and tend to maintain proximity at other times as well." (Beckel 1982)

Visual

"Few visual displays have been recorded. With their short muzzle and ears and their more or less uniform coat of hair, otters are poorly adapted for visual display-based communication. A 'threat-face' characterized by pulling the ears back and a gape display is used." (Toweill & Tabor 1982)

Beckel (1982) describes these visual signals: **Open-mouth scream** – the teeth are slightly bared; the scream is both a threat and a defensive vocalization; **Open-mouth relaxed face** – this occurs when otters wrestle or are trying to initiate wrestling.

Latrine dance is the treading of the back feet (usually six to eight times) with the tail arched while defecating or urinating. It often attracts other animals who then sniff the latrine and deposit their own urine/feces/anal gland scents. (personal observation)

Visual signals also consist of postures, such as the supine position adopted by a pup after scolding from the dam. (Liers 1951a) A subordinate or defensive animal will adopt a supine position on its side or back when being harassed by a dominant, or more assertive animal.

A more assertive/aggressive/dominant animal will place its front feet on a supine animal. This gesture is followed by a nuzzle or a bite.

Play

“The river otter’s playful reputation is unparalleled. Highly intelligent and active, inquisitive and quick, the river otter possesses characteristics conducive to play. Provided with a comfortable environment and adequate food and protection, captive and tame otters have ample time to indulge in playful activities. Play behavior does not appear nearly as prevalent among wild, free-ranging otters, even though such behavior may have important survival implications.” (Melquist & Dronkert 1987)

The otter’s memory is reported to be exceptional. (Liers 1951, Harris 1968)

“Much of their active time is spent exploring new surroundings or objects, often in the form of apparent play. Northern river otters have been taught to retrieve objects from land and water, to capture and retrieve fish, and to hunt other animals.” (Toweill & Tabor 1982)

As is true for most mammals, play-like behavior is more frequently observed in immature otters. In captivity, otters can be seen chasing, wrestling, and bounding in what appears to be a playful fashion. Also, otters will manipulate, or carry around objects in a manner reminiscent of play.

“An otter swimming downstream and meeting a twig floating on the surface will nonchalantly push the twig ahead of it for a time expertly balancing that twig with its broad nose whether swimming above the water or below it. It fondles pebbles the drops them, picks them up and carries them, loses them, finds them, hides them, searches for them, and eventually abandons them as something new attracts its attention.” (Park 1971)

All of us who work with otters can relate to each of these statements. There is no doubt that otters are active, inquisitive animals quick to learn and quick to “play”. For these reasons, in captivity it is important that an effective, well thought out enrichment program is in place and implemented. There are a number of enrichment options listed in the Enrichment chapter of this notebook but don’t forget the simple things! Small river stones, leaf piles, straw or leaves to carry, dirt to dig and role in, and twigs or rocks to push or carry around often prove to be favorite “play-things” and can occupy an otter for hours.

Body Care

“The most common means of body care in otters is rubbing and rolling, whether in sand, grass, snow, or whatever else is available and relatively dry. This activity is commonly associated with considerable scratching, and both activities apparently serve to clean the animal’s fur and thereby maintain its insulative qualities, as well as to dry the otter quickly after its emergence from the water. Areas used for this activity, called ‘rolling sites’, ‘scrapes’, ‘haul-outs’, or ‘landings’. (Mowbray et. al. 1979, Melquist & Hornocker 1979), are among the most common evidence of otter activity.

“Allogrooming does occur to some extent among otters, but is not common.

“Otters typically have particular ‘toilets’ (Greer 1955) near regular landings for defecation purposes, although single scats may be deposited near rolling areas, scent posts, or on logs or points extending out into the water.” (Toweill & Tabor 1982)

Areas used for grooming sites are typically referred to as “rolling sites”, “scrapes”, “haul-outs” and “landings”. (Toweill & Tabor 1982)

Breeding/Reproductive Behavior

Receptive females may advertise their condition by marking at haul-outs and scent stations. (However, "...the location of the natal den does not appear to be advertised or disclosed to other river otters.") (Melquist & Dronkert 1987)

When she is receptive, copulation generally occurs in the water (but also can occur on land) and can last 15 to 30+ minutes. Although there does not appear to be any pair bonding, a male may spend a few days with a receptive female with copulation occurring repeatedly during that time. Zoological institutions that do not normally house their pairs together due to aggression, report an abatement of this during the breeding season.

A female in estrus will spend more time rubbing and marking her exhibit/surroundings. A 'courting' pair of otters will spend more time in chase/play behavior, mutual grooming, muzzle-touching, and nuzzling. A non-receptive, or uninterested, female will chase the male away or roll onto her back, scream, and/or paw at the male's face.

A. Beckel (1982) reports that muzzle-touching was common in all the captive groups (n=7) she studied and was observed among free-ranging animals. There was a definite increase in this activity going into, and during, the breeding season. She also observed an increase in the amount of social grooming between adult males and females during the breeding season.

Otters are not reported to dig their own dens, (at least, not typically), but will take advantage of what is available. Abandoned beaver lodges are a favorite. They also have been reported to use hollow trees and logs; abandoned nutria dens; log jams; drift piles; piles of loose rock; abandoned buildings, and duck blinds.

"The natal area is infrequently used by the female and her offspring during other seasons." (Melquist & Hornocker 1983) Also, *"...female otters generally do not use the same natal den each year."* (Melquist & Dronkert 1987) See natal holts under Parental Care.

Captive otters have been known to fashion their own nests when given the opportunity. In captivity, it is important to give a dam more than one nesting choice, plenty of nesting material, and privacy for her and the pups.

Just prior to parturition, many institutions report that their females refuse to leave their nest boxes and do not eat. There are always exceptions to this such as the JBZ female that quickly consumed all of her AM feeding than one hour later sat outside her nest box and gave birth to her first pup (this was her first litter, since that time she exhibits more typical anorexia prior to parturition).

Liers (1951) reported the birth process as lasting three to eight hours.

For additional information see the Reproduction Section.

Parental Care

General Maternal Behavior

Dams are generally very solicitous mothers and solely responsible for care of the litter. The female will vigorously defend the natal den/holt and pups from exhibit mates or passing otters in the wild. There are numerous reports of 'helper' otters accompanying a female and pups, or of two adult animals traveling with pups (which is generally believed to be two females with pups and probably gave rise to reports of males joining the family group). (Rock et al. 1994) However, it is not known when during the pups' development the females join forces, or for how long the association lasts. (Scott Shannon studying otters in Trinidad Bay, N. California has found a matriarchal situation in the population he has followed for the last seventeen years. Several females live in close association with one another, all related.)

Natal Holts

Females frequently use dens dug by other animals as natal holts. These natal holts are generally removed from water, Reid et. al. (1986) reported one female utilized an abandoned fox den 300 meters (984.25 feet) from the shore. The pups were moved closer to water when about three to four weeks old. Liers (1951) reported natal dens located 150 yards (137.16 m) from water and 150 feet (45.72 m) above high-water (female 1) and ½ mile (.085 km) from the water and about 500 feet (152.4 m) above high-water (female 2).

Swimming Lessons

Otter pups must be taught how to swim. In captivity, females may begin these lessons earlier (day 38 plus or minus a few days), than in the wild (it could be swimming lessons this early in the wild have gone unobserved); lessons are very short to begin with and lengthen as the pups gain control of their body and limbs. (Young pups most resemble hairy-corks bobbing in the water.) Females will decide when it is time to teach the pups to swim but these early lessons should be monitored to be sure she stays vigilant and takes pups out of the water before they tire. The depth of the water does not seem to matter but provisions should be made to ensure it is possible for pups to pull themselves out of the water.

Hunting

In the wild the dam will release food for the pups to catch, in captivity an experienced mother will carry food to her pups, or allow them to eat first, when they are old enough to begin eating solids. Inexperienced dams may not be so generous and pups may have to be separated during feeding times. (See Social System, Feeding Style, Diet & Nutrition)

General Paternal Behavior

Liers (1951) reported that, if given the opportunity, many males will assist in caring for the pups. However, the dam usually will not allow any other animals near the pups until they are about three months old. Several facilities have successfully reintroduced the male when the pups were three months or older. These males have all been very gentle and playful with the pups. Those facilities that leave the male in the exhibit have found the same thing once the female allows the male near the pups. (See Developmental Stages – Reproduction)

Behavioral Ontogeny

“...helpless at birth, young otters begin to open their eyes by the age of 21 to 35 days, and by 25 to 42 days they begin playing with each other and with their mother. The pups may be introduced to the water by the age of 48 days and may venture out of the den on their own by the age of 59 to 70 days. By 49 days, young begin to use a specific, localized area for defecation. At the age of 63 to 76 days, they begin eating solid food, although weaning does not occur until about 91 days.” (Toweill & Tabor 1982) (See also Reproduction Section & Pup Development)

Dispersal

Pups will usually emerge from the natal den or nest box at about 2 months of age. Weaning generally does not begin until about three months. *“Young otters are self-sufficient by five to six months, but the family remains intact for at least seven to eight months, or until just prior to the birth of a new litter.”* (Melquist & Dronkert 1987) The phenomenon of 'helper' otters has raised the question that these individuals may be elder daughters of the female with young pups. It is unclear if this daughter has stayed with her mother or simply shared a home range and occasionally spends several days with the new family group. In captivity, a few facilities have left multiple females together when one has pups; the dam has tolerated the other female's presence. See Lowry Park Zoo and St. Louis Zoo under Reproduction.

Melquist & Hornocker (1983) found that juveniles would disperse at 12 to 13 months of age, usually in April or May. However, the extent of dispersal was highly variable, with some individuals not dispersing at all. Dispersal does eventually occur before sexual maturity.

They concluded:

“Dispersal appeared to be an inherent trait stimulated by certain physiological changes unrelated to those accompanying sexual maturity. Although dispersal and the

exploration of new areas without dispersing coincided with the breeding season, dispersing otters were not sexually mature. This would suggest that other physiological changes, probably related to day-length, stimulated dispersal. A lack of evidence linking dispersal with density-dependent factors also indicated that dispersal was an inherent trait.”

“...not all otter dispersed, suggesting an unequal development of the dispersing tendency among individuals. The failure of some otters to disperse also suggests that subadult otters were probably not forced from the natal area by the adults.” (Melquist & Hornocker 1983)

In conclusion, dispersal may occur as early as about eight months of age or not until closer to sexual maturity (15 to 24 months, Liers 1958). In general though, it is believed that young animals leave the dam by 12 to 13 months of age.

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CHAPTER 6

REPRODUCTION

BREEDING: CHARACTERISTICS, SEASON, & BEHAVIOR

Breeding season

Monestrous; season ranges from November to June. There is evidence that breeding season varies somewhat with latitude. In general, breeding occurs in late spring (late March, April, May, early June) at northern latitudes, and during late November, December, January, or February at more southern latitudes. (Reed-Smith 1997)

As with all things otter, in captivity, there have been exceptions to this rule reported. For example, while living in Minnesota, Liers (1951) reported December estrous in some of his females, also, there are a few historic records of December/January breedings in New York.

Estrous cycle & length

The estrus period lasts approximately 42 – 46 days, unless mating occurs. During this time, captive observations suggest peaks of maximum receptivity are roughly six days apart with intervals of only mild receptivity during which the female may completely reject the male. (Liers 1951 and pers. obs.)

A post-partum estrous occurs soon after parturition lasting the same 42 – 46 days of a typical estrous. Hamilton & Eadie (1964) give the post-partum estrous as occurring not long after parturition. Most zoos that have observed post-partum estrous see behavioral signs one to two weeks after parturition. Estrous behavioral signs may include an increased interest in the male's quarters, increased rubbing, grooming, and marking.

Signs of estrous

Females may show any, all, or occasionally none, of the following signs of estrous: 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 (obviously will only be apparent in pairs that do not normally do this), chuckling to the male; genital sniffing of the male by the female and vice-versa, and, of course, copulation.

A vaginal discharge associated with estrous is not typically reported. Female river otters are prone to urogenital infections which frequently cause a milky, milky-blood-tinged, or slightly off-colored discharge which has been interpreted as a possible indicator of estrous. If this kind of discharge is seen the female should be closely observed and the condition monitored by a veterinarian. (See also Health Care.)

See also copulation characteristics.

Male sexual characteristics

Males mature sexually at about 2 years of age. The production of mature spermatozoa begins at this age; however, it is believed by many that they are not successful breeders until about five years old. (Liers 1951) The reason for this is thought to be the continuing development of the baculum for the first six years. (It increases in length until age three and weight until age six.) It has been postulated that the baculum requires this greater length and weight to induce ovulation.

The results of the 1993 N. A. river otter breeding survey showed four of nine breeding males to be four years old, and one that was three years when their first litters were born. The exact explanation for this early breeding success is unclear but may have something to do with easy access to the females and lack of competition from older, more experienced males. Data on breeding males accumulated since the 1993 survey does not alter these findings.

The male's testes begin to enlarge sometime in October/November (or earlier at more southern latitudes), and remain distended until the end of the breeding season. (Liers 1951 and pers. obs.)

Female sexual characteristics

Generally, females also mature sexually at two years of age. (Although, Liers (1958) mentions one female who was bred at 15 months.) The ovaries and uterus continue to grow until about two years of age. The uterus is bicornate (two horned). (Toweill & Tabor, 1982)

“Adult females...may develop an os clitoridis, the female counterpart to the male os baculum. The os clitoridis is a cartilaginous structure in females less than two years old, but may ossify in older individuals.” (Toweill & Tabor, 1982)

Two pairs of mammae are the norm.

Females are induced ovulators and experience delayed implantation. (See delayed implantation.)

Age of sexual maturity

Both males and females are sexually mature at the age of two years. (See Male and Female sexual characteristics)

Ovulation rate

“The average ovulation rate for northern river otters has been reported to range from 2.40 to 3.02.” (Toweill & Tabor, 1982).

Copulation characteristics

Although copulation generally takes place in the water, it also can take place on the land. The copulatory act is vigorous, noisy, and can be lengthy with intromission lasting up to 25 minutes. A pair will copulate repeatedly over a period of an hour or two then take a break for several hours before starting again. Copulation generally occurs several times over successive days.

“The male approaches the female from the rear, holds the female by the scruff of the neck with his teeth, and bends the posterior part of his body around and below the broad tail of the female.” (Toweill & Tabor, 1982, Liers 1951)

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 then run away.

A female entering estrous will frequently spend more time rubbing and scent marking to advertise her condition. In captivity an increased interest in the male's quarters, if they are housed separately, is frequently a good cue. Vulvular swelling has been reported by a few facilities. (John Ball Zoo, Minnesota Zoo, although, the a keeper at the later feels this vulvular swelling is observable at other times of the year.) In my experience this can be difficult to see, but in addition to the vulva being slightly swollen it may appear somewhat pinkish.

At this time, I find no evidence of a vaginal discharge being associated with estrous. If this is observed the female should be watched closely for signs of illness, as *L. canadensis* females appear to be prone to urogenital infections.

Delayed implantation

Lontra canadensis females experience delayed implantation. The fertilized egg stops developing at the blastocyst stage and floats freely in the uterus for a number of months before implanting in the uterine wall. "The exact duration of arrested development of the blastocyst and the period of activity and growth of implanted embryos before parturition (actual gestation period) are not fully known." (Melquist & Dronkert, 1987) However, researchers generally agree on the numbers given above.

"It has been postulated that insufficient secretion of gonadotropic hormones from the pituitary results in delayed implantations in mustelids." (Mead & Wright 1983)

The reason for delayed implantation in the N. A. river otter is not really understood. It is always assumed that there must be an adaptive advantage to delayed implantation, but this is not necessarily the case, at least in modern times. It is possible that at one time there was an evolutionary advantage bestowed on river otters by delayed implantation --- perhaps coordination of breeding season with parturition made it easier for males to locate females (see below) or allowed pups to be delivered when food was most abundant. This could still be argued for animals found at higher latitudes but may not be as important to animals found in the southern part of *L. canadensis*' range (however, there can be seasonal fluctuations in resources at the southern latitudes). It may be that this trait is simply evolutionarily neutral; it is no longer advantageous or disadvantageous.

R. A. Mead cites the work of G. B. Stenson in which Stenson theorizes that embryonic diapause (delayed implantation) in the river otter allows the synchronization of births without a similar synchronization in mating. "This would allow mating to occur over a relatively long period of time. Alternatively, Stenson proposed that delayed implantation might have temporally synchronized parturition and breeding. Stenson believes this might be of advantage in that lactating females would be much more restricted to the vicinity of their dens, making it easier for males to locate estrous females at this time." (Mead, 1989) (See female sexual characteristics.)

Embryos

Once implanted, embryonic growth proceeds rapidly. (Huggett & Widdas, 1951) It appears that intrauterine mortality levels are low. (Tabor & Wright, 1977; Mowbray, et. al., 1979)

Gestation

Total gestation:	285 – 380 days (Liers, 1951) 245 – 360 days (Duplaix-Hall, 1975)
Actual gestation:	60 – 63 days (Lancia & Hair, 1983) 50 days (Toweill & Tabor, 1982)

Some total gestations (in days) reported in captivity are: 309, 313, 314, 324, 333, 334, 335, 339, 350, 351, 354, 355, 356, 361, and 367. A report of 397 days is considered to most likely be an error.

Inter-birth interval

Due to delayed implantation there is at least a year (theoretically this could be 10 to 11 months but there are no records of intervals less than 11+ months) interval between litters. In some areas of the river otter's range a two-year interval appears to be more common.

Tabor & Wright (1977) determined that most females breed annually in Oregon. Mowbray, et. al. (1979) discovered that only 25% of the females in Maryland had bred the year before. Lauhachinda (1978) concluded the majority of female otters in Alabama and Georgia probably breed in alternate years.

The 1993 *Lontra canadensis* Breeding Survey indicated that most zoos were breeding their females every other year; this was primarily due to management practices and no observable signs of the post-partum estrous in many captive females. At the time of the survey, and in the years since, there has continued to be a few facilities that breed river otters every year. To my knowledge these are all facilities that allow the male to stay in the enclosure with the female and pups. (See Management for Breeding). The Minnesota Zoo did have some success breeding their females annually in the 1980's, a success that was due to good management practices, close observation by the keepers, and females that showed obvious signs of estrous.

In captivity, management practices will influence inter-birth intervals. If pairs are kept together throughout pregnancy, parturition and pup rearing there is a higher likelihood the pair will reproduce annually. (See Management for breeding.)

Intrauterine mortality

It is believed that intrauterine mortality is low. (Toweill & Tabor, 1982)

Pre-partum weight gain

Weight gains of 1.1 kg, 1.2 kg, 2.3 kg, 1.2 kg, and 3.1 kg, for two females, over five litters were recorded during the 60 days pre-partum at the Minnesota Zoo. (2.425 lb, 2.645 lb, 5.07 lb, 2.645 lb, 6.83 lb)

Females at the Lowry Park Zoo and John Ball Zoo showed a weight gain, but there are no records of the exact gain (generally two to three pounds (.90 – 1.36 kg) for the JBZ female).

Signs of imminent parturition

The female may exhibit a number of different signs including: increased 'nest' building, swollen mammae, aggression towards exhibit mates or keepers, depressed appetite, frequent floating in the pool, refusal to leave the nest box, restlessness, or lethargy. No pre-partum discharge has ever been noted.

PARTURITION

Birth season

Parturition may occur from November through May, however, the peak time appears to be March or April in the northern latitudes (40° - 50°N) and January to February at more southern latitudes (23° - 30°N). There are always exceptions, if not, they would not be otters. (See table Latitude & Birthing Dates.) It is not known what role, if any, captivity played in the early births seen in some of the more northern latitudes. What this does mean is that we cannot be certain that a female in New York will not give birth in January! However, early births at the more northern latitudes should be considered rare.

Parturition

Otter births are seldom witnessed; Liers (1951) reported that the birthing process takes three to eight hours. He also states that the dam stood on all four feet for the births he observed.

I don't know how obvious signs of contractions are – the one birth I witnessed was quick and not accompanied by any obvious contractions. About two hours after consuming her morning diet, the female sat down, began licking her genital area and delivered a pup within a period of minutes. Because she was not under observation prior to this, it can be assumed she had been in labor for a while, but it is unknown how long contractions may have been occurring.

Post-partum weight loss

Little information is available. The Minnesota Zoo recorded a loss of 0.8 kg. within the first 24 hours for one female. (See Lowry Park Zoo, Adult Weight Table)

Litter size & sex ratio at birth

One to six pups have been reported; generally a litter consists of two to three. No information could be found on the sex ratio at birth. A review of the ISIS (International Species Information System) database shows that since 1969 there have been approximately 61 litters bred and born (litters born to females bred in the wild are not included here) with a sex ratio of 63.52.34 (males.females.unknown sex). (Information current available as of May 2000.)

N. A. River Otter - Age at Birth of First Litter – Table

(Sample from ISIS records and personal communication)

Facility	Animal ID	Sex	Age (nearest year)
BU	#M86119	0.1	4
GR	#9	0.1	4
JBZ	#300715	0.1	4
LR	#3720	0.1	10
NE	#222218	0.1	4
SAC	#100834	0.1	4
ST	#090106	0.1	4
SU	#005879	0.1	8
SU	#053184	0.1	3
FL*	#100005	0.1	6
FL*	#100004	1.0	6
BU	#M86177	1.0	3
GR	#7	1.0	4
JBZ	#300869	1.0	4
LR	#3731	1.0	13
MIN	#73	1.0	9
NE	#222219	1.0	4
ST	#087036	1.0	7
SU	#000181	1.0	10
VL	#L288	1.0	4

* Florida Aquarium, Tampa, Florida

***Lontra canadensis* Latitude & Birthing Dates - Table**
(H – Harris, 1968; B – Breeding Survey, 1993; C – Current review)

Place	Approx. Lat. °(N)	Date
Little Rock, AR	34°	March/April (B)
Toronto, Canada	43°	Nov. & Apr. (B)
Sacramento, CA	38°	March (B)
California	34 - 42°	March/April (H)
Bridgeport, CT	41°	Early January (B)
Bristol, England		April (C)
Homosassa Springs, FL	28°	Dec. & Jan. (B)
Tampa, FL	27°	Dec. & Jan. (B)
Florida	26 - 30°	February (H)
Evansville, IN	38°	February (B)
Manhattan, KS	39°	March/April (B)
Baton Rouge, A	30°	Early February (B)
Manitoba	50°	Late April (H)
Michigan	42 - 46°	Peak March/April (H)
Grand Rapids, MI	43°	Late April (B, C)
Lansing, MI	43°	End of January (H)
Apple Valley, MN	44°	March/April (B)
Winona, MN	44°	End of January (H)
Minnesota	44°	'Early spring'(H)
Kansas City, MO	39°	February/March (H)
St. Louis, MO	38°	February/March (B)
Lincoln, NB	40°	March/April (B)
New York City	41°	January (H)
Rochester, NY	43°	Spring (B)
New York State	41 - 45°	Mid – End March (H)
West Orange, NY	39 - 40°	January/February (B)
Syracuse, NY	43°	Early April (B)
N. Mackenzie	62 - 67°	? Jan./March (H)
Oregon	42 - 46°	April/May (H)
Memphis, TN	35°	March (B)
Nashville, TN	36°	February (B)
Corpus Christi, TX	27°	January (B)
Texas	28 - 34°	End February (H)
Texas	28 - 34°	Feb./Mar. (B)
Utah	37 - 41°	Mid-April (H)
Virginia	37 - 39°	April/May (H)
Virginia	37 - 39°	March (B)
Washington, D.C.	39°	Dec./February (H)
Milwaukee, WI	42°	March (B)

PUPS AND PUP DEVELOPMENT

Neonatal mortality

As with most animals, mother neglect, injuries from the mother's exhibit mates, cold, and dampness must be watched for. Facilities responding to the 1994 Breeding Survey listed the preceding reasons, or unknown, for most neonatal deaths. K. Petrini has more recently reported being notified of a neonate's death due to kidney stones.

Young otter names

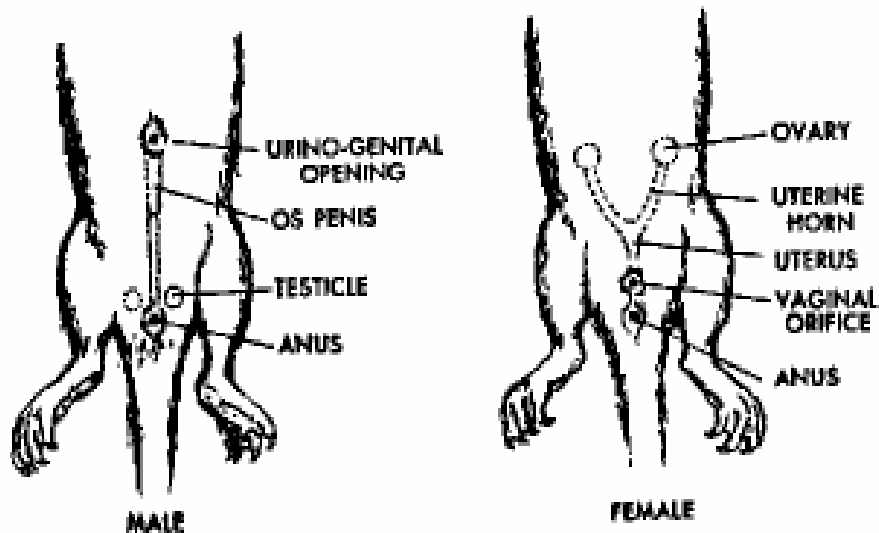
Most commonly pups, cubs, less frequently kits.

Neonate condition

Otter pups are born completely dependent on the bitch. 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 of birth.

Sexing Pups

Sometimes sexing of young animals can be difficult. If you sex them just after birth, you may want to re-check when they are a few weeks old.



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Developmental stages

This time line is intended as a general guideline only. The information all comes from the 1994 Breeding Survey (except where noted). Additional captive information provided by Debbie Jackson of the Little

Rock Zoo, Lowry Park Zoo staff, and communication with a number of other U.S. and International facilities.

**Pup Development Stages – Table
N. A. River Otter**

Eyes open	Day 31 to 35 (Liers, 1951) Day 29 to 33 – eyes beginning to open (JBZ) Day 36 to 40 – eyes open, not focusing (GR, JBZ, LR) Day 21 to 35 (Toweill & Tabor, 1982)
Eyes focus	Day 50 (GR) i.e. appeared to be opening
First walk	Day 36 (LR, JBZ) unsteady
Pelt change	Day 46 – beginning to show light hairs around the face (Johnstone, 78) Day 26 – muzzle hairs lightening (JBZ)
Leave the nest box	Day 38/50 (JBZ) carried by mother (see swim) Day 49 (LR) left the box by themselves Day 59 to 70 leave nest box on their own (Liers, 1951)
First play	Day 25 to 42 begin playing together (Liers, 1951) Day 49 (LR) playing together
First swim	Day 15 (LR) female put pup into pool Day 38 (JBZ) in large exhibit pool – 2 nd litter Day 50 (JBZ) in large exhibit pool – 1 st litter Day 58 (GR) in female’s water tub Day 28 to 55 (LR) lessons got longer by day 42
Localized latrine use	By around day 49 (Liers, 1951)
First solid food	Day 57, Day 66 (JBZ) Day 59 (GR) Day 60 (LR)
Total nursing time	Three to four months (Nowak, 1991)
Weaning age	Day 91 – or about that time (Liers, 1951) Day 75 – started weaning (GR)

First Swim

Otter pups must be taught how to swim. In captivity, females tend to begin these lessons earlier (day 38 plus or minus a few days), than in the wild (it could be that early swimming lessons in the wild have gone unobserved); lessons are very short to begin with and lengthen as the pups gain control of their body and limbs. (Young pups most resemble hairy-corks bobbing in the water.) Females will decide when it is time to teach the pups to swim but these early lessons should be monitored to be sure she stays vigilant and takes pups out of the water before they tire.

The depth of the water does not seem to matter but provisions should be made to ensure it is possible for pups to pull themselves out of the water. Like the adults, young animals do seem to enjoy playing or exploring in shallow water so if possible shallow water tubs, water bowls, stream beds, etc. should be provided, especially as they are learning to swim.

Pup weights

Weekly weights have been taken from the 1994 Breeding Survey responses. Because facilities weighed their animals on varying schedules, weights listed for a given day may be from as much as three days before or after the day listed. Consult the institution's listing for the exact day the weight was taken. (See Hand-rearing for additional weight data.)

Weights given in Little Rock's daily charts come from the AAZK Zoo Infant Development Notebook 1994, H. Frazier and K. Hunt editors. Information submitted by Joyce Ford, Little Rock Zoo, Little Rock, Arkansas.

N. A. River Otter Pup Weights – Weekly Increments - Table

	Day	Weight (grams)
Birth Weight		132 (Toweill & Tabor, 1982) 120 – 160 (Melquist & Dronkert, 1987) 135 – 170 (LR) 111 – 146 (FL)
Day 7		266 – 33 (LR)
Day 14		499 – 544 (JBZ – 1993 litter) 532 – 671 (JBZ – 1995 litter)
Day 21		428 – 496 (LR) 687 (MIN)
Day 28		566 – 687 (LR) 721 – 912 (JBZ) 930 (MIN)
Day 35		907 – 910 (JBZ) – 1993 litter 952 – 1180 (JBZ) – 1995 litter 756 – 890 (LR)
Day 42		1045 (MIN) 1115 – 1230 (GR) 997 – 1043 (JBZ) – 1993 litter 1232 – 1562 (JBZ) – 1995 litter
Day 49		1030 – 1151 (LR) 1343 (MIN) 1230 – 1290 (GR) 1200 – 1300 (JBZ) – 1993 litter 1215 – 1428 (LR)
Day 56		1161 (MIN) 1339 – 1478 (GR) 1473 – 1649 (LR) 1736 – 2072 (JBZ) – 1995 litter
Day 63		1656 – 1814 (JBZ) – 1993 litter
Day 70		1742 – 1907 (LR) 1914 – 2247 (LR) 1678 – 1996 (JBZ) – 1993 litter 1845 – 2419 (GR) 2410 (LR)

N. A. River Otter Pup Daily Weights - Table
 (From AAZK Zoo Infant Development Notebook 1994)
 Little Rock Zoo, Grassmere Wildlife Park, John Ball Zoo,

Males (N = 9)				Females (N = 8)			
Age/days	Weight	Age/days	Weight	Age/days	Weight	Age/days	Weight
1	110 - 170gr.	32	992g-1.03kg.	1	170gr.	32	971gr.
2	177 - 184gr.	33	998g-1.09kg.	2	177gr.	33	
3	193 - 220gr.	34	1.08-1.11kg.	3	198gr.	34	1.01kg.
4	204 - 241gr.	35	1.11-1.14kg.	4	213gr.	35	1.05-1.15kg.
5	241 - 276gr.	36	1.13-1.19kg.	5	248gr.	36	1.06kg.
6	249 - 298gr.	37	1.16-1.18kg.	6	262gr.	37	1.09-1.23kg.
7	266 - 333gr.	38	1.20-1.25kg.	7	298gr.	38	1.13kg.
8	28 - 354gr.	39	1.23-1.28kg.	8	333gr.	39	1.15-1.30kg.
9	325 - 376gr.	40	1.28-1.34kg.	9	347gr.	40	1.23kg.
10	353 - 404gr.	41	1.35-1.36kg.	10	383gr.	41	1.28kg.
11	364 - 425gr.	42	1.32-1.41kg.	11	397gr.	42	1.25-1.35kg.
12	398 - 453gr.	43	1.35-1.39kg.	12	411gr.	43	1.28kg.
13	414 - 475gr.	44	1.40-1.43kg.	13	439gr.	44	1.35kg.
14	496gr.	45	1.45-1.57kg.	14	454gr.	45	1.39kg.
15	531 - 539gr.	46	1.52-1.62kg.	15	489gr.	46	1.43kg.
16	499 - 574gr.	47	1.43-1.62kg.	16	517gr.	47	1.34-1.48kg.
17	595gr.	48	1.59-1.69kg.	17	546gr.	48	1.46-1.60kg.
18	617 - 624gr.	49	1.59-1.67kg.	18	560gr.	49	1.58kg.
19	624 - 645gr.	50	1.69-1.79kg.	19	609 - 685gr.	50	1.62kg.
20	666 - 680gr.	51	1.62-1.74kg.	20	637gr.	51	1.56kg.
21	687gr.	52	1.67-1.87kg.	21	652gr.	52	1.53kg.
22	765 - 780gr.	53	1.74-1.88kg.	22	660 - 730gr.	53	1.62kg.
23	780 - 808gr.	54	1.74-1.92kg.	23	723gr.	54	1.64kg.
24	810 - 843gr.	55	1.71-1.96kg.	24	758 - 850gr.	55	1.66-1.81kg.
25	822 - 858gr.	56	1.54-1.68kg.	25	720 - 795gr.	56	
26	829 - 872gr.	57	1.71-2.03kg.	26	772gr.	57	1.93kg.
27	850 - 872gr.	58	1.87-2.10kg.	27	794gr.	58	1.76kg.
28	865 - 910gr.	59	1.90-2.06kg.	28	815 - 900gr.	59	1.80kg.
29	907 - 921gr.	60	1.52-2.12kg.	29	872gr.	60	1.86-1.70kg.
30	935 - 978gr.	61	1.97-2.15kg.	30	907gr.	61	1.84-2.33kg.
31	971g-1.00kg.	62	1.96-2.24kg.	31	928gr-1.06kg	62	1.88kg.

MANAGEMENT FOR BREEDING OR NON-BREEDING

Environmental cues

It is assumed that photoperiod plays a part in signaling the onset of estrous and the implantation of the embryo. Photoperiods in indoor exhibits should mimic a natural day/night cycle regardless of breeding or non-breeding goals.

M. Ben-David (per. com.) has theorized that temperature change could play a role in prompting the onset of estrous.

Breeding in captivity

Emil Liers appears to have been the first one to breed N. A. river otters, consistently, in captivity. (At least the first from whom we have extensive records.) The majority of his work took place in the 1930's, 1940's and 1950's; his landmark paper was published in 1951. Arthur Hoffman was the next significant breeder of captive otters. Mr. Hoffman supplied a number of zoos with offspring from his otters during the 1960's. (Davis, 1985)

It is believed Liers and Hoffman used similar management strategies to get their otters to breed. Information on Mr. Hoffman's management techniques comes from a conversation with him Joe Davis reported on during a River Otter Breeding Symposium held at the Turtle Back Zoo in 1985. Davis states that Hoffman kept 6.6 animals and found that the same pair did not always breed each year. Hoffman would introduce different pair combinations until he hit on a pairing that worked, i.e. breeding occurred. Generally, breeding took place within the first hour if it was going to occur at all. With this method, Hoffman's otters produced four litters from six pairs annually.

The Mole Hall Wildlife Park in Essex, England bred otters in the late 1960's and early 1970's achieving at least a complete third generation birth (Duplaix-Hall, 1975).

Joe Davis, formerly of the Brookfield Zoo, and the staff at the Minnesota Zoo, where seven litters were born between 1986 and 1990, agree that the best way to manage river otter for breeding is to maintain enough animals to allow for multiple pairing combinations. It is undoubtedly the preferred method, one which would insure the production of litters every year but, not many facilities are equipped to house that many animals.

The Minnesota Zoo took the concept of multiple mate selection and added a variation to it, the stranger factor. Separating animals during the months prior to breeding season, then reintroducing them seemed to stimulate interest. It was using this technique and the option of different pairings by maintaining multiple animals that led to Minnesota's success in the 1980's.

Pair management

Some single pairs have been successful at producing litters. Breeding in most of these pairs has essentially been fortuitous, nothing was really done to encourage breeding. Some of the animals are kept together all of the time, some are separated at night, some have been together for years before they breed successfully, some have just recently been introduced. Many, although not all, of these pairs are found in large, semi-naturalistic exhibits – particularly the pairs that reproduce more than once. A few of these pairs reproduce again after the first litter, others have produced only one litter.

Following are five examples of pair management practices from facilities that have had successful otter breedings at their institutions:

Homosassa Springs had a breeding pair that is illustrative of the successful, single pair. The animals were kept together all of the time, the pair reproduced annually until the untimely death of the male. The male was not removed when the female gave birth but he 'knew enough' to stay clear of her nest box and out of sight if the female was outside of the pupping box. Essentially, the female decided when it was all right for the male to approach the pups, generally when they were swimming fairly proficiently.

Oakland Zoo maintained a pair together for 11 years before they bred successfully in 1998. They were unaware that the female was pregnant until the day before she gave birth. The morning of parturition, she snapped at the male, ate very little then gave birth one hour later. 0.1 pup was born on 20 February 1999; the male was reintroduced to 0.2 on 06 May 1999. Unfortunately, their adult female was stolen in 2000 so we do not know if this pair would have bred again.

John Ball Zoological Garden has exhibited a pair of otters since 1992 (there was a third female until early 1993 but the females were rotated on exhibit with the male because the girls did not get along). The pair is kept together during the day, separated at night. The protocol was to separate the pair in December and begin reintroducing them in late March. The introductions occurred every few days and lasted only ½ to 1 hour unless breeding was seen at which time the pair was left together all day. In 1997 the protocol changed and the pair was not separated in December. They continue to breed successfully and have produced two litters since that time.

Lowry Park Zoological Garden houses 2.2 animals. These animals are kept together 24 hours year around except during feeding, estrous, and when a female has pups. During a female's estrous she is separated from the males at night to give her a break from breeding. She is first introduced to the subordinate male, for about one week. The next step is the introduction of the dominant male. There is some fighting between the males for the right to breed the female but to date there have been no serious injuries. As of this writing, due to a variety of reasons, the two female's are never in estrous at the same time because one is usually pregnant while the other is cycling. It should be noted that the two females in this group were raised together from a very young age which may contribute to their continuing compatibility even after separations of several months. (Mother and pups are not reintroduced to the group.)

North American river otter (*Lontra canadensis*) - Table
ISIS Recorded Captive Births: 1969 – 2000
(Litters born to wild bred females not included.)

Birth Date	No. & Sex	Birth Date	No. & Sex	Birth Date	No. & Sex
12 Mar. 1969	0.0.1	02 Apr. 1972	0.1	25 Jan. 1974	0.1
26 Mar. 1975	1.1.1	27 Mar. 1976	0.0.1	01 Mar. 1977	1.1
20 Feb. 1980	0.0.4	25 Feb. 1980	1.0	06 Feb. 1981	0.1.1
19 Nov. 1982	1.0	17 Mar. 1983	0.0.4	07 Apr. 1983	0.1.2
06 Apr. 1984	1.1	05 Jan. 1985	?	11 Feb. 1985	3.0.1
11 Mar. 1985	1.1.2	05 Apr. 1986	3.0	01 Feb. 1987	?
07 Apr. 1987	0.3.0	10 Apr. 1987	2.1	30 Apr. 1988	2.1
20 Mar. 1989	0.1	04 Apr. 1989	1.2	05 Apr. 1989	1.1
26 Mar. 1990	0.1	21 Apr. 1990	2.2	01 Mar. 1991	0.1
01 Apr. 1991	1.1	16 Feb. 1992	1.2	09 Mar. 1992	2.1
20 Mar. 1992	2.0	06 Apr. 1992	2.0	24 Feb. 1993	0.1
17 Mar. 1993	2.3	01 Apr. 1993	0.0.2	20 Apr. 1993	3.0
01 Jan. 1994	1.1	04 Mar. 1994	0.0.1	20 Mar. 1994	0.0.1
21 Dec. 1994	0.2	25 Dec. 1994	0.0.3	15 Jan. 1995	0.0.3
24 Apr. 1995	3.0	13 Dec. 1995	2.1	20 Dec. 1996	2.1
05 Apr. 1996	1.2	22 Mar. 1997	1.0	15 Dec. 1997	0.5
19 Dec. 1997	4.1	20 Jan. 1998	0.0.3	30 Jan. 1998	1.1
16 Feb. 1998	1.1	03 Mar. 1998	1.2	03 Apr. 1998	1.0
22 Apr. 1998	0.2	06 Jan. 1999	3.1	20 Feb. 1999	1.1
02 Mar. 1999	1.0	21 Mar. 1999	0.0.4	31 Mar. 1999	1.0
12 Apr. 2000	0.2				

Diet and a pregnant female

"The energy requirements and food intake of pregnant females are from 17 to 32% higher than nonreproducing females." (Robbins 1993)

Only 10 to 20% of this increased consumption is actually utilized by the female, most of the metabolized energy is turned into heat and lost. Therefore, *"...lengthening the gestation period by slowing the growth rate will disproportionately increase the total energy cost per unit of fetus produced, which may explain why most delays during pregnancy are not via a reduced growth rate but occur prior to the initiation of growth (i.e. delayed fertilization or implantation).* (Robbins 1993)

A pregnant female's diet should be increased by at least 1/3 during the last trimester and early lactation. The female's diet during lactation should be monitored closely and increased as necessary. (See Diet & Nutrition)

1994 N. A. river otter Breeding Survey

The 1st edition of the husbandry notebook contained the complete results of the 1994 John Ball Zoo North American River Otter Breeding Survey, including the survey sent to twenty-seven U. S. and Canadian Zoos. These zoos were selected because, 1) ISIS records showed they had had captive bred and born *L. canadensis* litters, or, 2) the institution had indicated an interest in breeding these otters in their response to the 1993 Central Park Wildlife Center Survey. All twenty-seven facilities responded. The original list was as follows: Audubon Park Zoo, Baton Rouge Zoo, Beardsley Zoological Gardens, Blank Park Zoo, Burnet Park Zoo (BU), Calgary Zoo, Dakota Zoo, Dreher Park Zoo, Ellen Trout Zoo, Erie Zoo, Folsom Children's Zoo, Grassmere Wildlife Park (GR)(now Nashville), High Desert Museum, John Ball Zoo (JBZ), Little Rock Zoological Gardens (LR), Memphis Zoo, Mesker Park Zoo, Metropolitan Toronto Zoo (TO), Miller Park Zoo, Milwaukee Zoo, Minnesota Zoo (MN), New England Science Center (NE), Sacramento Zoo (SAC), St. Louis Zoo (ST), Seneca Park Zoo, Sunset Zoo (SU), Turtle Back Zoo, Virginia Living Museum (VL).

Note: This section has not been updated. For more current captive birth information please contact the North American Otter Studbook Keeper – David Hamilton (Seneca Park Zoo, 2222 Saint Paul St., Rochester, NY 14621. dhamilton@monroecounty.gov. 585.336.2502)

The information below was contained in the 2nd edition and contains only the information submitted by those facilities that reported captive bred and born litters at the time of its publication in 2001. Where appropriate, i.e. additional litters have been born or significant changes made to protocol, updated information is included. Facilities reporting births since the initial surveys (1993 & 1994) are included.

Audubon Park & Zoological Gardens, Louisiana

1980 – 4 born/0 survived

No further information available.

Baton Rouge Zoo, Louisiana

1981 – 4 born/2 survived (06 Feb.)

1983 – 4 born/4 survived (06 Feb.)

The facility maintained 4.2 adults, so the sire is unknown, same dam for both litters. The animals were kept together at all times but the female was separated as close to predicted parturition as possible. No physical or behavioral changes were noted prior to parturition. A 24" x 24" plywood nest box was provided. The pups were introduced to the family group at about 8 months of age.

The two pups that died in 1981 succumbed to multiple bite wounds received before being pulled off exhibit with the dam.

Beardsley Zoological Garden, Connecticut

1991 – 2 born/2 survived (01 Apr.)

The male and female were kept together year around. A small nesting area was provided in the exhibit. There was no behavioral change observed prior to parturition.

Bristol Zoo, Bristol, England

1996 – 3 born/ 3 survived (05 Apr.)

See Chapter 14 for detailed information.

Burnet Park Zoo, New York

1989 – 2 born/2 survived (05 Apr.)

1992 – 2 born/2 survived (06 Apr.)

Same dam and sire for both litters. Management technique varies for different animals. Males and females held separately are introduced during breeding season. Pairs held together are separated at night one-week prior to parturition, and then separated entirely after the birth of the pups. They introduced the male to the second litter when the pups were six months old.

“The only behavioral difference in the female prior to giving birth is lack of food consumption the night before birth. After the pups are born she becomes very protective of the nest box.”

Her mammae did become slightly engorged.

Two holding areas each with a 22”W x 32”L x 24”H nest box with a 6” x 6” entrance (55.88 cm x 81.28 cm x 60.96 cm with a 15.24 x 15.24 cm entrance) are provided. *“She will move the pups to the clean nest box when she feels current one is dirty. This is the only time we clean the nest box.”*

Ellen Trout Zoo, Texas

1980 – 2 born/1 survived (25 Feb.)

1982 – 2 born/1 survived (12 Mar.)

Same dam and sire for both litters. The pair is kept together year around except after the birth of pups when the male is removed. The male is reintroduced to the family group when the pups are weaned.

The female spent most of her time in off-exhibit shifts, the den area of these shifts measures approximately 18”W x 36”L x 18”H (45.72 cm x 91.44 cm x 45.72 cm).

Folsom Children’s Zoo & Botanical Gardens, Kansas

1972 – 1 born/1 survived (02 Apr.)

1975 – 3 born/2 survived (26 Mar.)

1977 – 2 born/2 survived

Same dam, different sires for the 1972 and 1975 litters. Same sire, different dams for the 1975 and 1977 litters. The 1972 pup was accidentally introduced to the male at five weeks of age. No other information available.

Grassmere Wildlife Park (Now Nashville Zoo at Grassmere), Tennessee

1992 – 3 born/3 survived (16 Feb.)

1996 – 3 born/3 survived (14 Feb.)

The pregnant female was housed with 2.1 adults until her nipples “dropped” at which time she was separated and confined to two holding runs (6 ft x 4 ft, or, 1.83 m x 1.22 m). This was eight days prior to giving birth. During this time she had visual access to the other animals through the chain mesh. Two nest boxes measuring 14”W x 24”L x 18”H with an entrance 8” x 11” (35.56 cm x 60.96 cm x 45.72 cm, 20.32 cm x 27.94 cm entrance) were added to the runs. Absorbable bedding and straw were used to line the boxes. The large water tub was removed and replaced with a small water bowl. Her behavior first changed about 30 days prior to parturition when she became more lethargic; her appetite dropped; she did a lot of nest building; she became more quarrelsome with her exhibit mates; and her nipples became noticeably

enlarged. Just prior to parturition she became very aggressive and vocal towards the keepers. She was introduced to the males, individually and together, about one month after birth. Copulatory behavior was observed (15 & 16 Mar.) but she was separated again due to aggression on her part.

During the 1991 breeding season, all four animals (2.2) were exhibited together during the day and same sex pairs were kept together at night. Late in 1992 a pair manipulation study was carried out to determine if the animals would show any mate preference. One preferred pairing was observed however, due to the introduction of a new female, and removal of one of the original females, no breeding was observed during the 1993 season. During the 1994 breeding season all animals were again exhibited together during the day and separated at night.

N. A. River Otter Pup Development – Table Grassmere Wildlife Park/ Nashville Zoo	
Day	Developmental Stage
Day 24 – 37	Tooth eruption.
Day 36 – 37	Eyes first open.
Day 50	Pups alert and tracking moving objects with their eyes.
Day 58	The female briefly placed the pups in the water bowl. After one minute she returned them to the nest box. This all occurred after a necessary immobilization to treat an abscess on her head (total time away from pups was one hour).
Day 59	Tasted first solids.
Day 75	Started weaning.
Day 77	First time on exhibit to teach pups to swim.
Day 119	Began first molt.

N. A. River Otter Pup Weights – Table Grassmere Wildlife Park/Nashville Zoo			
Day	Weight	Day	Weight
Day 19	620 – 685g	Day 47	1339 – 1478g
Day 24	770 – 850g	Day 60	1523 – 1702g
Day 31	940 – 1065g	Day 73	1845 – 2419g
Day 37	1115 – 1230g	Day 86	2150 – 2240g
Day 39	1230 – 1290g	Day 112	3400 – 3540g

High Desert Museum, Arizona

Animals given full access to each other from February until mid-April when they are separated at night and alternated on exhibit. They will continue supervised access by one male at a time during future breeding seasons. The female appears to get along better with one of the males. A two chambered nest box measuring 36” x 24” would be made available to the female.

Homosassa Springs, Florida

1994 – 2 born/2 survived (21 Dec.)

1995 – 3 born/ 3 survived (13 Dec.)

1996 – 3 born/ 3 survived (19 Dec.)

1997 – 5 born/ 5 survived (15 Dec.)

The pair was kept together all of the time. The male stayed out of the females way when she had pups. Once the pups were swimming well the female allowed the male to interact with them.

John Ball Zoological Garden, Michigan

1993 – 3 born/3 survived (20 Apr.); pups were 3.0

1995 – 3 born/3 survived (24 Apr.); pups were 3.0

1998 – 2 born/2 survived (22 Apr.); pups were 0.2

2000 – 2 born/2 survived (12 Apr.); pups were 0.2

JBZ exhibit: There are a few structural features of the JBZ exhibit, that although not ideal do make it possible to manage different groupings of otters at the same time. The following description of the basic exhibit layout was submitted to the AAZK Zoo Infant Development Notebook (1994) by Joan Ryskamp.

“The outside area of the exhibit consists of a gunite land area and two pools. The land area is 819 sq. ft. The larger of the two pools is 1730 cu. ft. (48.99 m³) The smaller pool is 1708 cu. ft. (48.37 m³). (Total surface area, land and water, of the exhibit is about 1,720 ft², or, 160 m² plus some usable vertical and free-floating space) There is a small waterfall between the two pools. The water is recirculated, being drawn off the smaller pool and filtered through a 2.2 cu. ft. (.0623 m²) sand filter. The water is then pumped to the top of the exhibit and returned to the larger pool via a waterfall.

“The off-exhibit area for the otters consists of six connected dens, side by side. The dens are cement block construction on three sides, the fourth wall consists entirely of the keeper access door to the den. The den floors are poured cement with a gutter in front of the dens. The dens are built three feet off the floor with storage underneath, and are 4 ½ ft (1.37 m) tall. Each of the end dens has an outside access door for the otters. These dens are 2 ½ ft x 4 ft (.762m x 1.22 m) with metal clad plywood access doors for the otters’ privacy. The four center dens are 3 ft 8 inches x 4 ft (.91 m x 1.22m). These dens have 1” x 4” (2.54 mm x 10.16 cm) aluminum industrial floor grate keeper access doors for easy observation of the otters. There are heat pads in the cement floors of the four center dens.

“The dens are connected by sliding, metal-clad plywood doors, 8” x 8” (20.32 cm x 20.32 cm). These sliding doors are operated by the keepers from the outside and can be locked shut from the outside.

“This den arrangement makes it possible to separate the animals in the exhibit and still allow each animal access to the outside. It is also easy to move the animals from den to den for cleaning.” (Note: The floor heating units are not used and the floor grate doors proved to be hard to see through and are due to be replaced.)

In 1993 and 1995 the male and female were exhibited together during the day and separated at night until mid-December. They were then kept separated until the start of breeding season, mid-March, when they were introduced to each other every few days. If no breeding behavior was observed within the first ½ to one hour they were separated again. This was repeated every three days until breeding was observed, if breeding behavior was seen the pair was left together for the remainder of the day. From that day, until no further breeding activity was seen the animals were exhibited together daily. The process was then

repeated until the end of breeding season in late May or early June. After breeding season the pair was exhibited together during the day and separated at night. During the time the pair was separated the animals were rotated through the exhibit – this provided each individual exposure to the scent of the other one.

1993 litter: Breeding was observed on 18 April, 05 May, and 10 May which equates to a total gestation of 345 days from the last observed breeding. Other than being intolerant of the male's presence (during two brief introductions not long before parturition), the female showed no obvious behavioral signs of pregnancy. However, a weight gain of approximately 2 lbs (.91 kg) was noted over the three months leading up to parturition. The first pup was born outside of the nest box in front of the keeper at 11:15am but she quickly took up the pup and put it in one of the nest boxes provided. She never missed a meal prior to, or after parturition, and was never aggressive toward the keeper staff.

Visual introduction to the male was first attempted 16 days after parturition; this only provoked agitation in the female. Physical introduction was tried approximately one month after birth but due to the female's aggression toward the male they were separated and introduction was not attempted again. This physical introduction was probably done too late to hit the post-partum estrous (she did not then, nor has she ever shown any signs of this post-partum estrous), and introductions were never tried again because we decided to only breed her every other year.

The female was given access to the exhibit for the first time on day 33. On day 50 she carried the pups out into the exhibit one at a time by the scruff of the neck. Each one was briefly dumped in the pool for its first swimming lesson. All the pups floated like off-balance corks. She built a straw nest under a stump that was used when she and the pups were on exhibit. The family was exhibited only part of the day; the female carried the pups onto the exhibit and the keepers carried them back into holding when she was brought in for her mid-day feeding. This daily contact did not appear to disturb her. She finally had to be separated at feeding time so the pups could get some solid food; she was not good at sharing food with the pups, at least initially.

1995 litter: Breeding attempts were observed on March 30, 31. Breeding behavior was seen on April 12, 13, 18, 19, 28, 29, 30, and, May 1, 2, 3, & 4. This gives a total gestation of 355 days taken from the date of last observed breeding.

The female's mammae became distended and visible when viewed underwater about one month prior to parturition. The female gained weight but no weights were taken because it was stressful to her.

Her behavior prior to birth varied little from 1993. She spent more time in the nest box the last few days before parturition. Also, the day before the pups were born she became more aggressive towards the male with whom she had been exhibited all year. Her appetite stayed as voracious as ever. The male was introduced to the family without incident when the three male pups were about 93 days old.

N.A. river otter Pup Development - Table
John Ball Zoo

Day	Developmental Stage
Day 1	From the first day all pups were very vocal.
Day 31	Female put one pup into her water tub, briefly. The pup was very vocal, chirping the entire time.
Day 33	Eyes beginning to open. Holding den door to the exhibit open for part of the day (no other animals in the exhibit).
Day 40	Eyes open but not focusing.
Day 60	Eyes focusing.
Day 47	Female first took pups into the exhibit for their first swim
Day 62	Pups beginning to put heads under water when swimming. Playing some in the water.
Day 57	One pup observed licking at feline diet, another eating a piece of fish.
Day 73	Female separated at feeding time so pups can get some solid food.

N. A. River Otter Pup Weights – (Males /n = 6) Table
John Ball Zoo

Day	Weight	Day	Weight
Day 16	499 – 544gr.	Day 57	1.588 – 1.724kg.
Day 28	907 – 910gr.	Day 59	1.633 – 1.814kg.
Day 33	998 – 1.089kg.	Day 63	1.588 – 1.814kg.
Day 35	997 – 1.043kg.	Day 65	1.656 – 1.814kg.
Day 41	1.200 – 1.300kg.	Day 72	1.678 – 1.996kg.
Day 45	1.270 – 1.452kg.	Day 190	4.990 – 5.443kg.
Day 55	1.588 – 1.724kg.	Day 253	7.212kg.
Day 56	1.542 – 1.678kg.		

N. A. River Otter Pup Weights – (Females /n = 4) Table
John Ball Zoo

Day	Weight
Day 22	660 – 730gr.
Day 25	720 – 795gr.
Day 28	850 – 900gr.
Day 35	1.10 – 1.15kg.
Day 42	1.25 – 1.35kg.
Day 48	1.460 – 1.600kg.
Day 55	1.665 – 1.775kg.

Day 61	2.125 – 2.325kg.
Day 240	6.577 – 7.711kg.

Pseudo pregnancy: In 1996 a thirteen-month-old pup was videotaped attempting to breed his mother just before he was sent out to another facility. The adult male was never seen attempting to breed the female. In the spring of 1997 the female began putting on weight, spending time in her denning box and the on-exhibit holt, all normal pre-parturition behaviors or occurrences. This continued through April and May. During this time, no signs of abortion, parturition, or consumption of pups was noticed (night dens and on-exhibit holt was checked daily for blood or signs of fetal tissue). The female went well past her typical delivery time of late April then came into estrous in May. Some breeding attempts were observed beginning May 10th but actual breeding did not occur until 28, 29 May and 12, 13, and 23 June. It is believed that the female experienced a false pregnancy in 1997 due to the sterile breeding attempt by the sexually immature pup in 1996.

1998 litter: Two females were born after a total gestation of 334 days (calculated from last observed breeding). Both pups were sent out to the same facility when they were just a few days short of eight months old. At the time they weighed 17lbs (7.71 kg) and 14.5lbs (6.58 kg).

1999 estrous: For the first time during this estrous season a physical change was noticed in the female, her vulva became slightly pink and swollen. This has been reported by at least one other facility, Minnesota Zoo, and can be assumed to be a normal occurrence, just one that is difficult to observe. The pair was kept together year around in 1999 because it was decided we would not intentionally breed them again, but allow breeding to continue if the pair was interested. The male began to show interest in the female on 06 May but she rebuffed his interest by refusing to stand or go in the water, and, squabbling with him. On 11 May the female's vulva was observed to be pink and enlarged; breeding attempts were seen during the afternoon of the 11th and on the 12th. Successful breeding was observed on 13 May.

2000 litter: The female began to be slow about going outside in the morning on the 8th of April. The morning of the 12th she came out to eat and then went back into her nest box. Pup noises were heard when she was checked on at about 11am. There were no pups at 9am. Her appetite did not come back quickly with this litter the way it did with her litter in 1998. She also was very protective of this litter. She exhibited this protectiveness more with the last two litters than the first two.

Total gestation was 335 days.

After the first two litters, the female did not need to be separated from her pups during once they began eating solid food. For her last two litters she proved to be very good at sharing food with the pups and most frequently allowing them first access to food items.

Pre-partum signs for this female are: weight gain; distended teats; floating in the pool more frequently, often with the front legs resting on the shore; spending more time in the nest box or den; increased appetite (which decreases again 24 to 48 hours prior to parturition); and aggression towards the male.

Little Rock Zoo, Arkansas

1990 – 4 born/3 survived (21 Apr.)

1992 – 3 born/3 survived (09 Mar.)

1994 – 1 born/0 survived (20 Mar.)

Three exhibits allowed them to rotate animals as needed. “Our breeding pair of otters is only put together around the time the female is in estrous (March or April). The rest of the year the female is housed alone. We have 2.0 that are compatible so they are housed together the rest of the year. Our male and female otters are housed in adjoining exhibits. They can be given access to a den where they can see each other. We watch for the female to show interest in the male. When she does, we put them together. If no breeding is observed, they are separated at night. Once breeding is observed, they are left together for

several days until the female is no longer receptive. They are then separated. The female is housed alone until the following year when she delivers. We also have a young male that we have been housing with a female that has never reproduced. They are very compatible so they have been left together the past year. Now that the male is getting old enough to breed, we will be watching for signs of mating activity this spring.

“When our breeding female is in estrous, she starts to spend a lot of time watching the male through the screen door and pawing at the door. If she is not quite receptive when they are put together, she screams at the male, rolls on her back to prevent mounting, and runs to a safe place away from him. When she is receptive, both otters rub across the exhibit on their bellies, and she does not roll onto her back when the male approaches. Most of the observed breeding has been in the deep pool, and lasts for extended periods of time (up to 70 minutes). When the female is no longer in estrous, she will not tolerate the male being anywhere near her. She will scream and run aggressively towards him.” (Debbie Jackson, Sr. Animal Keeper, Little Rock Zoo)

A 36”W x 48”L x 19”H (91.44 cm x 121.92 cm x 48.26 cm) nest box, split by a solid divider, is provided. Access to both sides of the box is through 6” diameter PVC pipe.

Just prior to parturition the female spends more time in the nest box. She may not come out at her normal feeding time on the first day after birth but generally comes out to eat later that day. This female experienced total gestations of 367 days, 339 days, and 354 days.

The male is not introduced into the family group.

See pup weight chart under Pup Development.

Lowry Park Zoo, Florida

1994 – 3 born/3 survived (25 Dec.) – pups were 2.1 pulled for hand rearing. (Katie)

1995 – 3 born/3 survived (15 Jan.) – pups were 3.0 (Okie)

1995 – 4 born/3 survived (06 Dec.) – pups were 1.3 (Katie)

1997 – 5 born/4 survived (1 pulled for hand rearing) (19 Dec.) – pups were 4.1 (Katie)

1999 – 4 born/4 survived (06 Jan.) – pups were 3.1 (Okie)

1999 – 4 born/4 survived (15 Dec.) – pups were 1.3 (Katie)

N. A. River Otter Female Reproductive Record – Table				
Lowry Park Zoo				
Female's #	Breeding dates	Birth date	Total gestation*	# & sex of pups
100419	unknown	25 Dec. 1994		2.1
100419	01,06,07 Jan. 1995	06 Dec. 1995	333 days	1.3
100419	17 Nov. 1996 (attempt)	19 Dec. 1997	397 days – this is uncertain	4.1
100419	05, 07,10 Feb. 1999	15 Dec. 1999	309 days	1.3
100408	unknown	15 Jan. 1995		3.0
100408	19 & 21 Jan. 1998	06 Jan. 1999	350 days	3.1
100408	02, 03, 04 Feb. 2000			

* Total gestation calculated from last observed breeding.

They house 2.2 animals which are kept together most of the time (thus the sire's identity is uncertain). See Hand-rearing for additional pup information.

Valerie M. Burke, Assistant Curator, Florida Mammals provided the following over view of their pair management (personal communication, 2000):

“River otter breeding seems to occur in January and February, although there is noted aggression between the males starting in December. We feel that two males are healthy competition for breeding the females. We also feel that separating the female from the males helps stimulate breeding behavior. We do not feel that the female needs to be

separated for those three weeks that we separated Okie from Oscar and Elvis. We feel that a week will be sufficient. During that separation time there probably will be

continued aggression between the males. The intense breeding season will vary depending on the location of the facility or the environment of the enclosure. We are seeing that the breeding and births of our captive otters directly corresponds to otters in the wild. Our otters are outside on exhibit during the day and inside in a night house throughout the night (most of the time).

“After the female is separated from the males she is reintroduced to the subordinate male first, on exhibit. She will then remain with him for a few days to a week, after which time the dominant male will be reintroduced to the female and subordinate male. This will be done in the outside exhibit. We do not reintroduce otters in the night house any longer. We will separate the female from the males if they have been relentlessly breeding her all day or we will keep them outside in the exhibit together. The female will not be locked in with the males in the night house. The night house is so much smaller and does not allow the female enough room to get away from the males. There is quite a bit of aggression when breeding. Once the intense breeding aggression decreases the female can then have access to the males in the night house all night long.

“We used to lock a suspected pregnant female in the night house at the beginning of December until she either gave birth or we were confident she was not going to give birth. That protocol has changed. We will set up 2 dens for the pregnant female, one water den with a tub of dirt and one den with a den box (crate with the door removed), nesting material, floor mats and a heat lamp. The female will be allowed to go out into the exhibit if she would like to go, she probably will stay in the night house most of the time though. The pregnant female will be separated and locked in her 2 dens throughout the night. She will not be denied access to a pool any more. The males are given access to the pregnant female in the AM after feeding when shifted on exhibit; we noted extreme aggression towards the males from both females when they entered the pregnant female's dens.

“After the pups are born they are not allowed out in the exhibit until they can swim well. They seem to be able to swim well at about 8 – 10 weeks. We no longer retrofit the bottom of the night house pool to make it shallow. The pups can have access to a full pool. The pups are extremely buoyant. The depth of the water does not seem to be a problem. Pups will stay with their mother until they are at least 5 months old. After all the pups are separated from their mother, the female will be reintroduced to the group. The females will be reintroduced first, then the subordinate male and finally the dominant male. The reintroduction is done in the exhibit.”

N. A. River Otter Adult Weight - Table
Lowry Park Zoo

Date	1.0 #100262 Oscar	1.0 #100437 Elvis	0.1 #100419 Katie	0.1 #100408 Okie
15 Feb. 1995				23.2 lbs.
23 Feb. 1995	19.3 lbs.	18.7 lbs.	20.1 lbs.	
28 July 1995			24.0 lbs.	
29 July 1995	20.0 lbs.			18.0 lbs.
04 Aug. 1995		26.0 lbs.		
15 Oct. 1995			26.0 lbs.	21.0 lbs.
18 Nov. 1995			26.5 lbs.	22.0 lbs.
03 Dec. 1995			28.0 lbs. *	23.0 lbs.
24 Dec. 1995			25.5 lbs.	
31 Dec. 1995				23.0 lbs.
28 Jan. 1996				24.0 lbs.
01 April 1996			26.0 lbs.	23.0 lbs.
27 April 1996	20.5 lbs.	27.0 lbs.		
12 July 1996		30.0 lbs.		
28 Sep. 1996	23.5 lbs.	33.5 lbs.	24.0 lbs.	21.0 lbs.
10 Nov. 1996	22.5 lbs.	30.0 lbs.	24.5 lbs.	20.0 lbs.
12 Dec. 1996		28.0 lbs.	26.5 lbs. *	24.5 lbs.
17 Jan. 1997	26.0 lbs.	24.0 lbs.	29.0 lbs.	27.0 lbs.
04 April 1997	20.0 lbs.	22.5 lbs.	23.5 lbs.	22.0 lbs.
13 Nov. 1997	20.0 lbs.	23.5 lbs.	21.5 lbs.	21.0 lbs.
28 Nov. 1997	28.0 lbs.	25.0 lbs.	26.5 lbs.	23.0 lbs.
18 Mar. 1998	19.4 lbs.	22.0 lbs.	22.7 lbs.	18.0 lbs.
17 Oct. 1999		26.0 lbs.		19.0 lbs.
13 Nov. 1999	22.0 lbs.	24.5 lbs.	24.0 lbs.	18.5 lbs.
27 Nov. 1999			25.5 lbs.	
08 Dec. 1999			27.0 lbs. *	
02 Feb. 2000	22.0 lbs.	21.5 lbs.		
06 Feb. 2000	22.0 lbs.	20.0 lbs.	28.0 lbs.	
19 Mar. 2000	21.5 lbs.	23.0 lbs.	25.0 lbs.	
22 April 2000	20.0 lbs.	22.0 lbs.	23.0 lbs.	19.0 lbs.

* Female gave birth after this weigh date and before the next weight was taken.

Memphis Zoo, Tennessee

1965 – 1 born/0 survived (13 Mar.)

1983 – 3 born/0 survived (17 Mar.)

No records are available for the 1965 birth. In 1983 the pair was kept together year around. Just prior to parturition the female moved into the nest box and became very aggressive. The nest box was concrete, 24" x 36" (60.96 cm x 91.44 cm) and very tall (no top). There are no records of what, if anything was done with the male. The female's nipples became distended and noticeable prior to parturition. The pups apparently died due to maternal neglect. No additional information is available.

Mesker Park Zoo, Indiana

1983 – 4 born/3 survived (11 Feb.)

The female was believed to be pregnant on arrival. Although the male who came in with her is listed as the sire, it is not known for sure as both animals were wild caught.

The pair was kept together at all times and a nest box was always available. Just prior to parturition, the female retreated to the nest box and stayed there. The male was not removed from the exhibit however, the female kept him well away from the nest box until the pups were ready to come out.

The dam ate the pup that did not survive.

Metro Toronto Zoo, Canada

1982 – 1 born/0 survived (19 Nov.)

1984 – 2 born/1 survived (06 Apr.)

Same dam and sire for both litters. The pair was kept together year around. A nest box was available at all times. The entire box measured 24"W x 36"L x 18"H (60.96cm x 91.44 cm x 45.72 cm) however, it was divided into a vestibule measuring 12" x 24" x 18" (30.48 cm x 60.96 cm x 45.72 cm) and a privacy chamber measuring 24" x 24" x 18" (60.96 cm x 60.96 cm x 45.72 cm).

The female was very aggressive towards the male shortly before giving birth and for two weeks after. She stayed in the nest box whenever people were present. No physical changes were observed prior to parturition. When she was ready, the female introduced the pup to the male.

Milwaukee County Zoological Garden, Wisconsin

1969 – 3 born/0 survived (12 Mar.)

No additional information available.

Minnesota Zoo, Minnesota

1986 – 3 born/3 survived (05 Apr.)

1987 – 3 born/2 survived (10 Apr.)

3 born/3 survived (07 Apr.)

1988 – 3 born/3 survived (30 Apr.)

1989 – 3 born/3 survived (04 Apr.)

1 born/1 survived (20 Mar.)

1990 – 1 born/1 survived (26 Mar.)

Litter's Dam and Sire:

Dam #2113, Sire #0073: 1986 (3b/3s)	Dam #2113, Sire #2079: 1988 (3b/3s)
1987 (3b/3s)	Dam #2113, Sire #5537: 1989 (3b/3s)
Dam #0075, Sire #2079: 1987 (3b/3s)	Dam #0075, Sire #4768: 1989 (1b/1s)
	1990 (1b/1s)

(One of Minnesota's breeding females was sent to Little Rock in 1990 where she gave birth to several more litters, unfortunately, the other one died after successfully raising her 1990 pup. In the intervening years the Minnesota Zoo has found it difficult to find a breeding female, in 1999 two females were brought in from England.)

"Breeding pairs are always separated, usually all year except for breeding. At times, some pairs have been together until January. On at least one occasion a female was left with a male until shortly before parturition, but this was her male offspring from a previous litter to whom she was not introduced for breeding, i.e. our separation is for at least 2 – 3 months for animals which are going to be introduced for breeding.

"Open females are introduced to a male every 2 – 3 days beginning in mid-March, unless signs of estrus are noted earlier. Pairs are mixed only briefly until there are positive indications, and then intros are extended. When definite breeding occurs, the pair is left together all day unless we have reason to do otherwise (e.g. injury).

"The last few weeks before birth females become intolerant of other animals. They tend to spend more time swimming, probably for comfort. Some animals spend more time in the nest box and are reluctant to go on exhibit, especially the last few days. Typically, the female will not eat the afternoon prior to birth.

"Post-partum estrus has been obvious in our experience. A dramatic behavior change occurs. The female, who has spent 10 – 14 days secluded with her litter in the nest boxes, suddenly is active; moving around the cage frequently and often scratches at the shift doors to the exhibit or the males' cage. Her reaction to a male provides conclusive evidence."

No pregnancy associated pelage changes have been noted but abdominal distension has always been noted and usually mammary development. Generally, a female's diet is increased 10 – 20% for the last trimester of her pregnancy. No dietary supplements are added pre-parturition or during lactation however, "...the increase in the fish portion of the diet generally precedes the proportional increase of the rest of the diet."

A second nest box is added during the winter prior to parturition.

Pregnant females show a weight gain in the last 60 days pre-partum that cannot be explained by diet increases. During the course of five pregnancies, two females showed the following weight gains: 1.1kg, 1.2kg, 2.3kg, 1.2kg, and 3.1kg (2.43lb, 2.65lb, 5.07lb, 2.65lb, 6.83lb). Total gestations have ranged from 361 days, 356 days, 351 days, to 324 days for one female to 313 days and 314 days for their other female.

Average N. A. river otter Pup Weights - Table

Minnesota Zoo (from five litters, 8.7 animals)

Day	Weight	Day	Weight
Day 7	345g.	Day 35	1.234kg.
Day 14	477 & 528g.	Day 42	1.537kg.
Day 21	698 & 756g.	Day 48	1.771kg.
Day 28	892, 772, & 983g.		

New England Science Center, Massachusetts**1993** – 2 born/2 survived (end of March, estimate)

There are no seasonal variations in management of the pair; they are kept together year around. However, they were separated on 30 March 1992 because breeding had become so aggressive. They remained separated until after the pups had been sent to another facility at 6 months of age. The pair was reintroduced in May of 1994 at which time there was a lot of breeding activity. Currently they are housed together.

The female essentially disappeared for the month prior to parturition. She selected to burrow under the nest box provided and only emerged to eat when people were not present. They confirmed the presence of pups just before they opened their eyes so the birth date is an estimate. She also became more aggressive toward the keeper staff and her appetite was less.

The nest box provided measures 36"W x 48"L x 24"H (91.44 cm x 121.92 cm x 60.96 cm)

Sacramento Zoo, California**1993** – 2 born/2 survived (20 Mar.)

The pair was kept together until the day of birth. The male was separated at this time due to the female's aggressiveness towards him. He was never put back in while the pups were there. The exhibit includes a 5' x 3' (1.52 m x .914 m) den so an additional nest box was not put in.

Prior to parturition, the female increased her nest building activities; pulling pine needles, sticks and leaves into the den. Her mammary glands did not show until the day of birth. After giving birth, she was very aggressive towards the male and any keepers that approached the den. She would not leave the den completely for feeding until ten days after birth.

The female was implanted after the birth of this litter (an MGA implant was used).

St. Louis Zoo, Missouri**1991** – 4 born/ 4 survived (01 Feb.)**1993** – 5 born/ 5 survived (17 Mar.)**1995** – 5 born/ 5 survived (22 Mar.)**1999** – 4 born/ 4 survived (21 Mar.)

The same dam and sire for both litters. The male is separated from the female at the end of December or beginning of January. If the female gives birth he is not reintroduced until the pups are removed.

“The female has access to two portable wooden den boxes throughout the year. She also uses a burrow that she dug in the soil near her pool. All three of these dens are used by the female when she is raising pups. She becomes more vocal to keepers and spends ore time in the den boxes or in different spots in the yard that she normally does not occupy. Also, her feeding habits change prior to birth and after giving birth. Instead of coming to both feedings daily, she comes to only one feeding or refuses to come out to feed.” (Steve Bircher, Assistant Curator of Mammals – St. Louis Zoo)

The change in her feeding behavior is reported as being sporadic both before and after parturition, usually starting one to two months before and continuing one to two months after.

The nest boxes provided are 24”W x 36”L (60.96cm 91.44 cm) with an 8” (20.32 cm) entrance made of ¾” (1.9 cm) plywood painted with brown latex paint.

1999 St. Louis Litter – This litter was born to one of the 1995 pups, sired by a new non-related male. The dam of the ’95 pup was left in the yard. Details, contributed by Steve Bircher, are as follows:

Otter Exhibit (Maternity Yard) Individual IDs:

- (1) Male "Hercules" - ISIS# 971094, captive born 4/4/89, acquired on 10/22/97 from Minn. Zoo (parent reared)
- (2) Female "Louise" - ISIS# 090106, wild born ~87, Louisiana, acquired on 11/8/90 from Sevin (mother reared in wild)
- (3) Female "Scamper" - ISIS# 950325, captive born 3/22/95, St. Louis Zoo (parent reared by Louise in her third litter born at our zoo)

Sequence of events leading up to and after the birth which occurred on 3/21/99:

12/97 - Hercules introduced to Louise & Scamper in maternity yard.

3/21-28/98 - Observed Hercules mounting and/or breeding Scamper.

4/2-11/98 - Observed Hercules mounting and/or breeding Louise.

12/8/98 - Removed Hercules from the females' yard and placed him in a yard at the Small Mammal Pits (SMP).

3/5/99 - Louise & Scamper discontinued sharing the same underground den. Their yard has three dens; 2 wooden den boxes & 1 underground (tree) den. Scamper is still using the underground den, but Louise has moved into one of the wooden den boxes above ground near the visitor bridge.

3/21/99 - Scamper gave birth to 3.1 pups. She did not come out of her den for either of the two feedings today. Louise continues to show up normally at both feedings and is eating well.

3/29/99 - Scamper came out of the den to eat for the first time since her pups were born. Scamper & Louise fed on opposite sides of the yard.

3/30/99 - Observed Scamper swimming in the pool for the first time since her pups were born. Scamper & Louise continue to feed on opposite sides of the yard.

5/13/99 - Observed Scamper carrying leaves & limbs into her den before feeding.

5/15/99 - Observed a single pup out of the den for the first time with both Scamper & Louise in the yard. No aggression observed between the adult females.

5/19/99 - Observed all four otter pups out of the den for the first time.

5/20/99 - Observed Louise grab one of Scamper's pups with her mouth and begin circling & playing with it in the pool. Louise appeared to be showing some maternal interest in the pup. No aggression observed between the adult females, however, after an approximate 10 minute "play" period, Scamper grabbed her pup (which appeared exhausted) from Louise, and took it back into the den. The other three pups, which were also out in the yard, followed Scamper back into the den. Louise stuck her head in Scamper's den several times but retreated when Scamper confronted her with threatening vocalizations.

5/21/99 - Observed Louise playing with a pup in the pool. After several minutes Scamper removed the pup from Louise, using her mouth, and took it back into the den. Several minutes later Scamper came out of her den by herself and began playing with Louise.

5/22/99 - Observed Louise playing a little rough with the pups in the pool, but Scamper intervened without any apparent aggression or vocalizations, and Louise moved away from the pups.

5/23/99 - Observed one of the pups eating a piece of herring for the first time.

5/24/99 - Observed three pups eating feline diet for the first time; the fourth pup ate a piece of herring.

5/28/99 - Scamper moved her pups out of the tree den at 1:30 PM into one of the wooden den boxes under the visitor bridge. At 4:30 PM the pups went back into the tree den.

5/29/99 - Scamper and pups came out of the wooden den box at morning feeding. Louise is now using the tree den. Scamper appears more comfortable & tolerant of Louise when she shows interest in the pups. All were observed playing together on land and in the pool.

1/23/00 - 3.0 pups were removed from the maternity yard and introduced to Hercules in his yard at the SMP; kept 0.1 pup with Louise & Scamper in maternity yard.

2/8/00 - 0.1 pup was removed from the maternity yard & sent to another facility.

Seneca Park Zoo, New York

All of the animals are housed together unless the females become stressed from incessant breeding activity. In this case, they still have visual and olfactory contact when separated. If a female's behavior indicates impending parturition, i.e. increased nesting activity, she would be given sole access to the holding areas with nest boxes. Again, visual and olfactory contact with the rest of the group would be maintained.

One of their females experienced a false pregnancy in the spring of 1994. She exhibited nesting behavior, digging a den on exhibit and moving straw from one nest box to the other. Once she had selected a next box she vigorously defended it from the other three animals. *"The female had obvious mammary development with the teats being more visible."* However, a routine radiograph determined that it was a false pregnancy.

Sunset Zoo, Kansas

1983 – 3 born/ 2 survived (07 Apr.)

1985 – 4 born/ 4 survived (11 Mar.)

Same sire, different dams for these litters. The animals were housed together and only separated occasionally due to aggression by the female. The female exhibited increased aggression towards the male just prior to parturition but, it did not become necessary to remove him. Two or three more nest boxes were added to provide the female with a choice.

Texas State Aquarium, Florida

1991 – 3 born/ 3 survived (? Jan.)

1994 – 2 born/ 2 survived (01 Jan.)

Same dam, different sires for these two litters. The female and the sire of the 1991 litter produced two litters, in 1985 and 1987, at a previous facility. The sire of the 1994 litter is the dam's pup from the 1987 litter. The pair was housed together year around with a female pup from the 1991 litter. When the female (Julie) gave birth in 1994, the other two animals were not removed from the exhibit; Julie did a fine job of keeping them away from the nest box for as long as she wanted. When it came time to teach the pups how to swim, all three adult animals participated. They did see a lot of post-partum breeding activity roughly one to two weeks after birth. However, she did not produce pups in 1995.

Turtle Back Zoo, New Jersey

1968 – 2 Born/2 survived (17 Jan)

1972 – 3 born/ 3 survived (05 Feb.)

1974 – 2 born/ 2 survived (25 Jan.)

The female came in pregnant in 1968, so the sire for that litter is unknown. She produced the subsequent two litters with the same sire. To their knowledge, the animals were never separated.

Virginia Living Museum, Virginia

1992 – 2 born/ 2 survived (14 Mar.)

1994 – 2 born/ 1 survived (04 Mar.)

The pair was housed together; separated only at the birth of pups.

Same dam, different sires for both litters. The male was not introduced to the first litter. In 1994 the male was separated from the female when she gave birth, then introduced to the pup when it was swimming well at about three months of age. Prior to reintroduction, the male was allowed into a squeeze cage which provided visual and olfactory access to the female. There was no aggression between the two during this phase. After 24 hours, the male was given access to the exhibit alone for several hours to allow him to get reacquainted with the terrain. The female and pup were then released into the exhibit. There was a great deal of aggression on the females part for the first 24 hours. This gradually diminished over the next 48 hours until on day three the male and female were lying next to each other. The male first tentatively approached the pup on the third day. After a few days he was observed playing with and grooming the pup. his interactions with this young female pup were always very gentle.

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CHAPTER 7

CAPTIVE MANAGEMENT

*“Otters in general are most attractive exhibits in the zoological garden, their antics in the water being especially engaging. The races of **L. canadensis** and **L. lutra** are best suited for northern institutions, since their hardiness permits them to be shown in permanent outdoor installations. The first essential is a pool of fresh, clean water, deep and long enough for swimming, diving, and play. Moderately running water is certainly preferable, if not actually essential. There should also be sufficient land area to allow reasonable space for the explorations in which the otter seems to delight. For, while we tend to think of the otter in terms of water, the animal really spends much more time out of that element than in it. A dry, clean shelter, well packed with clean straw, will complete the requirements, at least as far as the welfare of the otters is concerned.”*

(Crandall 1964)

The basic requirements for a river otter exhibit have been understood for a long time, at least since Crandall was writing in 1964. However, zoological institutions were not always cognizant of what Crandall had to say, as a result many old river otter exhibits were poorly designed and did not address the species behavioral or physiological needs. Additionally, in the past the zoological community had a tendency to think: small mammal – small exhibit. Wallach & Boever (1983) gave minimum dimensions for otter (species not specified, figures taken from the AZA Animal Health Committee) as 10.98 m² floor space for one animal and 12.80 square meters floor space for two animals; minimum height is given as 1.22 meters. More recently the AZA publication, Minimum Exhibit Requirements (1997) gives 231 ft² as a minimum requirement for two animals with additional space ‘probably needed’ for breeding pairs.

After looking at 25 zoos and observing more than 100 otters, Duplaix-Hall (1975) concluded that the lack of breeding success could be linked to three factors: “...*the enclosure, the diet, and the otters themselves.*” Duplaix-Hall believed that most often, the lack of success was due to one of the first two, inadequate enclosures and/or poor diet.

There have been significant improvements in our captive management of river otters since this time however, U.S. and Canadian zoos have only recently experienced anything more than hit and miss breeding. The reasons for this appear to have been: inadequate enclosure and den design; poor diet; insufficient numbers of animals to allow for mate selection; a lack of the resources needed to implement an appropriate breeding arrangement protocol, and, a lack of interest in breeding this species.

Understandably, it is not possible, or desirable, for every institution housing river otters to breed them. However, it is advisable that the otters are housed and cared for in a manner that does not preclude breeding if it becomes a desired goal. Proper diet, adequate enclosure facilities, and good management practices are important to the health and well-being of otters.

Now that this species has been designated a Population Management Species (PMP) by the American Association of Zoological Parks and Aquariums (AZA) Small Carnivore Taxonomic Advisory Group (SCTAG) and a Studbook Keeper has been appointed, the overall management of this species should take on a more cooperative character. All non-AZA facilities are encouraged to participate in the N. A. River Otter Studbook program and can do so by contacting David Hamilton at the Knoxville Zoo – see Useful Websites for his address, phone, and email address.

HOUSING AND ENCLOSURE REQUIREMENTS

Minimum Size

Duplaix-Hall (1975) recommended a minimum enclosure size of 15 x 10 meters, or 150 m² (1614 ft²). Reuther (1989) requires a minimum exhibit size of 100 m² (1076 ft²) for *L. lutra* (Eurasian otter) that are sent on “loan contract” from the Otter Zentrum in Hankensbüttel, Germany. After visiting over 50 otter exhibits worldwide I agree with Duplaix’s recommendation of a minimum of 150 square meters. Having said this, I will add that I have seen exhibits smaller than this that offer the otters a highly varied and enriched environment. These include Columbus Zoo and Central Park Wildlife Conservation Center; both of these facilities offer good quality land space, bushes and trees for shade, soil and natural vegetation for digging and rooting around in, and streams that run through the land area. However, it is suggested that all new exhibits be designed with a minimum of 150 square meters of useable land/water surface.

Although there is no definitive way to establish a species’ minimum spatial requirements, the river otter is an active animal, adapted to traveling long distances, and curious by nature. For these reasons, otters are best kept in environmentally complex exhibits where they can be offered a variety of behavioral choices to include: a long water/land interface for exploration and object manipulation; a variety of substrates and vegetation; resting sites; holts or denning sites; pools; logs or other high spots for grooming and as sprinting spots. It is possible to provide these options, to a limited extent, in exhibits smaller than 150 square meters but these exhibits will prove difficult to maintain and enrich over time. Inquisitive animals will quickly become overly familiar with small, un-enriched environments; the result of this familiarity is generally, excessive sleeping, or, stereotypic behaviors such as rotational swimming, pacing, and self-directed aberrant behaviors. Although a larger exhibit does not guarantee these behaviors will not occur, it does provide the animal with more behavioral options, room for exhibit-mates to interact or not-interact, and offers the management team greater enrichment and education choices.

Land/Water Ratio and Interface

In 1975 Duplaix-Hall set down guidelines that are frequently cited as the desired standard. These guidelines were based on an assessment of the river otter exhibits she had seen, a historical literature review, field experience with some otter species, and gut instinct (pers. com.). Her recommendations were an exhibit size as listed above, a land to water ratio of 4:1, a turf to shrub ratio of 2:3, and a containment barrier at least 1.80 meters (6 ft) high with an 80cm (2.6 ft) smooth overhang. These guidelines are still considered valid today. A land to water ratio of 3:1 also is acceptable.

The land to water ratio is critical because the river otter actually spends more time out of the water than in the water. Dry, land area is important because this is where the animals groom, sleep, rest, play, and eat their food. Swimming pools are important because this is where otters play, hunt for food, most frequently breed, sometimes defecate, and, where our visitors expect to see them.

In recent years, Claus Reuther of Otter Zentrum in Hankensbüttel, Germany has talked of the importance of the bank length, or land/water interface (1989). He determined that the Eurasian otter actually spends most of its time in the area where the water meets the dry surface.

“Looking at the space using behaviour of the Eurasian Otter in captivity it has to be realized that the length of the banks seems to be more important than the water-land-ratio. More than 60% of the total activity happens in an area of 1.5 – 2.0 meters (5 ft – 6 ½ ft) left and right of the water-line.” (Reuther 1989)

For the last two years the author has observed the same phenomenon in the N. A. river otter. This is not to say that river otters are not utilizing their pools, just that attention should be paid to bank length and

complexity. Many exhibits, large and small, can be enhanced by the placement of logs, branches, rock outcroppings, mud banks, etc. sticking out into pools.

North American River Otter – Exhibit Size and Land to Water Ratio A Sampling from 1994 - Table					
Size in Ft. ²	Size in M ²	Land/Water Ratio	% Land	% Water	Animals Exhibited
3,900	363.32	7 to 1	87%	13%	2.2
4,500	418	1.5 to 1	58%	42%	2.2
1,350	125.5	5 to 1	82%	18%	1.2
806	75	1 to 1	57%	43%	1.1
560	52	4 to 1	80%	20%	2.1
1,200	111.5	3 to 1	73%	27%	1.1
1,800	167.25	3 to 1	76%	24%	2.1
2,000	186	12 to 1	92%	08%	1.1
375	35	1 to 1	50%	50%	1.1
423	39.25	?	?	?	1.1
420	39	2 to 1	68%	32%	1.1
450	42	3 to 1	76%	24%	2.0
2,695	250.25	?	?	?	1.1
16,384	1522	3 to 1	73%	27%	0.1
540	50	?	?	?	1.1
525	48.75	2 to 1	69%	31%	1.1
1,443	134	1 to 1	50%	50%	2.2
653	60.5	1 to 1	58%	42%	2.2
855	79.5	1 to 1	50%	50%	3.2
224	20.75	0 to 1	20%	80%	0.1
3,600	334.5	1 to 1	60%	40%	1.1
400	37	0.3 to 1	25%	75%	2.1
1,650	153.25	3 to 1	76%	24%	1.1*
700	65	2 to 1	60%	40%	1.1
840	78	2 to 1	70%	30%	1.1
600	55.75	2 to 1	65%	35%	1.1

* This exhibit as had as many as 4.1 which includes pups.

Containment Barriers

Otters are diggers and are known to climb, therefore sinking perimeter fences/walls at least 2.6 feet (80 cm) into the ground is advisable and containment walls should be unclimbable and at least six feet (180 cm) high (temperate facilities need to take into account snow levels). If the containment barrier is chain-link fencing, it should be topped with an unclimbable overhang. (Foster-Turley 1990, Reuther 1989, Duplaix-Hall 1975) Hot wire can be used effectively but caution should be taken to ensure that animals cannot reach the hot wire from the water.

Studies conducted on *L. lutra* at Otter Zentrum (Reuther 1989) showed that the Eurasian otter can “...jump well leaping a distance of 130cm (4.27 ft) in height when jumping from the ground to a platform, 160 cm (5.25 ft) in width when jumping from one platform to another and 90 cm (3 ft) in height when jumping out of the water on to a platform if there is a possibility to push off from the bottom.”

There are numerous reports of climbing otters; personally, I know of several. We should not be trying to completely prevent them from climbing, just controlling what and where. Placement of trees and the design of solid surface containment walls (gunite, rock, etc.) should be considered carefully.

Dens/holts

There should be a one to one ratio of dens to animals. Dens should be large enough for an adult animal to turn around and curl up in comfortably.

Denning areas and/or nest boxes are important and can be made from PVC tubes, plywood, cement blocks or more natural materials such as hollow logs and 'constructed' log jams (make sure the logs are secure and will not collapse onto the animals).

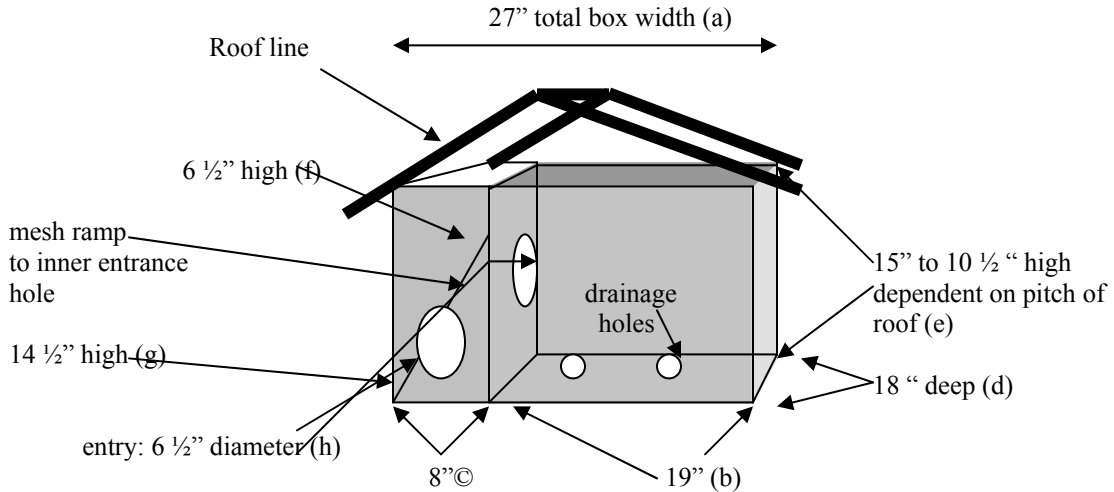
Suggested dimensions include: 30" x 30" x 17" (.76 m x .76 m x .43m) (Wallach & Boever 1983 citing AAZPA[AZA] Animal health Committee)

75 cm x 75 cm x 50 cm with a 22 cm entrance (2.46 ft x 2.46 ft x 1.64 ft, entrance is 8.66 in) (Duplaix-Hall 1975)

Sample Nest Boxes

John Ball Zoo Nest Box

This nest box is used off exhibit in the night quarters, especially for the female when she is due to give birth. The rest of the year this box is alternated with an air kennel and a 30" (76.2 cm) diameter heavy-rubber tub with, or without, a lid constructed out of the end portion of a soft drink barrel.



(a) 68.58 cm (b) 48.26 cm (c) 20.32 cm (d) 45.72 cm (e) 38 cm to 26.67 cm
 (f) 16.5 cm (g) 36.83 cm (h) 16.5 cm

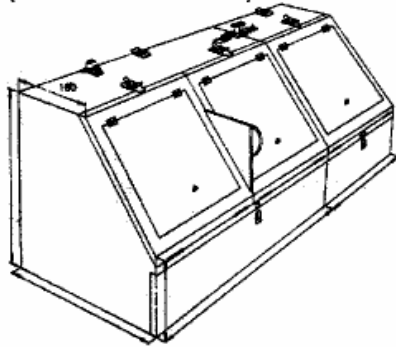
(Pictured below with the top up. The top is hinged on one side and held with a hasp on the other side.)



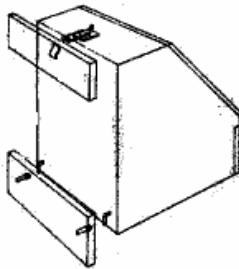
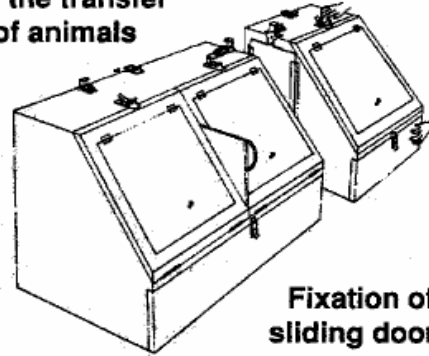
Sleeping-boxes for Eurasian Otters

Type AKTION
FISCHOTTERSCHUTZ

Closed position
(all measurements in mm)



**Removable section
for the transfer
of animals**



**Hanging and
removable
fixation
on the wall**

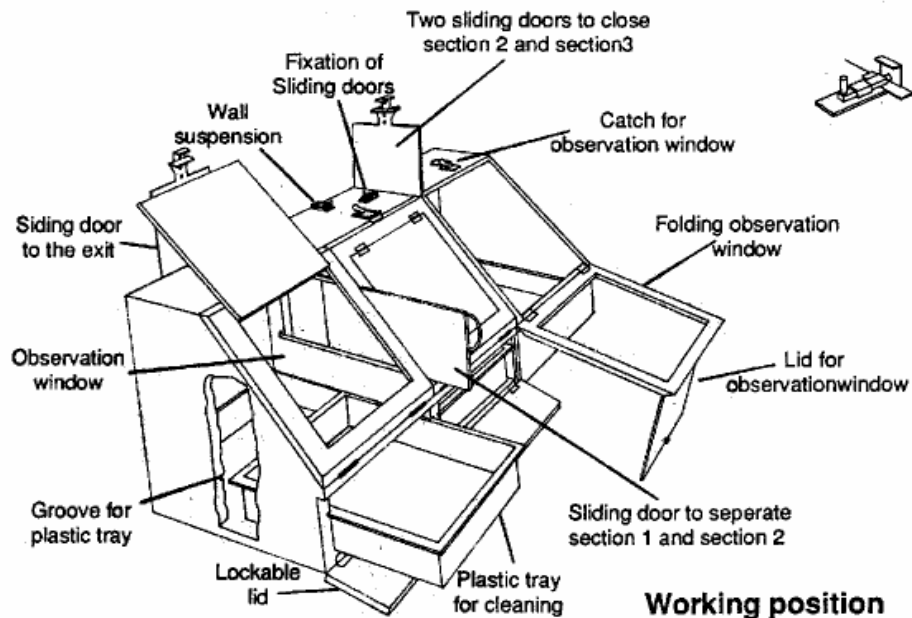
**Fixation of
sliding doors**



Slide door
closed



Slide door
open

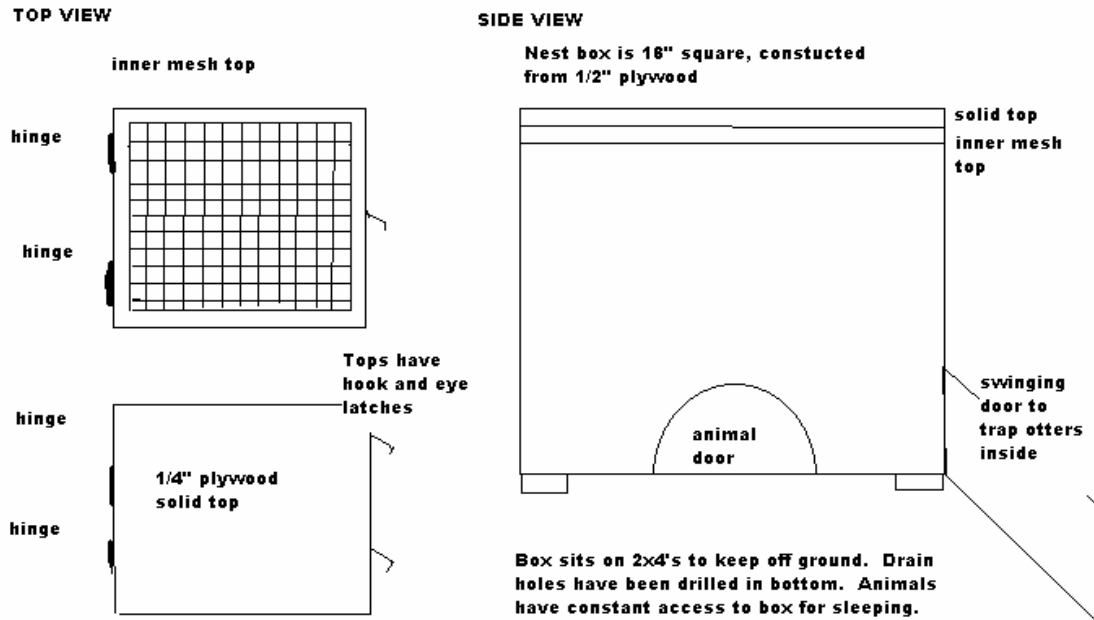


Working position

Sleeping-boxes for Eurasian Otters, Type AKTION FISCHOTTERSCHUTZ.

Stone Mountain Zoo Nest Box

Contributed by: Sandy Elliot, Lead Keeper. Nest box design, allows animals to be locked in and moved.



Off-exhibit Holding

Night holding facilities may be used as an alternative to on-exhibit dens, if, the exhibit has sufficient hiding places to provide the animals with a sense of security and shelter.

If at all possible, it is preferably that animals be given access to holding at night but not locked in. Some facilities require that all animals be secured in holding at night. In these cases it is advisable that the animals be given access to: a nest box or sleeping area per individual (otters most frequently choose to sleep together but provisions must be made for social dynamics); pool; fresh drinking water separate from the swimming pool; dry bedding, and rotating furnishings and/or institution approved enrichment items.

Off-exhibit holding varies greatly in size based on its intended use. Whenever possible design off-exhibit holding that is satisfactory for at least short term maintenance of sick or new individuals, or animals separated for other management reasons.

Bedding Material

It is advisable to provide some kind of bedding material on, and off, exhibit year around, particularly when the exhibit substrate is gunite, concrete or something similar. The roughness of these surfaces can be tough on foot pads in the absence of material for the otters to dry off on. Straw, wood-wool, hay, grass, sedges, pine needles, and leaves have all been used. Bret Sellers of Oregon Zoo has a caution regarding the use of conifer shavings such as pine or fir; he says that these stripped their otters' coats of their water repellency due to the natural turpentine found in these products. His advice is to use Beta chips made from autoclaved maple and alder chips if wood shavings are the bedding material you choose. (per. com.)

Hiding Places

Areas where the otters can feel protected are important as resting places. These can be depressions near logs, hollow stumps, bushes, solid walls away from viewing areas, etc. When designing exhibits keep this in mind. A well designed space should offer a sleeping area that will attract the otters, yet leave them at least in view of the public. As previously mentioned, this can be achieved by creating a depression with some sort of shade covering and providing bedding. A word of caution, otters like to build beds, they will haul material from one spot to another which may drop into the pools. The best way to counteract this is to design a bedding location back far enough from the water so that it is not an issue, or keep a good long-handled skimmer on hand!

Shade

It is important to provide shaded area for animals exhibited outside.

Drainage

Proper drainage is very important. There should be enough dry area in the exhibit to allow all animals room for rubbing and drying their coats. Inside holding facilities should be provided with dry areas as well as built in pools or water tubs for swimming.

Substrate/Topography

Land to water ratio should be around 4:1 to 3:1. This, unfortunately is seldom the case. The majority of facilities have a land to water ratio of 60%:40% or 50%:50%; older facilities may even be weighted the other way. This is because for so long river otters were regarded as aquatic mammals instead of semi-aquatic or amphibious. It is preferable to provide a variety of substrates in the exhibit area. If an exhibit is all concrete the animals will not have a suitable surface for adequate coat maintenance. Otters are diggers – while this should be kept in mind, and exhibits designed so animals cannot dig out, natural substrates in which the animals can dig aids in coat care and provides natural behavioral opportunities. Duplaix-Hall (1975) cautions against the use of sand, unless it is of a non-abrasive quality. In particular, builder's sharp sand is dangerous because it can wear away the otter's guard hairs. It is recommended that as far as possible different substrates should be made available, to include: soil, sand, gravel, rocks, mulch, leaves, pine needles, grass, river rock, etc.

Special Furnishings

In addition to a pool, preferably of varying depths, logs, rocks, grass, bushes, bedding choices and a variety of substrates are all important to the maintenance of healthy otters. These items not only provide stimulation by provoking investigatory behavior, but they are important to the maintenance of a healthy coat. Water falls, shallow streambeds, periodic flooding of shore lines, underwater entrances to holts, log jams, stumps, complex root systems and structures all add variety and environmental enrichment.

Water Source/Treatment

Fresh drinking water should always be available. Drinking containers should be cleaned daily and disinfected at least every other day.

Pool, or swimming, water should at least be monitored for chlorine level. Many facilities also monitor PH level and some monitor Coliform levels. Water may be changed daily or re-circulated through some sort of filtration system. What is important is the maintenance of potential disease causing vectors at concentrations below health hazard levels. Vacuuming of outdoor, re-circulating pools can be very effective at keeping algae growth and debris under control, but it is time consuming.

What sort of water treatment system is the most effective, and safe for the animals is still subject to some debate. In general, it is this author's opinion that every method available carries with it some risk: natural flowing streams may carry pathogens or pollutants; ozone systems may be set, or designed improperly; chlorinated systems are now fairly widely accepted as detrimental to the animals' health and the water repellency of their coats; dump and fill systems are potentially expensive and may be utilizing chlorinated municipal water; filtration systems using chlorine free water may not do as good a job at keeping the water clear for underwater viewing. And then, there is cost. Whatever the solution chosen by your facility, please keep all of the information provided in this chapter in mind.

At this time, the safest, and most effective systems appear to be properly designed ozone systems, de-chlorinated dump and fill, or de-chlorinated filter systems using a secondary filter medium for algae control.

Algae Control and Underwater Viewing

Underwater viewing offers a unique look at this semi-aquatic animal. Problems presented include keeping the water clear enough for viewing, and algae growth. The 1st edition of the husbandry manual suggested the use of chlorine, maintained at .05ppm or less, as a means of controlling algae. Further research has uncovered concerns about the use of chlorine as an algaecide due to its potential impact on the otters' coat quality and its role as a possible carcinogen (see Chlorine). Unfortunately, some of us are still restricted to the use of chlorine. If this is the case, these precautions should be taken: 1) Chlorine should be added only when the animals are not in the pool. 2) Animals should not be allowed back into the exhibit until the chlorine level is lower than .05ppm – this level is ARBITRARY, future research may reveal this to be too high, or it may be safe at slightly higher levels. The best policy is to monitor your otters coats' water repellency quality closely. 3) Research alternate methods of algae control that will work in your institution. 4) The addition of Sodium Thiosulfate will neutralize the chlorine.

Note: Boness (1996) raises questions regarding the effectiveness of using chlorine as a disinfectant if the breakpoint chlorination approach is not used. To use this approach effectively in a pool where ammonia may be continuously added via animal urines it is necessary to continuously monitor chlorine levels.

“Breakpoint chlorination is generally believed to be the most effective technique of chlorine disinfection. When chlorine is first added to a system, it reacts with ammonia and nitrogenous waste to form combined chlorines. With time and increased chlorination, the ammonia levels decline, so that the addition of more chlorine results in the formation of a free chlorine residual. The point at which the combined chlorine residual is at a low is called the breakpoint. Breakpoint curves are unique to each water system because they are dependent on the initial concentrations of nitrogenous material and other oxidizable substances in the water.

Breakpoint chlorination is possible in an aquatic mammal facility, but, because ammonia is added continuously via the animals' waste products and because the animals are in the water all the time, careful monitoring of chlorine levels is required to stay beyond the breakpoint once it is achieved. The relatively high chlorine residuals that might be required to stay at breakpoint should not be a problem because free chlorine appears not to be toxic, but if breakpoint is lost and these high residuals become mainly combined

chlorine, one has a serious problem. Depending on the concentration of nitrogenous material added to the pool on a daily basis (a direct function of the number of animals in the pool), whether or not there are precursors of trihalomethanes present, and the bacterial load of the system, it may be more feasible in an aquatic mammal exhibit just to use a low level of combined chlorines to keep bacteria levels down.

Chlorine should always be administered to the pool through a high-quality injection system. Manually adding any type of chlorine is unsafe and does not properly distribute the chemical in the pool....Because of the known and probably negative effects of chlorine on animal health, alternatives should be considered.”

Chlorine

“Chlorine is a very active oxidizing agent, and it readily reacts with ammonia and other nitrogenous materials to form chloramines, or combined chlorines.

“Free chlorines are much more effective disinfectants than combined chlorines....Combined chlorines are more toxic than free chlorines, but free chlorines used in the presence of humic and fulvic acid or some algae can produce carcinogenic trihalomethanes. And, even though chlorine is a good bactericide, many protozoans, yeasts, cysts, and viruses are resistant to it.” (Boness 1996)

There is a great deal of debate over the use of chlorine as an algaecide. However, after completing my own, simple water tests and observations, questioning over 50 institutions worldwide and speaking with several water quality experts, I have come to the conclusion that chlorine levels of .5ppm are potentially harmful and levels above this have a definite impact on the water repellency of otters' coats. I have left a recommendation of .05ppm if chlorine is used or present in the water supply however, all facilities are strongly urged to explore other methods of algae control and water treatment.

Additionally, LaBonne (per. com.), Boness (1996), Oliver (1980), Briley et al. (1980) raise questions about the presence of Trihalomethane, a chlorinated organic compound and “...a volatile substance...” (LaBonne per. com.) that is a known carcinogen in aquatic mammal pools. “*The concentration will depend upon how much dissolved organic material is available, the concentration of chlorine (how much is free and how much is combined), the water temperature, and the filtration equipment (copper, ozone, biofilter, sand filter, etc.).*” (LaBonne per. com.)

Humidity

Due to the semi-aquatic nature of these animals, humidity should not be a problem in properly designed exhibits. Lack of sufficient land area for drying-off on is more often the problem.

A relative humidity of 30 – 70% is recommended for mustelids in general.

Lighting Requirements

Animals not housed out of doors year around, or a full 24 hours a day, should be provided with a varying photoperiod which can be easily set up with timers. Indoor facilities should provide full spectrum lighting, if possible, in addition to the varying photoperiod.

Temperature

Indoor facilities should be kept at an ambient temperature below 70 - 75°F (15.5 - 18° C) (Wallach & Boever 1983) Obviously, the temperature of outdoor facilities cannot be controlled however, shade in the warm months and shelter from inclement weather in the cold months is very important. Dry bedding material should always be provided in, or near, the otters' denning facilities.

Animals housed indoors should be provided with a thermal gradient within the exhibit. This will allow for the selection of a comfortable temperature by each individual animal. (Moore, unpubl.)

Ventilation

“Indoor exhibits should have negative air pressure of 5 – 10 air changes per hour of non-recirculated air. Separate ventilation systems should be provided between exhibit and visitor areas to reduce air (and odor) transmission, and potential disease transmission, between humans and animals.” (Moore, unpubl.)

Capture and Handling

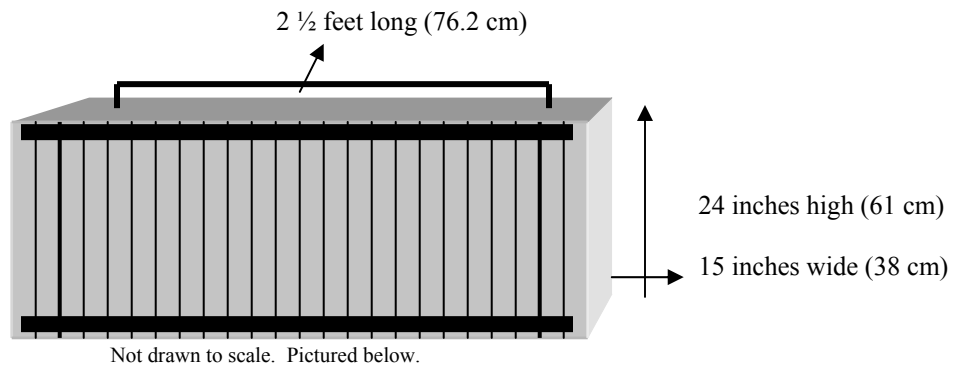
Many facilities are training their animals for routine husbandry procedures; target training can be very useful in reducing stress on the animal and the keeper staff. See Training Section.

McCullough et. al. (1986) describe a squeeze box they used on otters. Serfass (1994) gives the design of a transport tube used by the Pennsylvania State Wildlife Agency. Reuther (1989) includes the design of a squeeze cage used at Otter Zentrum in Hankensbüttel, Germany. Air Kennels (or similar), squeezes designed in-house, and smaller sized squeeze cages are probably the most frequently used methods of capturing and containing otters in zoos, other methods include nets or catch-poles. Due to their loose skin, it is not advisable to hand catch these animals; it could lead to keeper injury and undue stress on the animal. If it is necessary to hand hold an otter, gloves should be worn. For anesthetizing information see the Health Care section.

Sample Squeeze Cages

John Ball Zoo Squeeze Cage

Side view, bars on each long side separated by 1" (2.54 cm) gaps. Removable guillotine doors on each end. One side wall moves inwards via a hand crank on the top of the cage.

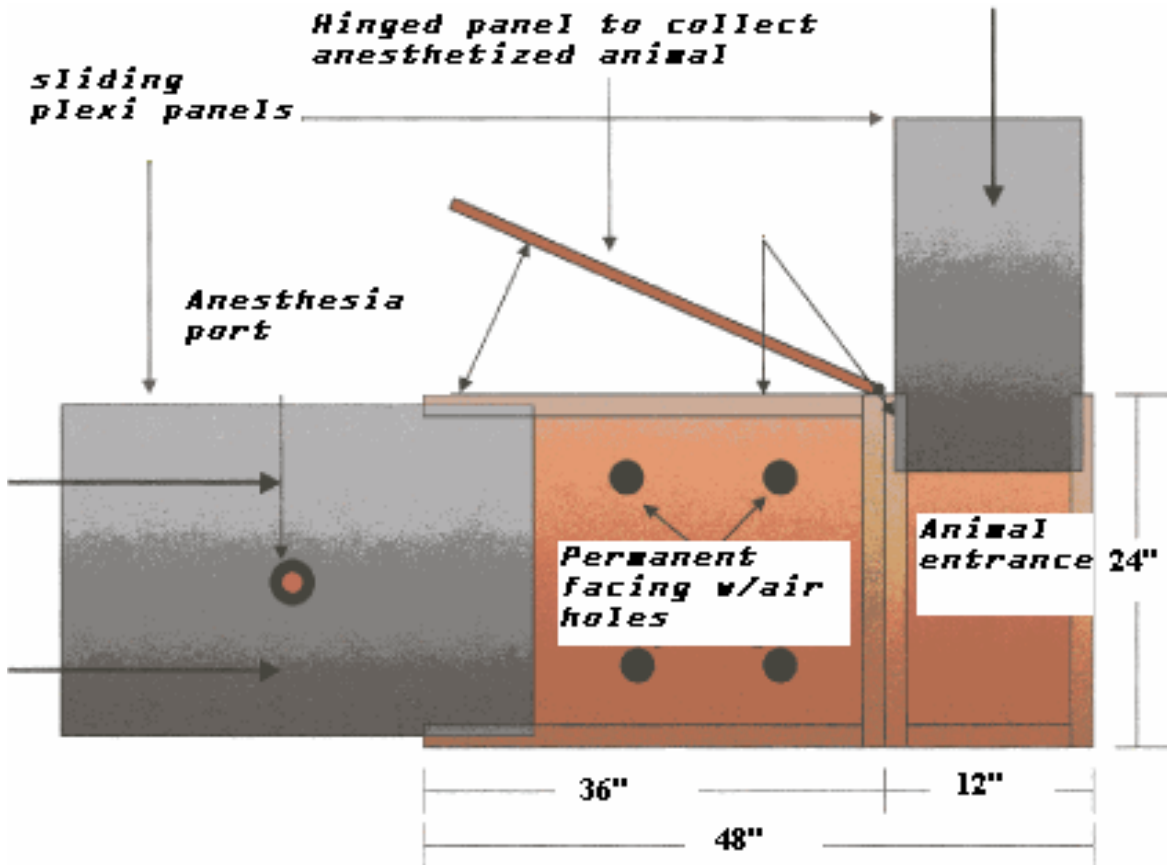


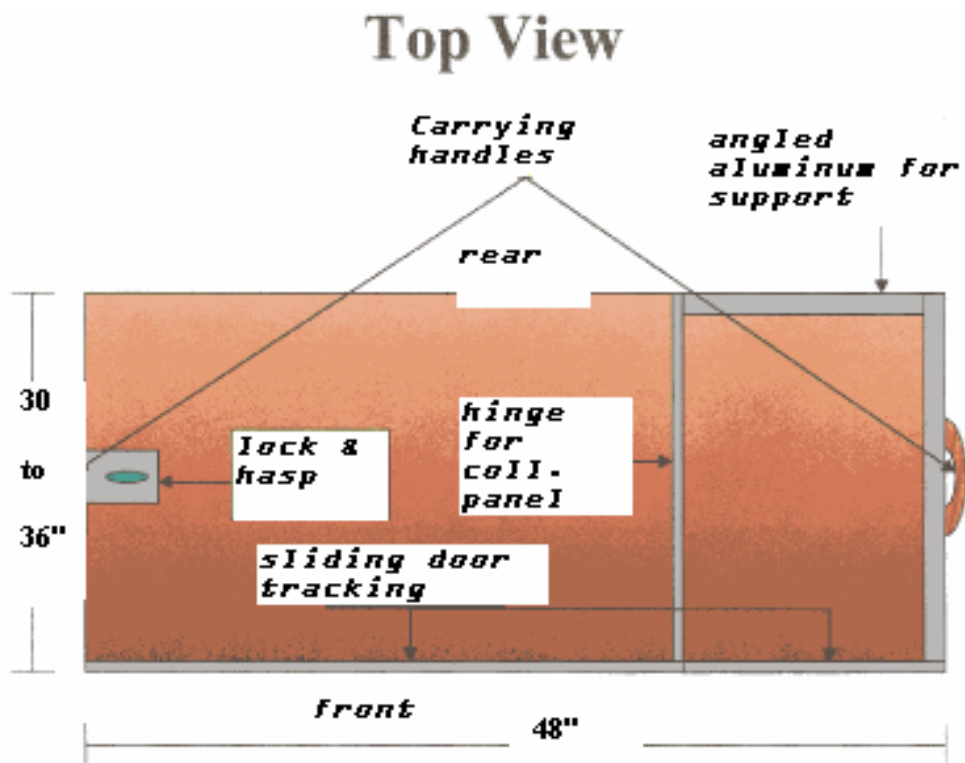
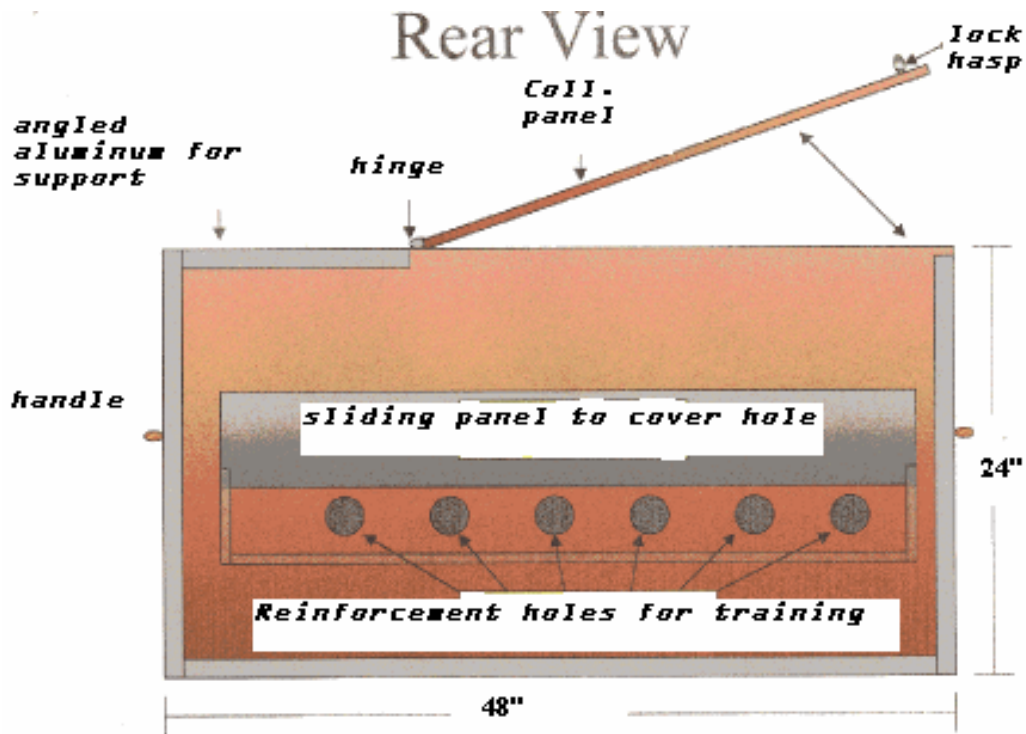
Small Mammal Transport Container – C. Schultz design

Craig Schultz of Disney's Animal Kingdom has designed a small mammal transport container, "that is ideal for training an animal to shift into, hold while being contained, transported, anesthetized and released without the stresses associated with conventional capture and restraint techniques.

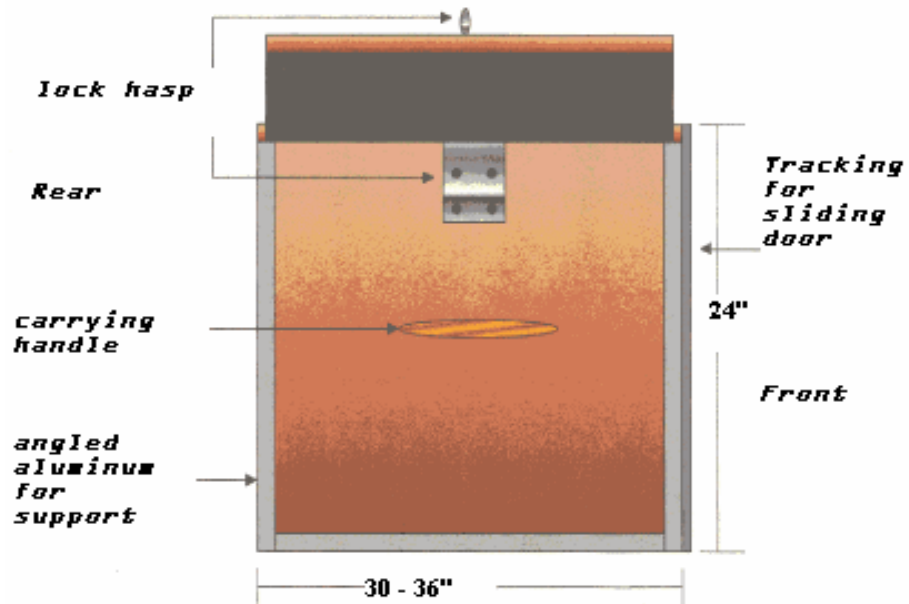
Container description:

- "The face of this container is made of acrylic see-through material for visual monitoring while the top, back, sides, and bottom are made of ½ (1.27 cm) inch to ¾ inch (1.9 cm) plywood."
- "It has three removable, see-through, sliding panels that can be locked into place."
 - 1 sliding panel used to lock the animal inside.
 - 1 sliding panel with an anesthesia portal used to effectively anesthetize your specimen.
 - 1 sliding panel in the rear to close off reinforcement holes.
- "This container's frame is reinforced on all 8 sides by angled metal preferably aluminum."
- "This container should have a top-swinging panel that allows easy collection of the anesthetized specimen. This panel can be locked in the closed position during containment and transport."
- "I would recommend that handles be added to the construction of this container to ease the weight burden during transport."
- "...I recommend that the container be at least 24" (61 cm) deep so that the animal can turn around and exit during the training process."



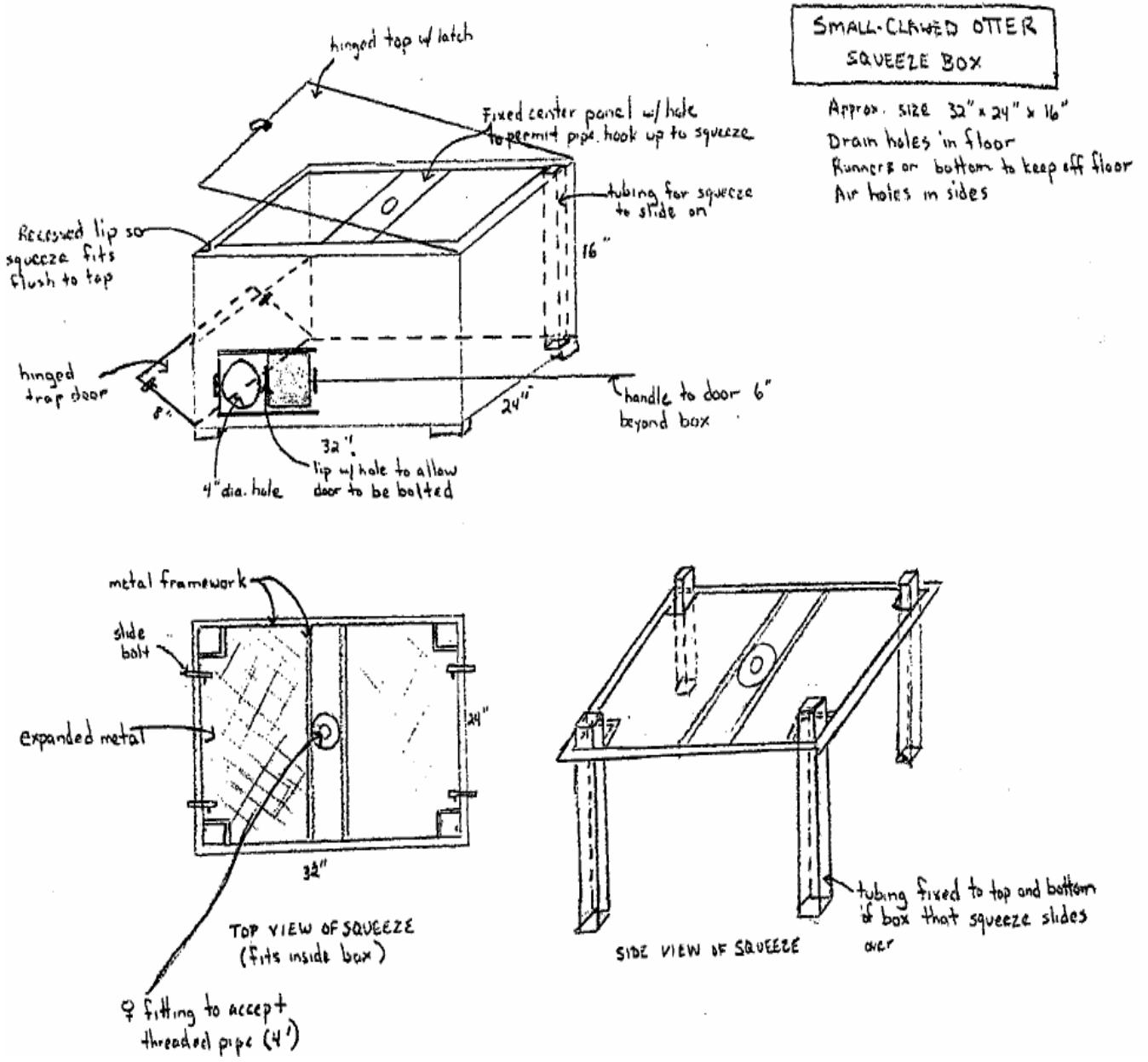


Side View (with collection panel partially open)



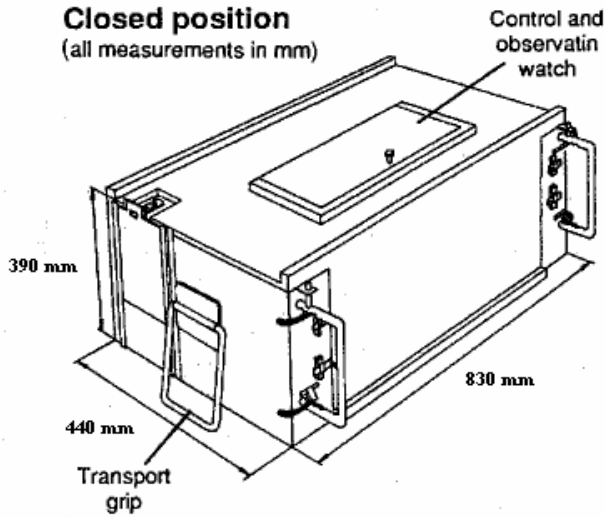
Asian small clawed otter Squeeze cage.

Dimensions would have to be adapted to fit the N. A. river otter. Contributed by:



Otter Zentrum Squeeze Cage

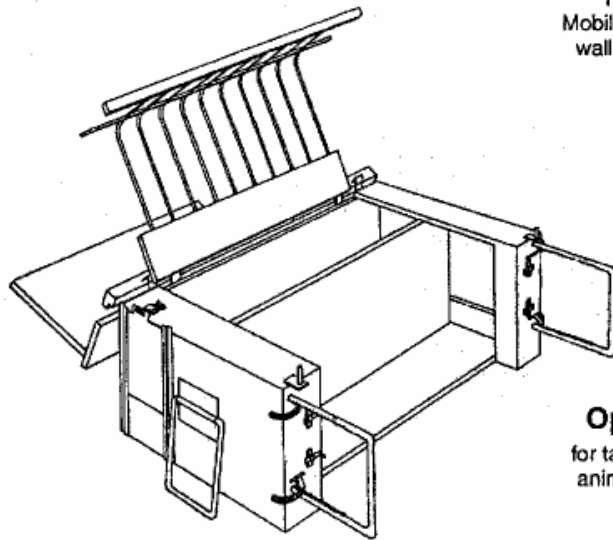
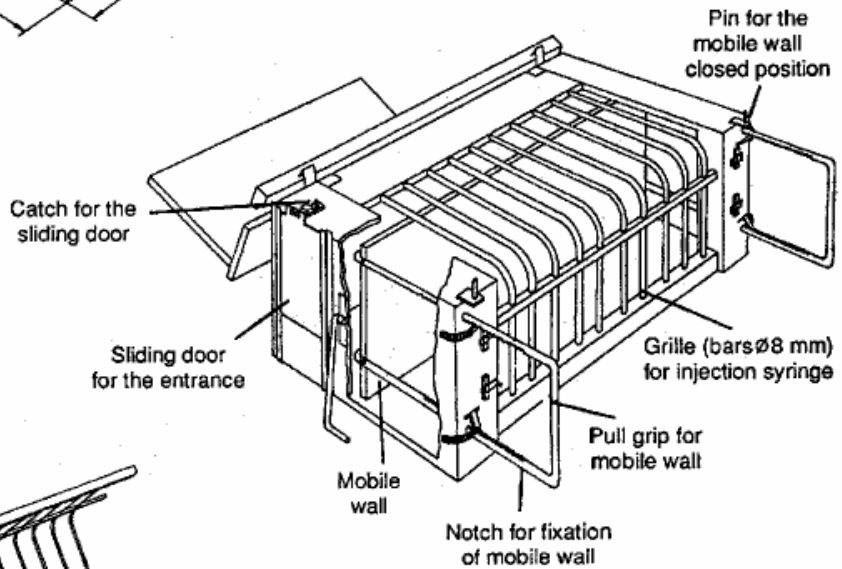
Closed position
(all measurements in mm)



Fixation-cage
for the treatment
of Eurasian Otters
Type AKTION
FISCHOTTERSCHUTZ

From: Reuther, C. 1989. Otters in Captivity - A Review with Special Reference to L. lutra. Proc. V. Intl. Otter Colloquium, Hankensbuttel, Germany. HABITAT, Aktion Fischotterschutz.

Working position



Open position
for taking out immobilized
animals and for cleaning

Clearwater Marine Aquarium Squeeze Box
Contributed by Angela Gabbert – Marine Mammal Trainer



(Photo was enhanced by outlining the box for clarity)

“Many facilities have incorporated crate training into their husbandry routines. At the Clearwater Marine Aquarium (CMA), a squeeze-cage was designed and proved to be more effective in having the animal enter without hesitation, as opposed to the standard dog crate. The squeeze-cage is used primarily in transporting CMA’s resident North American river otters to the veterinarian’s office for physical examinations.

“The squeeze-cage is made of durable lexan (the same material used for bulletproof windows) and is transparent. This allows the trainers/handlers to assess the animal’s condition, while the animal is able to see in all directions. The top of the squeeze-cage lowers to a level at which a veterinarian can vaccinate or anesthetize the otter, making the over-all examination as stress free and safe as possible. All of the resident otters at CMA will readily enter the transport crate, to the point where at times it is difficult to get the otter to exit, as they feel very comfortable and relaxed, not confined or enclosed!

“The squeeze-cage is 1 foot 7 ¼ inches wide, by 2 feet 3 ¾ inches long, and 1 foot 7 inches in height.(48.9 cm x 62.86 cm x 48.26 cm) The entrance consists of a sliding door, which can be raised and lowered with ease. Numerous holes have been drilled into the body of the crate for increased airflow and circulation, and for easy accessibility to the animal’s body for injections. The holes can be easily covered so that gas can be administered to the animal without transporting the animal to another contained box for gassing. Two steel rods hold the top in place and can be removed so that the height is adjustable and collapsible. Two handles are positioned to provide leverage when lowering the top and for easy carrying options.”

Clearwater Marine Aquarium Staff. For information contact: Chris Koberna, Director of Animal Care, CMA, 727-441-1790 or aquariums@CMAAquarium.org

Cleaning and Waste Removal

Food bowls and feeding stations should be disinfected daily; water bowls should be cleaned daily and disinfected at least every other day. Enclosures and holding facilities should be cleaned daily and disinfected as necessary. Do not disinfect every den, or the entire exhibit, at the same time, (it is preferable to leave the animal's scent on something); disinfecting of dens and sprainting sites should be done as necessary. Because scent is important to this species, nest boxes and exhibit furniture should not be cleaned as frequently as other surfaces. When these items are cleaned do not do all of them on the same day. In the AZA's Minimum Exhibit Guidelines (1997), Moore suggests not more than 25% be cleaned at any given time.

Soiled or wet bedding should be removed and replaced daily. Pools should be kept free of accumulated feces or discarded food.

Waste and trash should be removed in a timely fashion to minimize odor, disease hazards and pest infestation.

The enclosure design should facilitate the drainage of excess and/or cleaning water.

ANIMAL MANAGEMENT

Identification of Individual Animals

Generally each animal has a slightly different shaped rhinarium (nose pad), this can be used to identify some individuals visually from the outside of the exhibit. Many otters also have some sort of spot pattern on the upper lip area. Scott Shannon (personal communication) has used these "mustachial maculations" to identify individuals in the otter population he has studied for the last 14 + years in Northern California. Behavioral cues and coat color variations also may prove to be useful identifiers. However, all of these methods require patience, experience, and familiarity with the animals.

Permanent identification should be done in a manner consistent with the holding institution's policy. Options include: transponders, tattooing on the inside of a hind leg, or tattooing on the interdigital membrane of two hind toes a method used by Melquist & Hornocker (1983).

Temporary pup identification can be achieved by the clipping of a small patch of hair in a different location for each pup.

Behavioral Indicators of Social Stress, Harassment, Illness, etc.

If an animal is being harassed by exhibit mates it may show some of the following symptoms: wounds, stereotyped or neurotic behaviors, hiding, self-mutilation, loss of appetite, poor coat condition, hair loss, screaming. Because these also can be indicators of illness it is sometimes difficult to determine the true cause. If an animal shows any of the first five (wounds, stereotypies, neurotic behaviors, excessive hiding & self-mutilation) an environmental/exhibit-mate problem should be thoroughly checked out. This may be difficult to do and could necessitate 24 hour observations. Once the problem has been identified immediate steps should be taken; if one animal is harassing another the harasser should be temporarily removed. Re-introduction of this animal should be done slowly and with close supervision. Causes of hair loss also can be very difficult to determine; in addition to considering illness or parasites in cases of hair loss, over-

grooming, hair plucking, and limb or body sucking are all factors that need to be considered. See Exhibit-mate Aggression.

Feeding

Due to their high metabolic rate and rapid digestion (Davis et. al. 1992, Spelman et al. 1997) (Iversen 1972; Towell & Tabor 1982; Kruuk 1995; Estes 1989) otters should be fed at least twice a day, three is preferable. This prevents consumption of spoiled food, accommodates their rapid digestion of food as well as their high metabolism and can stimulate increased activity. Note: The consumption of spoiled food can lead to enteric problems, something otters are very susceptible to.

Duplaix-Hall (1975) found that in the wild, river otters rarely ate more than 500 grams of food at a time but that they would eat approximately 20% of their own body weight daily. See 1997 Survey Results and Diet/Nutrition.

New Animal Introduction

Introduction of new animals can take anywhere from one day to several months; it just depends on the animals. It is advisable to plan on proceeding slowly via sight and smell first, gradually building to a physical introduction. The animals will generally give you behavioral cues as to what their reaction to a physical introduction will be.

It is possible to introduce adults, some of these introductions work, some do not. Two factors appear to be very important 1) Both animals have a place to get away. 2) Introductions take place in neutral territory, or, less preferable is to introduce them in the home turf of the animal likely to be the more submissive. (personal observation & K. Butkiewicz pers. com.)

Problem introductions should be done slowly, back up a few steps if need be. Be aware that some animals will just never get along (especially females) and an introduction may have to be abandoned. The reverse of this also is true, some animals hit it off right away and an introduction can be accomplished in just a few days, or in some cases, hours.

Several facilities have had problems reintroducing an animal after an extended absence from the exhibit due to illness. Again, this usually occurs with females and these reintroductions may need to be treated as if the animals were meeting for the first time.

Exhibit-mate Aggression

It appears that more fighting has occurred between female-female cage-mates than male-male or male-female pairings. Mixed-sex groups are exhibited, but, they have most frequently required a long introduction period particularly if the animals are adults. Males are frequently reintroduced to family groups, the time frame ranges from three months to one year. Males left in an exhibit with a lactating female should be provided with enough room to stay out of her line of sight until she decides he may approach the pups. See Behavioral Indicators of Social Stress.

What Sort of Group to Exhibit

Otters in the wild

Most frequently zoos exhibit a pair, this is fine, and will probably continue to be the norm, but is not believed to be the typical social grouping found in the wild.

Most frequently female otters are found alone (Blundell et. al. 2000), or, with 1) pup(s); 2) offspring from the previous year (probably female, but it is not known for sure); 3) pup(s) and a "helper otter" which is generally believed to be a female (Rock et. al. 1994, Blundell 1999 & Blundell et. al. 2000), or 4) with a

male (Blundell et. al. 2000). Blundell (2000 and pers. com.) has found females joining groups of animals in marine environments for some part of the year.

Most males are found, by themselves or in a group of males; less frequently, but observed, they are found with a female or with a female and pups. (Blundell et. al. 2000)

It is difficult to observe otters in the wild so it has been hard to determine the otters' social history. However, recent, and on-going studies, are showing the river otter, particularly males, to be more adaptable socially than previously thought.

All Male Groupings

All male groups do very well. The Virginia Marine Museum exhibits a group of five males and researchers at the University of Alaska, Fairbanks housed 15 males together without any problems. (Harshaw per. com., Ben David per. com.) There are frequent reports from the wild of all male groups (for example: Blundell 1999 pers. com., Shannon 1999 pers. com., Melquist & Hornocker 1983, Blundell et. al. 2000), in fact, all male groups containing up to 20 individuals have been seen.

Male/Female Pair

As stated earlier, this is the most frequently seen captive grouping. Although pair living is not the normal social structure for otters in the wild they seem to adapt well to living in pairs. An option to explore, even if a facility is not interested in breeding their river otters, is rotating the pair through the exhibit. The male can go out for awhile, then the pair, then just the female or any variation. This mimics their natural social state a little more closely, will help stimulate activity in the exhibit, and provide an enriched behavioral environment for them.

Multiple Pairs

Facilities keep multiple pairs in two ways: all together (Lowry Park Zoo & Nashville Zoo @ Grassmere), males and females separate (Minnesota Zoo, St. Louis Zoo), or, separate pairs (Little Rock Zoo, St. Louis Zoo).

All Female Groupings

In a zoo, it is generally wiser to not exhibit multiple females together unless they are related or introduced at a very young age. Several facilities that have been successful with multi-female groups have had problems arise when one animal has been reintroduced after a brief absence.

However, as with everything, there are exceptions. Some multi-female groups get along for years (the individual relationship history of many of these groups is unknown, this is not true for all), and have no trouble adjusting after brief separations. Related females kept together tend to do well over the long term.

Multiple Female-Single Male

Knoxville has been successful with 1.2 (females came from the same source, same age, same acquisition date but it is not known if they are related). These animals are together 24 hours a day. There are a few other facilities that have housed multiple females. If this group structure is selected you should watch for signs of stress because the females may fight with each other or team up against the male.

It is possible to house 1.2 but exhibit the females separately with the male by rotating them through the exhibit. If this method is chosen adequate off-exhibit holding should be provided.

Multiple Male-Single Female

There is not a good reason to exhibit multiple males and one female unless something happens to one of your animals. If this is the case, the group should be monitored closely to ensure the female is not being traumatized by too much attention from the males. If possible, rotating animals through the exhibit is recommended. This could include different pairings such as 2.0, 1.1, 0.1, the other 1.1.

North American river otter # of ISIS institutions holding <i>L. canadensis</i> / sex and group size breakdown. (All animals held by an individual facility are not necessarily housed together.)			
	1999		2000
Total Institutions	97		114
# and Sex of Animals	# of Institutions	# and Sex of Animals	# of Institutions
1.1	48	1.1	52
1.0	9	1.0	8
0.1	5	0.1	7
1.2	12	1.2	9
2.1	9	2.1	9
2.0	6	2.0	4
0.2	4	0.2	8
2.2	5	2.2	4
3.0	1	3.0	1
0.3	1	0.3	1
3.1	1	3.1	1
1.3	1	1.3	3
3.4	1		
2.3	1	2.3	2
3.3	1		
4.3	1		
4.2.4	1		
5.0	1	5.0	1
		1.1.3	1
		4.2	1
		2.4	1
		7.2	1
		1.0.2	1

Mixed-species Exhibits

North American river otters are not routinely kept with other species. I have heard rumors of a Canadian facility housing them with raccoons and/or fox but have not been able to confirm this. They also have been kept with sea lions. There have probably been other mixed species groupings, both successful and unsuccessful but I have not been able to find any further information.

Record Keeping

In general, most facilities have record keeping procedures in place. Information on an animal's behavior, food intake, weight, health, reproductive status, vaccinations, etc. should be maintained to facilitate its proper care. All facilities should participate with the AZA North American River Otter Studbook Program. (See Website Addresses for the Studbook Keeper information.)

Shipping

The IATA regulations are subject to constant review, so the current Live Animals Regulations Volume at the time of any animal shipment should be consulted. This information is provided as a guideline only.

The sample crate below and all information contained in this section comes from the International Air Transportation Association (IATA) Live Animals Regulations 26th Edition, Effective 1 October 1999.

“ The height of the container must allow the animal to stand in a natural position with its head extended and the width must permit it to turn around and lie down comfortably. The actual measurements will vary with the species involved.

“ The frame must be made from solid wood or metal parts bolted or screwed together. It must be constructed so that it cannot be damaged from continual biting or scratching at the corners. If the total weight of the container plus the animal exceeds 60kg (132 lb.) metal bracing must be added to the frame.

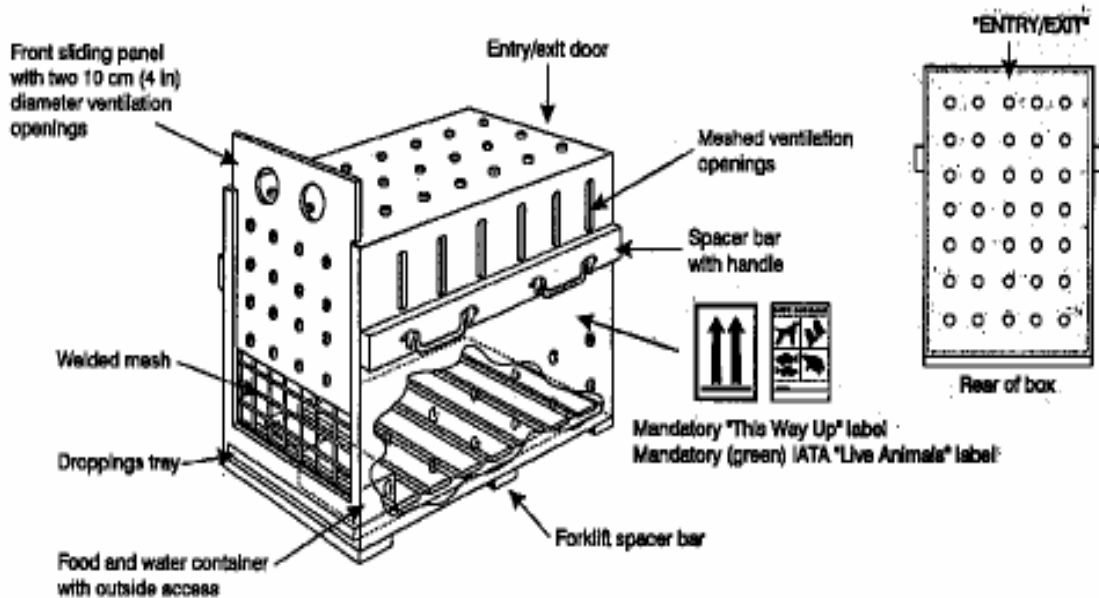
“ The sides and door must be made of metal or solid wood. The front of the container must be constructed of weld mesh. The mesh must have a diameter that will prevent the animal protruding its nose or paws to the outside. The whole front must be covered by a sliding shutter which can be raised and lowered to permit feeding and watering. It must have two observation holes of at least 10 cm (4 in.) in the upper part and ventilation holes, with a minimum diameter of 2.5 cm (1 in.), spread over the remainder of the surface in order to give good ventilation but at the same time leave the animal in semi-darkness.

“ The floor must be slatted, over a leak-proof droppings tray.

“ The roof must be solid wood or metal with ventilation openings over its surface.

“A sliding door must be provided, it can be made from the weld meshed ventilation front if required. It must have a secure means of fastening so that it cannot be opened accidentally.

EXAMPLE:



Container Requirements 82 apply to otters.

“ The main ventilation front must be supplemented by meshed openings along the upper part of the container walls and/or holes with a minimum diameter of 2.5 cm (1 in.) spread over the top third of the sides and the whole of the back and top. These holes must be spaced both horizontally and vertically at intervals of approximately 10 cm (4 in.) center to center. It is essential that there is some ventilation provided in the lower third of the sides for the removal of harmful waste gases.

“The total ventilated area must be at least 20% of the total area of the surface of all four sides. More ventilation and the use of larger meshed openings is permitted but the animal must not be able to protrude its nose or paws to the outside from any opening.

“If the mesh is fixed to the interior of the container all sharp edges must be protected.

“Spacer Bars/Handles must be made to a depth of 2.5 cm (1 in.), must be present on the sides of the container as shown in the illustration. (See illustration)

“ Food and water containers must be provided with a means of access from the outside.

“Forklift spacers must be provided if the total weight of the container plus the animal exceeds 60 kg (132 lb.) (IATA Live Animals Regulations 26th Edition, p296)

Regulations have obviously become fairly rigid. Hard plastic pet containers can be used with the following modifications:

- *“The grill door must be covered with securely fixed weld mesh and all ventilation openings covered with wire mesh;*
- *“The door of the larger containers must have secure fastenings at the top and the bottom;*
- *“A curtain, that can be raised and lowered and does not impede ventilation, must be fixed over the door to reduce light inside the container;*
- *“A dropping tray must be fixed to the floor and filled with absorbent material;*
- *“There must be ventilation openings on the rear of the container, extra ventilation openings may have to be made in order that the total ventilation area is at least 20% of the four sides;*
- *“ Food and water containers must be fixed inside with access from the outside;*
- *“The container must be correctly labeled.”*

When shipping an animal, especially across international borders, check to see what types of special requirements/restrictions may be in place. For example, some countries will not accept crates in which straw has been used as a bedding material.

All animals should be shipped one to a crate. Lactating mothers should not be shipped.

1997 N. A. RIVER OTTER *LONTRA (LUTRA) CANADENSIS* HUSBANDRY SURVEY
Participating Institutions

(The results of this survey were distributed to participating institutions in October 1997. Although some of this information may no longer reflect management practices at these institutions, much of it is still the same and the information is valid from a historical perspective.)

Akron Zoological Park, OH	AK	Arizona-Sonora Desert Museum, AZ	AR
Assiniboine Park Zoo, Bronx Intl. Wildlife Center, NY	AS BR	Baltimore Zoo, MD Brookgreen Gardens	BA BG
Brandywine Zoo	BW	Brevard Zoo, FL	BV
Burnet Park Zoo, NY	BU	Caldwell Zoo, TX	CA
Calgary Zoo	CG	Central Florida Zoological Park, FL	CF
Central Park Wildlife Center, NY	CF	Clearwater Marine Aquarium, FL	CM
Dakota Zoo, ND	DA	Denver Zoological Gardens, CO	DE
Dickerson Park Zoo	DI	Ellen Trout Zoo, TX	EL
Henson Robinson Zoo	HR	Homosassa Springs State Wildlife Park, FL	HO
John Ball Zoological Garden, MI	JB	Knoxville Zoological Gardens, Inc., TN	KX
Lee Richardson Zoo	LR	Lincoln Park Zoological Garden, IL	LP
Little Rock Zoological Garden, AR	LI	Lowry Park Zoological Garden, FL	LO
Metro Toronto Zoo	MT	Miller Park Zoo	MP
Minnesota Zoological Garden, MN	MI	NEW (N.E. Wisconsin) Zoo, WI	NZ
North Carolina Zoo, NC	NC	Northwest Trek Wildlife Park, WA	NT
Oakland Zoo, CA	OA	Omaha's Henry Doorly Zoo, NE	OH
Palm Beach Zoo @ Dreher Park, FL	PB	Riverside Zoo	RI
Salisbury Zoological Park	SZ	Salmonier Nature Park	SN
San Francisco Zoological Garden, CA	SF	Sedgwick County Zoo, KS	SE
Sequoia Park Zoo	SP	St. Louis Zoological Park, MO	ST
Sunset Zoological Park	SU	Texas State Aquarium, TX	TS
The Texas Zoo, TX	TT	Woodland Park Zoological Garden, WA	WO
Wildlife Prairie Park	WP	ZOOAMERICA, PA	ZA
Zoo de Granby	ZG		

How many N. A. river otters do you hold at your facility? How are they grouped? Are they separated at night?

This is 1997 information, management may have changed.

INSTITUTION	#/SEX	GROUPING
AK	1.2	1.2 (on exhibit; 1.1 & 0.1 at night.
AR	1.1	Animals held separately at the time of the survey.
AS	1.1	1.1 (24 hours)
BA	1.2	1.2 (24 hours)
BG	1.1	1.1 (24 hours)
BR	1.1	1.1 (24 hours)
BU	2.2	At the time of the survey 0.2 were in quarantine and the males were exhibited separately.
BV	1.1	1.1 (24 hours)
BW	1.1	1.1 (24 hours)
CA	2.2	1.1 & 1.1, exhibited and housed at night in these groupings.
CF	2.1	Historical info. no otters in 1997 – 1.1 (24 hours) & 1.0
CG	1.1	1.1 (24 hours)
CM	2.0	2.0 (24 hours)
<i>“The otters are on a rotation basis for their night time procedure. Each evening we rotate the otters between the following: gated in the stall areas which is connected to the main exhibit; in the exhibit (our exhibit is indoors); or open, where the otters have a continuous option of either going into the stall area or staying in the exhibit. Each month we change the rotation schedule so it stays random, and we have found this to be very successful. We rarely have difficulty moving the otters between the exhibit and stall areas.</i>		
CP	1.1	1.1 (24 hours)
DA	1.1	1.1 (24 hours)
DE	1.1	1.1 (24 hours)
DI	1.1	1.1 (24 hours)
EL	1.1	1.1 (24 hours)
HO	2.2	2.2 (24 hours, includes 1.1 pups from 1996 litter)
HR	1.1	1.1 (24 hours normally) temporarily separated when the female became aggressive after breeding.
JB	1.1	1.1 (separated at night)
KX	1.2	0.2 (24 hours); 0.1 currently separated from females by howdy door for pending introductions
LI	3.1	1.1 (24 hours) The other two males were kept together 24 hours until one of them died.
LO	2.2	2.2 (24 hours)
LP	1.1	1.1 (24 hours)
LR	2.1	2.1 (24 hours)
MI	2.0	2.0 (24 hours)
MP	2.0	2.0 (24 hours)
MT	1.1	1.1 (24 hours); at the time of the survey they only had 1.0
NC	0.2	0.2 (24 hours)
NT	1.1	1.1 (24 hours)
NZ	3.0	3.0 (24 hours)
OA	1.1	1.1 (24 hours)
OH	0.2	0.2 (24 hours, littermates)
PB	1.1	1.1 (24 hours)
RI	1.1	Were 1.1 (24 hours), 0.1 deceased
SE	1.1	1.1 (24 hours)
SF	1.1	1.1 (24 hours)
SN	1.1	1.1 (24 hours)
SP	0.1	When had 1.1 together 24 hours
ST	3.3	0.3 (24 hours, dam & offspring) 3.0 (24 hours, male offspring)
SU	1.1	1.1 (24 hours)

SZ	1.1	1.1 (24 hours)
TS	3.3	2.2 (? no information on other animals)
TT	1.1	1.1 (24 hours)
TZ	2.2	2.2 (24 hours)
WO	2.1	1.1 (24 hours) & 1.0
WP	1.1	1.1 (24 hours)
ZG	1.1	1.1 (24 hours)

How were these introductions made? How long has the group been together?

(See Table for additional information.)

AK *“1.2 introduced this spring. It took approximately one month. We had the older female (4 yrs. old) left over from another 1.2 group and acquired 1.1 (2 yr. olds). First they could see each other across an aisleway. 0.1 was let out on exhibit on alternate days then eventually put out together with 1.1 and observed. There was a lot of play fighting, nothing serious enough to draw blood. They are separated as 0.1 and 1.1 at night.”*

AR Male is 7 ½ years and held in the exhibit at this time. The female is 5 months and held off-exhibit in an indoor/outdoor situation.

AS *“Animals are off exhibit. They were introduced after several months of separation by wire mesh.”* Wild caught, no ages given.

BA *“Our introductions for the otters that we currently have began on 1/3/90 when ‘Screamer’ (female 89057 approximately 10 yrs. old), ‘Bunnie’ (female 89058, 1 yr. old), and Harley (female 89059, 1 yr. old) were released from quarantine. Our other otters, ‘Spike’ (male 88077, 2 yrs. old), Spike’s sister, (88078, 2 yrs. old), and Granny (female 89052 approximately 11 yrs. old) had been previously introduced.*

“We introduced the male 88077 and female 89052 to the three new females, 057, 058, and 059. Everything seemed to be fine so 88078 was added....that’s when the trouble began.

“There were several fights between 88078, 89057, and 89052 resulting in minor injuries. The group was separated and reintroduced in the afternoon. The afternoon session resulted in a big fight which caused even more injuries resulting in the need for medication to prevent infection. The group was separated for the night.

“The original female, 88078, was left separated the next day. There were only minor scuffles on this day between the male and the two older females.

“The female, 88078, was left out and not added to the group again. She was sent to Sacramento on 5/17/90.

“The remainder of the group, 88077, 89052, 89057, 89058, and 89059 got along well. There were minor confrontations on 1/19 and 1/20/90, the rest of the problems seemed to be solved with vocalizations between the otters. This group was housed together until the death of 89052, who passed away on 12/29/91.

“This inside enclosure has no howdy doors, so none could be used for our introductions. We have two sets of three dens separated by an indoor pool.... Each den can be separated from the others or can be individually accessed to and from the pool. This made it easy to separate the otters when fighting or for the night.” Baltimore houses 1.2 (88077, 89058, 89059).

BG *“1.1, the male was 1.5 years and the female 6 months (wild caught animals) when put into an exhibit with a male of about 15 years of age, both were accepted right off. The pair have been together for 6 years. Always left in the exhibit.”*

BR *The male was 7 years old and the female was 3 years when introduced in 1992. No information on the introduction process.*

BU *"0.2 (approximately 5 years) were received 28 May '97. Both had given birth in March. They are housed together in quarantine. 2.0 (captive born male is 11 years old, wild caught male is approximately 4 years old) are housed separately. Each has access to the same exhibit at different times of the day."*

BV *"1.1 (obtained from Bayou Otter Farm, approximately 5 ½ years old now) grouped previous to their arrival at Brevard Zoo. They have been together here since 11/04/94.*

BW *"Housed 1.1 together. Male was introduced to female (already in the exhibit for a week). Male introduced in a howdy squeeze cage. Both were very excited and happy right away so the male was let out in about 5 minutes. They were both about 7 months old at the time of introduction and have been together almost 6 years.*

CA *"2.1 siblings were already together, a howdy door was between 2.1 and 0.1. The male was introduced to the lone female. They fought some. (He was 11 months old and she was approximately 7 years at the time of introduction.) Each otter has to be separated at feeding time only.....All otters are kept in holding at night, with 1.1 together in 2 or 3 stalls.*

CM *"Our male otters reside together in the same exhibit. We do have the ability to house them separately if we need to. When the otters were introduced one was two and the other was four years of age. The otters were separated from each other for approximately one week prior to the door being opened. The otters could see and smell each other through a plexiglass door, but no physical contact could be made. After the one week period, the door was opened, and the otters were allowed together. There was no aggressive behavior observed between the otters. Since this time. the otters have resided together for approximately 3 years."*

CP *"1.1 (male approximately 10 years, female approximately 4 years) introduced mid-May of '97. Introduction took 5 minutes. It was love at first sight. Introduced in holding then let out on exhibit together."*

DA *"1.1 introduced when male was 2 years old and female was 4 years old. Introduction was immediate after a 2 week period of being housed near each other with a solid gate between them. They were companions from the first day."*

DE *"The male was already present (age 9 years at the time), and the female was 6 years old. The male had been here for a long time prior to her arrival. The female was kept in the holding area, while the male was locked out on exhibit for about one month. Then the male was given partial access (howdied) with the female by allowing him to use one of the holding stalls so that they could see and interact with each other but were not together. After one week of this they were put together briefly, then switched so the female had the exhibit and first holding cage while the male had the other two holding cages. A few days later they were reunited and left together. For the first week they were still separated overnight.*

"There was some fighting between them at each step but overall the introduction went smoothly. They have been together since then (2 years in October)"

EL *"1.1 introduced to each other when 0.1 was 5 years of age and 1.0 was 3 years of age; introductions took about one month and animals have been housed together ever since. The female had previously been paired with 2 other males before this current male. Copulatory behavior has been noted between the female and all 3 males but no animals have been produced to date."*

HO *"08 July 1993 Robbie (1.0) placed in with Olga (0.1); no introduction phase – all obviously went well.*

"Have successfully reared all young in 3 litters (0.2, 2.1, 2.1). Olga successfully intimidates Robbie when young are born. He stays clear until she brings them out of the den two months after birth."

HR *“We received our male otter in November 1996. After his quarantine period, we moved him to the exhibit with our female. They were separated by two chain-link fences. Each had its own outdoor pool and yard and inside; each had its own nesting and feeding areas. We housed them this way for six weeks, letting them become accustomed to each other by sight only. After the six weeks, we opened both doors and allowed them to investigate each side. They immediately hit it off. Mating occurred within 10 minutes of them being together.*

“We separated them again in mid-March. The female became very aggressive towards the male. We believe this is due to pregnancy or false pregnancy. We will reintroduce them when her aggression subsides.”

JB Female is captive born (1990 birth) and male is wild caught (1989 birth). The pair was introduced in 1991. The first week they were given visual and olfactory access via a howdy door between dens in the exhibit holding. On day seven they were introduced inside; the male spent most of the time cowering in the corner and screaming. He received one small bite from the female. They were separated for the night then reintroduced the next day with access to the exhibit; the male would not leave the holding area until late in the day, then he would not come back in. No other information available in the records so things must have gradually worked themselves out. This pair produced four litters before the male died in December 2000.

The adult male was reintroduced to the female and her first litter via a howdy door initially (three to four days), then in holding. There were never any problems with him, actually there was more concern about the female and her reaction to him, i.e. that she may be quite aggressive to him. This took place when the pups were seven months old. He was introduced to the female and her second litter without going through the howdy door stage when the pups were four months old. The male was never with female and her third litter, the fourth has just been born (12 April 2000).

Not too long after introductions to this female (female referred to above) began, he was introduced to another female in the same manner. There was no fighting with this female and he did not cower or scream.

An attempt was made to introduce the two females but it was unsuccessful due to severe fighting between the females. (This second female was about the same age, wild born but hand reared.)

Historically the zoo housed 1.3 otters. Two of the females were “pest” animals caught at the same time and believed to be siblings or mother daughter. They got along fine but could never be successfully introduced to the pair. When housed with the pair these two females spent all of their time hiding under a log in the exhibit.

KX *“Received both females at approximately 3 years old, they were already introduced. They have been together approximately 3 years. Male that was initially with them is now deceased, (dead approximately 11 months). Separated only for feeding and behavioral management training sessions.*

“Recently acquired male (3/97) preparing for introduction to females. Currently housed in off-exhibit holding. Howdy-door between male and females.” Male is about 3 years old.

LI *“Group 1 – 1.1 (male is captive born, 5 ½ years old; female is wild born, hand reared and 1 ½ years old) introduced after seeing each other through howdy door for 8 months. Could probably have introduced sooner – lack of time to do it. Did try an intro after one month and called it off due to aggression. Since 7/2/97 have been together 24 hours with access 24 hours to den and exhibit. Will change when she gets older.*

“Group 2 – 1.0 until the past month, this was a group of 2.0 (remaining male is captive born, about 10 years old; male that just died was captive born and about 20 years old). They were very compatible and left together 24 hours a day with access to an outdoor exhibit with a den and den box. (1.0 died recently.)”

LO *“2.2 otters are housed together. Have been together for several years.”*

LP *“Housed as 1.1. Otters arrived at LPZ already together. Animals were simply monitored when finally put into their exhibit. Received otters at around 17 months old.”*

LR *“Housed in enclosure 2.1. 1.1 two year olds were introduced in the enclosure in 1992. They have shared the enclosure without incident since that time.”*

MT *“Introduced when 1.0 was 4 years old and 0.1 was 5 years old. Introduced in holding using slide doors. Went well, no problems. Always got along very well.”* * The female died just after the survey.

MP *“These two males have been housed together since March 1995. Introduction began by letting the new male have the exhibit for about 1 week then had a howdy panel for another couple of days, then let together. There was some scuffling for awhile (several days) but nothing of importance.”*

MI *“2.0 introduced on exhibit; aggressive for 2 weeks, now 24 hour access.”*

NC *“...0.2 were first introduced at age 1 year 10 months and 11 months. They were howdy caged nest to each other. They had first visual, then both visual and tactile contact. Our introduction took us about 6 weeks. This group of 0.2 has been together for 1 year 8 months. Our exhibit is split into 2 halves by rock work. A tunnel runs through the rock work to allow otters movement between the two exhibits. A plug can be inserted to close off either side of the exhibit. We have off exhibit holding with 4 cages separated by sliding doors.”*

NT 1.1 together since 1991. Introduced in the quarantine area while held in adjoining pens; length of introduction process was 4 weeks.

NZ Currently house only males because the single female they had with the group seemed to suffer from frequent, minor injuries believed to be due to the 3.1 ratio. If they obtain females again they would only introduce two females; they would not try 3.1 again. No other introduction information sent.

OA *“1.1 are housed together. They were both approximately 10 months old at introduction. They were allowed olfactory introduction through a shared door. After three days they were released into a common area – no aggression observed. They have remained together since that time.”* Note: this pair produced their first pup in 1999.

OH *“Littermates”*

PB 1.1 have been together since 1985, unknown introduction process.

RI *“Currently at the Riverside Zoo we are only housing one male otter. We lost the female last fall to a uterine infection, but we are hoping to acquire another.”*

“This pair had been together for over two years. They were introduced at the ages of (1.0) 6 years and (0.1) 2 years. The female was howdied alongside the male in our sick animal holding building, with the shift door covered with wire. This process took about one month and there was little problem with the final introduction.”

“Once the exhibit was completed, the pair was placed together. The off-exhibit indoor area contains two elevated 3’ x 3’ x 4’ (91.44 cm x 91.44 cm x 121.92 cm) wire dens. Each den is connected to the exhibit by one single 6” (15.24 cm) radius plastic tube, with a guillotine door inside the den. Both had access to the exhibit except during feeding or exhibit cleaning, which occurred twice daily.”

“The outdoor exhibit is a 90’ x 40’ (27.43 m x 12.2 m) diamond shape with an 8’ (2.44 m) wall. Within the exhibit there are two pools. The smaller is 4’ (91.44 cm) in diameter and 6” (15.24 cm) deep and is above the main pool. The larger pool is 12’ (3.66 m) in diameter and 3’ (91.44 cm) deep with two viewing windows. The rest of the exhibit area contains turf, grass, clump grasses, one small pine tree, willow, and old logs.”

SE *“We house 1.1 otters here. They were introduced at age 3 when we first received them. The animals were introduced in our quarantine barn with a small pool. They were in separate sky kennels and released in holding together. Our group has been together 2 full years.”*

SF *“1.1 (1.0 captive born in 1991; 0.1 wild caught, rehab. otter, estimated May 1993 birth) housed together. At the time of intro we housed 2. males together, ages approx. 15 years and 3 years. Female was one year old at intro. Transferred the two males to hospital quarantine to introduce to female. Males kept*

in howdy cage for two days, then all animals introduced together. Absolutely no problems. Moved to exhibit two days later. Old male subsequently died of old age."

SN *"Male has occupied 0.6 hectare natural pond/river enclosure for 1 year. female recently introduced to this animal."*

(Because this female had been transported from her capture site in a small box the facility was anxious to get her out and into the exhibit, so she was just released into the enclosure.)

"We are blessed with a huge natural otter pond which is essentially a small oxbow lake on a stream. Water depth varies to about six feet. The area is naturally forested and has dense shrub cover. The animals simply avoided each other initially and gradually came to accept each other over about a one or two week period. Now they are inseparable."

SP *"Female is currently alone; previously 1.1. She was introduced to a new male (1 year old) at age 5 years, approximately. She was locked in den with a howdy door, male on exhibit during the day and they were switched at night. Introduction lasted 4 days; pair together until male died last year."*

ST Group 1 – 0.1 dam and 0.2 offspring. Group 2 is 3.0 sibling offspring of same dam.

SU *"1.1 – male 11 years at introduction to 1 year old female. Female was briefly howdied (several hours) in a kennel. Group has been together for 1.5 years. Male had been alone several years prior."*

SZ *"1.1 were put together when male was 1 ½ years old, female was less than a year old. Female was placed with the male – some aggression – female was separated. The next day they were together and doing fine."*

TT *"1.1 – 1.0 was 6 years old (wild caught) when 0.1 (wild caught, hand reared 1 ½ years old) was introduced. Took about 2 days. 0.1 was on exhibit when 1.0 escaped from holding area and entered exhibit with her."*

TZ *"2.2 – In '95 had 1.1 WC/HR (wild caught, hand reared), these two were raised together. In '96 a WC/HR female was introduced, first by herself to get used to the exhibit then all together. Older female mothered her. In '97 introduced male the same way, he was immediately accepted."*

"We have 2.2, however the 5 month old (male) will be going soon. The oldest female mothered the youngest by immediate acceptance and would carry her in and out of the large tank, and made sure she ate. Our younger female was approximately 2 months when they were introduced. The young male was also immediately accepted by the other otters."

WO *"The 2 one year old siblings....were brought in together and are very compatible. Will need to be separated by fall of this year though." The 6 year old male is currently being housed alone.*

An unsuccessful attempt was made to introduce the female of the above mentioned sibling pair to the 6 year old male. First, they were put in side by side holding for about ½ hour where..."they did ok, but not perfect. Some vocalizing, mostly by male."

Roughly two weeks later they were moved to another holding setup with a howdy screen between to allow animals to become further acquainted. After three days a small opening was allowed in the separating door, enough so female could put her paws through. No injury or fighting resulted. The pair continued to have limited interactions through the howdy screen, nothing of note however.

Eleven days after being howdied they were introduced for 1 ½ hours on exhibit. A lot of intermittent fighting occurred and it was eventually decided they were not compatible.

ZG *"We put the female in the outdoor exhibit when she was about 1 year old. We introduced the male to the female about three months later in the same exhibit. The male was one year old. They have been together since that time."*

1997 JBZ N.A. River Otter Husbandry Survey
Sex, Numbers, Groupings, Exhibit Style, Overnight Policy, Animal Status - Table

Institution	Sex & #	Outdoor Exhibit	Indoor Exhibit	Together 24 hours	Separated at night	Alone 24 hrs/day	Night Access to Exhibit	Nights in Holding	WC	CB	HR	Age
AK	1.2	X		1.1	0.1			X	1.0 0.1 0.1			2Y 2Y 4Y
AR ¹	1.1	X				1.0 0.1	1.0	0.1	1.0 0.1			7Y 5M
AS	1.1	OFF	EXH.	X					X			
BA	1.2	X		X				X		1.0 0.1 0.1		9Y 8Y 8Y
BG	1.1	X		X			X		1.0 0.1			7Y 6Y
BR	1.1	X		X				X	0.1	1.0		12Y 8Y
BU	2.2	X	0.2	X		1.0 1.0			0.1 0.1	1.0 1.0		~5Y ~5Y 11Y ~4Y
BV	1.1	X		X				X		1.0 0.1		5Y 5Y
BW	1.1	X		X			X			1.0 0.1		6Y 6Y
CA	2.2	X		1.1 1.1				X X	0.1	1.0 1.0 0.1		1.5Y 8Y 1.5Y 1.5Y
CG	1.1	X		X			X		1.0 0.1			+10Y +3Y
CF ²	2.1	X		1.1		1.0	X		1.0 1.0 0.1			18Y 2Y 17
CM	2.0		X	X			X	X	1.0 1.0			~3Y ~6Y
CP	1.1	X		X				X	1.0 0.1			? ?
DA	1.1	X		X				X	0.1	1.0		6Y 8Y
DE	1.1	X		X			summer	winter		1.0 0.1	X X	11Y 8Y
EL	1.1	X		X			X		1.0	0.1		6Y 8Y

Institution	Sex & #	Outdoor Exhibit	Indoor Exhibit	Together 24 hours	Separated at night	Alone 24 hours	Night Access to Exhibit	Nights in Holding	WC	CB	HR	Age
HO	2.2	X		X			X		1.0 0.1	0.1 1.0 0.1	X X	5Y 6M 7Y 6M
HR ³	1.1	X		X					1.0 0.1			8Y 6Y
JB	1.1	X			X			X	1.0	0.1		7Y 6Y
KX ⁴	1.2	X		0.2		1.0		X	1.0 0.1 0.1			~3Y ~6Y ~6Y
LR	2.1	X		X			X		1.0	1.0 0.1		11Y 7Y 7Y
LP	1.1	X		X			X		1.0 0.1			7Y 7Y
LO	2.2	X		X			X		1.0 1.0 0.1 0.1			? 6Y 6Y 6Y
MT	1.1	X		X				X	1.0 0.1			7Y 8Y* Dec.
MP	2.0	X		X			X		1.0 1.0			10Y 4Y
MI	2.0	X		X				X		1.0 1.0		8Y 2Y
NT	1.1	X		X			X			1.0 0.1		11Y 6Y
NC	0.2	X		X			X		1.0	0.1		4Y 3Y
NZ	3.0	X		X			X		1.0 1.0 1.0			6+Y 6+Y 4+Y
OH	0.2 L.M	X		X			X			0.1 0.1		5Y 5Y
PB	1.1	X		X					1.0 0.1			13Y 12Y

Institution	Sex & #	Outdoor Exhibit	Indoor Exhibit	Together 24 hours	Separated at night	Alone 24 hrs/day	Night Access to Exhibit	Nights in Holding	WC	CB	HR	Age
RI	1.0 Was 1.1	X		X		X	X		1.0		X	9Y
SE	1.1	X		X			X		1.0 0.1			~5Y ~5Y
SN	1.1	X		X			X		1.0 0.1			~4Y ~2Y
SP	0.1	X				X	X		0.1			~19Y
ST	3.3	3.0 0.3 Dam & pups		X			X		0.1	1.0 1.0 1.0		2Y 2Y 2Y ? 2Y 2Y
SU	1.1	X		X			X		1.0	0.1		12Y 2.5Y
SZ	1.1	X		X			X		1.0	0.1	X	3.5Y 3Y
TS	3.3											
TT	1.1	X		X			X		1.0 0.1		X	~7Y 1.5Y
TZ	2.2	X		X			X		1.0 1.0 0.1 0.1		X X X X	2Y 4M 2Y 1Y
WO ⁵	2.1	X		1.1		1.0	X	X	1.0 1.0 0.1			6Y 2Y 2Y
WP	1.1	X		X			X		1.0 0.1			~6Y ~6Y
ZA	1.1	X		0.1 in	quarant.	1.0			0.1	1.0		4Y 2Y
ZG	1.1	X		X			X		0.1	1.0		2Y ~2Y

Ages for many animals have been rounded to the nearest year. See detailed answers for more information.

1. Female too young to be introduced yet, will be done Feb. '98.
2. Historic information, no longer house N.A. river otters.
3. Animals are temporarily separated.
4. In the process of introducing these animals.
5. Animals are rotated on exhibit.

Specific product names and amounts of food items used as part of the diet.

Indicate if amounts are per animal, per feeding, per group per day, etc. Please list all enrichment food items and how often they are offered. How, where, and how often are the animals fed? Does the diet vary seasonally? Does and animal's age, or reproductive status influence the diet offered?

(See Tables for additional information; note, Nebraska feline diet and Carnivore diet are listed as the same in the tables.)

Note: Many facilities that were feeding Nebraska Brand feline diet in 1997 have since switched to other products. Individual institutions should be contacted for current products.

AK “ They are fed 1x daily when brought in to holding as 0.1 and 1.1. They eat ¾ lbs. (340 g) Nebraska Brand feline diet each. They get capelin as a treat and when keeper talks are given. Occasionally given live crayfish and goldfish in the pond. Not interested in rawhide chews.”

Diet does not vary seasonally or due to age or reproductive status.

AR “ Male: (Mon.) 6 oz. (170 g) smelt 2 x day; (Thurs.) 6 oz. (170 g) chopped chicken necks 2 x day; (Tu, W, F, Sa, Su) 4 oz. (113 g) Purina Dog Chow & 1 oz. (28 g) Nebraska Feline diet. He is fed 2 x day on exhibit or in night den.

“ Female: (5 months old), 1/3 can Science Diet Feline Growth 2 x day; 3 – 4 medium smelt 2 x day; 1/3 cup dry Science Diet Feline Growth 3 x day. She is fed 3 x day holding. The female will be switched over to the male's diet when she matures.”

The diet does not vary seasonally.

Enrichment:

<u>Natural</u>	<u>Food</u>	<u>Artificial</u>	<u>Placement</u>
Browse	Bloodcicles	Bobbin	Access to den
Cholla	Bread	Boomer ball	Buried (food, toys)
Furniture – new	Chicken necks	Cardboard box	Hidden (food, toys)
Horse hoof clippings	Ice cicles/ cubes	Kong toy	Rearrange furniture
Leaf pile	Crayfish		Scattered (food, toys)
Peat moss	Crickets		
Plant materials	Eggs		
Sand	Fish		
Snake shed	Jelly		
Snow	Mealworms		
Spices	Monkey biscuits		
Extracts	Peanut butter		
	Pumpkins		

AS “ Animals are fed twice daily.” The diet is: “ Previously frozen fish – Tulibee – with Sea-Tab, 1 ½ - 2 lbs. (680 – 907 g) of this daily. Dry dog/cat chow – handful each twice daily. ½ lb (227 g) Bird of Prey diet each animal. Toys include whole carrots, apples, etc. twice daily or more.” Diet does not vary seasonally or with reproductive status.

BA “Daily diet: Su, M, W, F – Females each receive 6 oz. Feline mixed with ½ oz. Mink chow in AM and PM. Male receives 6 oz. Feline diet mixed with 1 oz. Mink chow in AM and PM. The group receives 4 oz. dog chow and monkey chow.

“ T, R, Sa – Females receive 6 oz. (170 g) fish in AM and PM; male receives 8 oz. (227 g) fish in AM and PM. Group receives 6 oz. (170 g) carrot total with PM diet.”

Feline/mink mixture and fish fed to each animal separately. Dog chow, monkey chow, and carrots fed to the group. Diet is changed based on weight gain or loss but not varied seasonally or due to reproductive status.

Food items used: Nebraska Brand feline diet, Fauna Industries Rainbow trout, Mazuri (PMI Feeds) 25% monkey chow, Purina dog chow, GroFur dark mink chow, carrots. Enrichment includes crickets (30g or 1 oz.), earthworms (50g or 1.75 oz.), minnows (½ pt. = 8 oz. or 227 g) browse (3 branches), apple (67g or 2.35 oz.). “ One enrichment item is given per day around 1:30pm in the exhibit.”

BG “Saltwater fish and fresh chicken thighs. One thigh each and 3–5 Spots each per day. Spots average 5 to 6 oz. (141.75 – 170 g) each. The group is fed on exhibit once a day. It is a natural tidal exhibit, they catch and eat minnows, fresh water clams and crawfish on their own at times.” Diet amounts are increased during the winter months depending on how much they are eating. Diet does not vary with reproductive status.

BR “2 lbs. (907 g) Nebraska (per group) per day, Kale, Carrots, 3–4 Capelin. Fed once per day, together in holding.” Diet does not vary seasonally or with reproductive status.

BU “Diet mix (for four animals): 4 lbs. (1814 g) ZuPreem Canine diet, 2 lbs. fish, 1 ½ cups (12 oz. or 340 g) carrots, 4 cups (20 oz. or 567 g) dog chow – grind in food processor. Each animal is offered 1 lb. (453 g) of mix daily. 0.2 fed in separate dishes in the same cage. 2.0 each fed in their own holding.” Diet is not varied seasonally but it is increased for lactating females.

BV Animals are fed as a group one time per day. 2 lbs. (907 g) of Nebraska Brand feline diet or chicken, fish or rodents (2 lbs. or 907 g). “Combinations of the above are also given. Animals are enriched with chicks, live fish, live crabs or crayfish 1/week. Diet is not varied seasonally but will be varied if a female becomes pregnant.”

BW “Amounts are per animal, per feeding: 5 oz. (142 g) Nebraska feline, 4 smelt, 6 Mazuri Omnivore biscuits, 1 hard-boiled egg added on M, W, F. They are fed 2 x day on exhibit, together. Food is thrown to them to make sure they both get even share.” Diet is not varied seasonally or with reproductive status.

CA Items fed: Nebraska Brand canine & feline; carrots; Hunt’s Tomato Juice; Purina Calf Nurse; Parade Eggs; Bluebonnet chunky dog chow; Bluebonnet cat chow; Fort Dodge Clovite; Atlantic mackerel and beef bone. Minnows are offered in the water to encourage them to stay in water.

Diet: 70% ground meat; 5% liver; 20% mink chow; 3% milk – nursing chow; 2% tomato juice and scraped carrot may be added; 1 tsp. Cod liver oil per otter per day; 1 egg per day per otter. Fed individually 2 times daily, AM and PM. “We can feed them crawfish when available. We freeze some, but they don’t eat them as well as the live ones. These crawfish help to keep tartar off the otters’ teeth.” Age or reproductive status does not influence diet at this point.

CF Historic information, no longer house otters:

Nebraska Brand feline diet – 1 lb. (453 g) per animal day in PM; monkey chow/omnivore chow – approximately 8 pieces per animal in AM; minnows or other small fish – 1 dozen 3x/week; horsemeat – about ½ lb. (227 g) 2x/month offered with meat diet; horse tail bone – 2x/month; filet Bass and Roe when available (spring & summer); offered day old chicks for enrichment and when medicating animal.

Animals fed as a group on exhibit. Bass was offered based on availability, also, the amount of diet offered was increased on cold days. Diet was varied with age of the animal, i.e. juvenile fed several times during the day as he was growing.

CG “Per animal per day: 2 herring, 10 smelt, 2 chicken heads.

“Per animal per week: 1/8 lb. (56 g) hamburger, 1 day old chick, 1 – 2 eggs.

“Occupational: insects, e.g. crickets, invertebrates e.g. mussels and clams.”

CM “Our otters are not on the same amount of food year round since their diet changes seasonally. We feed the otters Science Diet Brand feline light formula wet food, capelin, night smelt, and carrots on a daily basis.

“The following are all enrichment foods that we feed our otters: minnows, once or twice a week; apples, occasionally; fiddler crabs, once a month; ice toys (filled with capelin or night smelt &/or carrots) given every other day.

“(* Our otters are also given a wide variety of toys for enrichment, along with the trainers having the ability to change the look of the sand portion of their exhibit for environmental enrichment purposes. Their toys include PVC pipes of varying size for tunnels or sand toys, large buckets that can be buried and filled with sand or water, rope toys, balls of different sizes, chew toys made of hard rubber and of different

textures and shapes, a large children's pool that can be filled with mud, hard plastic horseshoes, plastic bowling pins, etc. These objects are changed every other day, and the sand portion of the exhibit is changed approximately every third day.)

"Our otters are fed together four times daily. The majority of the feedings are conducted in the exhibit, but we do consistently feed them in their stall area as well. The otters are fed during training and feeding sessions, two of which are educational presentations for the guests that visit the aquarium daily."

CP "Per day each animal: 200g (7 oz) Nebraska feline, 100g (3.5 oz) Capelin, ½ carrot and 1 – 2 leaves greens chopped and mixed into the meat. Group is fed 1x day. Occasional live fish put in exhibit pool as enrichment item."

Diet does not vary seasonally or with age/reproductive status.

DA "Nebraska Brand feline diet – 2 lbs. (907 g)/animal/day divided into 2 feedings. Weekly substitutions of fresh fish for meat. Live fish enrichment when available. Animals fed separately twice per day." Diet does not vary seasonally.

DE "Nebraska Brand feline diet – ½ lb. (227 g) per animal; ; Diamond High Pro dog chow – 1 cup per animal; trout – 2 to 4 fish per animal. AM – dry food and canine diet fed individually; male out in exhibit, female in holding area. PM – trout fed on exhibit, animals together."

Diet does not vary seasonally or with age/reproductive status.

DI "4 days a week – 2 lbs (907 g)/group of Nebraska Brand feline diet; 2 days a week – 1 lb./group feline with 1 lb (454 g) of herring; 1 day a week – 2 lb (907 g) mackerel per animal. Live fish is fed on no particular schedule."

Animals are fed as group on exhibit twice daily.

Although diet does not vary seasonally, enrichment may increase during the summer with availability of live fish.

"Older otters' teeth are worn so more meat is offered with age."

EL "Diet is per group: 28 oz (793 g) ZuPreem feline; 1 cup cat chow; 8 oz (237 ml) V-8 juice; 1 cup low protein dog chow; 2 dozen minnows; 4 oz (113 g) carrots; chicks 2 x day.

"Animals are fed on exhibit at multiple feeding spots. They are fed 3 times per day. Diet does not vary seasonally.

"If it is determined the female is pregnant her diet is increased during lactation."

HO "Nebraska Brand Zoo Carnivore diet 50:50 with Iams dry cat food; 1 ½ lbs (680 g) each. 22 oz (624 g) can of pedigree chopped beef dog food, 17 oz (503 ml) water – otters get ¾ lbs (340 g) each of this mix in AM. Two to six herring each in PM. Three hatchling chickens each M, W, F and one rat on Sat."

"Fed as a group, except December through February when Olga has young, Robbie is fed away from her. Fed twice daily, meat mix in AM and fish in PM. Fed on exhibit.

"Pregnant female is given Vetamix Osteoform, 2 tsp. 2x/wk October through weaning in February. Increase her meat mixture as much as she wants December to February.

"(Also)...young get more and adult pair reduced intake of meat June through August. They eat about ¼ lb (113 g) or less each."

HR "For each: 1 lb. smelt in AM 1 ½ lb (680 g) smelt and ½ lb (227 g) feline (feline is mixed with 1 raw egg and Vionate or pet tab granules). in PM.

"Fed in separate pans two times per day. When housed together we do not separate them at feedings."

Diet does not vary seasonally but it will be adjusted if she becomes pregnant.

* This table lists in general terms dietary items fed by each institution. *Main diet ingredient* forms the bulk of the diet or is an item given in a significant amount on a daily basis. Those items listed under *Other dietary items offered* that fulfill the *Main diet* requirement are marked with an *. *Other dietary items offered* constitute those given less than 5 times per week or are only a small part of the diet. *Health problems* columns are used to indicate health concerns that influence diet formulation. Problems that have been experienced are indicated by (X). A (P) represents prophylactic inclusion of a dietary item i.e. vitamins, clovite, etc. or bones, chicken necks, etc when specifies as being given for dental hygiene; *GEN* category is utilized for those institutions that give dietary additives but do not cite a specific reason. *ADD* column covers vitamins, oils, coat supplements. *ENR* column covers enrichment food items. *C* = cat chow; *D*= dog chow; *F* = ferret chow; *Omni* = Omnivore biscuits; *Monkey* = monkey chow biscuits; *fr* = fruits; *v* = vegetables; *horse* = horse meat; *ham*= hamburger; *mou*=mouth

1997 N.A. River Otter Husbandry Survey Diet & Health - Table														
Insti- tution	Main diet ingredient				----- Other dietary items offered-----						Health prob.			
	Feline diet	Canine diet	Fish	Fish	dog/cat chow	mink or fur mix	chick. parts	Bones	Carrots & other	A D D	E N R	Teeth or Mou.	G E N	C&t P
AK	X			X						X	X			X& P
AR*	X	X	X							X	X		P	
AS			X		DC*				X BoP	X	X		P	
BA	X		X	X	D	X			X Monkey		X			
BG			X				X			X	X		P	
BR	X			X					X greens	X			P	
BU		X	X		D*				X	X				P
BV	X			X			X		Rodents		X			
BW	X			X					Omni HB eggs					X
CA	X	X		X	DC	X	X	X	X	X	X			X
CF	X			X				X	Horse Monkey Omniv	X	X		P	
CG			X				X		Ham eggs X		X			
CM	X		X						X	X	X		P	
CP	X		X						greens X	X	X		P	
DA	X			X							X			

Institution	Feline diet	Canine diet	Fish	Fish	dog/cat chow	mink or fur mix	chick. parts	Bones	Carrots & other	A D D	E N R	Teeth or Mou.	G E N	Coat
DE	X		X		D*									
EL	X		X		DC*		X*		X	X				X
HO	X		X		C*		X		rat	X				P
HR	X		X						egg*	X			P	P
JB	X			X				X	X		X	XP		X
KX	X								fr;v F8		X	X		
LR		X			D*									
LP	X		X		C					X	X	X	P	
LO	X		X							X			P	
MI	X		X											
MP			X							X	X	XP		
MT	X		X						rodent	X			P	
NC	X		X		D*				V X	X	X		P	
NT	X									X				
NZ	X		X							X		X	P	P
OA	X									X	X		P	P
OH	X			X			X							
PB	X		X							X			P	
RI	X		X		D*						X			
SE	X		X						omni*		X			
SN			X			X				X	X		P	
SP	X		X						egg.X	X				P
ST	X		X											
SU	X		X		C*					X	X		P	
SZ	X		X											
TS	X		X						fr &v	X	X		P	X
TT	X		X							X				XP
TZ	X		X				X	X	heart fr & v	X	X		P	
WO		X	X				X		rat	X				P

Institution	Feline diet	Canine diet	Fish	Fish	dog/cat chow	mink or fur mix	Chick. Parts	Bones	Carrots & other	A D D	E N R	Teeth & Mou	G E N	Coat
WP	X									X			P	
ZA	X		X				X							
ZG			X				X		rodent	X			P	

JB Animals fed twice a day in 1997. 6 oz. Nebraska Brand feline and ½ carrot (scattered on exhibit) in AM. 6 oz (170 g) Nebraska Brand feline in PM. 2 small to medium trout, herring, or mackerel fed mid-day to each animal twice a week. 1 – 2 rib bones offered 1 x week. Meat fed to animals individually in holding; the fish was offered whole or cut in pieces on exhibit. Rib bones offered during the day on exhibit. Live fish given every other week.

Diet does not vary seasonally but, does vary at times in response to weight gain. The female's diet is increased during the last trimester of pregnancy if she is showing signs of needing more food. Her diet is always increased by approximately 30% during lactation.

Due to weight gain both adults were reduced to 5 oz. Nebraska feline in 1999 (female) and 1997 (male) 2 x day. Beginning in 1998 rib bones were offered 2 x week. In 1999 additional fish was added to the diet to try and improve coat water repellency qualities. (This was successful.)

Current maintenance diet: 5 oz (142 g) Nebraska feline 2 x day; ½ carrot scattered in the exhibit in the morning. One medium trout offered mid-day 4 x week; 2 thin rib bones offered 2 x week (some weeks fish are substituted for the rib bones, especially because the male has a hard time with bones now due to the condition of his teeth.) Animals are fed three times a day.

Both adults maintained a fairly good weight on this diet until late 1999 when the female gained weight with her pregnancy and the male was receiving slightly more than his share of fish offered on exhibit for the female.

Lactation diet: 5 oz (142 g) feline diet 3 x day, one trout every day. Amounts are increased as pups grow, this varies from litter to litter.

KX “ 0.2: Nebraska Brand Feline diet – ¾ lb (340 g) each animal/one feeding daily 7 Missouri Brand Ferret diet – 2 tablespoons each animal/one feeding daily.

“1.0: Nebraska Brand Feline diet – ½ lb (227 g) AM & PM, feeding daily & Missouri Brand Ferret diet – 1 tablespoon AM & PM feeding daily.

“ Fresh fruits and vegetable according to individual animal tastes (bananas, apples, carrots, etc.)

“ Every 2 to 3 months they are given live fish in the pool for enrichment – tilapia or shiners. We use small pieces of capelin for behavioral management.

“ Animals fed individually in holding (off exhibit); females once daily and male twice a day. If appetite drops off in warmer weather we adjust accordingly.”

LI “ AM feeding: ¾ lb (340 g) Nebraska Brand feline diet per otter (amount varies based on individual size and need).

“ PM feeding: ½ to 1 ½ cups Spectrum Polar Bear diet per otter (amount varies based on individual size and need).”

No supplements are added. lactating females are fed more.

LO “ Per group (5 animals): 5 lbs (2.27 kg) Nebraska Brand feline; t tbsp. Cod liver oil (Tue. – Fri.); ½ oz (14 g) Zoovite (Tue. – Fri.); 1 ½ cup small fish and 10 live fish on exhibit. Diet is divided into AM and PM feedings – fed in night house as a group.”

LP “ At the current time each of the following are used: .660 lbs (300 g) each of Science diet feline maintenance dry food; Nebraska Brand feline meat; frozen then thawed any one of the following fish – mackerel, capelin, small trout, herring. Total amounts of food prepared varies depending on the amount

offered however the 3 items are always in a 1:1:1 ratio. Items are all food processed together then offered as small, bite sized meatballs. Currently our female receives 1.1 lbs (499 g) of food daily and the male receives .750 lbs (340 g) daily. Quantities are based on goal weights we have for our otters. when available, we have fed live fish, golden roaches. However, availability may be up to 2 or 3 times per year.

“ Both are fed 3 x day in association with 2 target training sessions and 1 public feeding.

“ Amounts offered are based on maintaining goal weights.” Age/reproductive status does not apply at this time”.

LR “ Nebraska Canine diet – 1 lb (453 g) each and 2 cups Quality Plus Hi-Pro dog food for the group. Fed on exhibit one time per day.”

Diet is not varied seasonally or with age/reproductive status.

MI “ 175 – 250g (6 – 9 oz) Nebraska Feline each in AM; variety of fish (~100g (3.5 oz) each) mid-day; 175 – 250g (6 – 9 oz) Nebraska Feline each in PM Animals fed individually in holding.”

Diet varies “very little” seasonally.

MP “ They are offered about 1 ½ lbs (60 g) of Columbia River Smelt or other freshwater smelt 2 times per day per animal. They are also given a few pieces of Mackerel or herring. In a fish is Vit. E and a B-complex daily. They are given live minnows or crayfish on occasion. This is usually done 1 to 2 times per week. the dead fish, i.e. smelt is thrown in their pools and they have to swim to get them. That is done all of the time.

“ They are fed together two times daily.

“ The amount offered is based on their need, are they hungry, not by season.”

Diet does not vary with age/reproductive status.

MT “One herring - Sunday; 4 medium smelt daily at lunch; 1 hamster – Tuesday; plain carnivore mix daily except Tuesdays and Sundays. One bone on Monday. Animals were fed together when the female was alive.”

Diet does not vary seasonally or with age/reproductive status.

NC “ ¾ lb (340 g) capelin (low fat fish); ¾ lb (340 g) high fat fish (herring, Pacific sardine)); 2 oz (57 g) Hills feline seafood; 1 cup Hi Pro dog food per animal. Enrichment includes: crickets, carrots, cucumbers, tomato, apple, bones. Items are offered usually one time per week.

“ Otters are fed individually in separate holding cages. They are fed twice daily with vitamin supplements crushed in the fish.” Diet does not vary seasonally or with reproductive status.”

NT “ Nebraska Brand Feline diet: male – 10 oz (283.5 g) 2 x/day (AM & PM); female – 8 oz. in the morning and 10 oz (283.5g) in the evening. Animals fed in separate holding pens.

“ Animals fed more in winter – activity, metabolism and energy requirements increase.”

Age/reproductive status not applicable at this time.

NZ “ Given ½ lb (227 g) feline diet (Nebraska) in the morning. Fish frozen into ice blocks at noon during the summer, ½ lb (227 g) feline diet and 3 smelt, or similar fish, in the evening. Fed 2 x/day, on exhibit. Each animal is tossed its share.”

“ The fish frozen into ice is added during the summer months.”

Diet does not vary with age/reproductive status.

OA “ Principal diet consists of Breeder’s Choice Diet #1 for non-domestic felines. Male receives 125 g (4 oz) 3x/day; female 135 g (5 oz) 3x/day. They are fed 3x/day, both individually in holding and/or at opposite ends of the exhibit.”

The diet does not vary seasonally.

“Their diets would certainly be changed should the female become pregnant, or should they become less active with age.”

Enrichment foods:

smelt

5x/wk (used for training)

hard-boiled eggs

2 – 3x/wk

<i>beef bones</i>	<i>2x/wk</i>
<i>live goldfish</i>	<i>3 – 4x/wk</i>
<i>imitation crabmeat</i>	<i>1x/wk</i>
<i>canned tuna (chunk-light in water)</i>	<i>2 – 3x/wk</i>
<i>sliced carrot (subs. cucumber, yam, zucchini, apple, or celery trout, salmon, catfish, sand-dabs or crabs</i>	<i>3 x/day (with each meal) 1x/wk</i>
<i>cooked poultry, no bones (A favorite.)</i>	<i>2x/mo</i>
<i>mild cheddar cheese (sml. amts.)</i>	<i>1/mo</i>
<i>greens – 1 leaf (mustard, kale) (Only the male likes greens.)</i>	<i>2x/mo</i>

OH “ 8 oz (227 g) Nebraska Brand Carnivore diet each/AM; 8 oz (227 g) carnivore diet each T, Th, Sa, Su/PM; 3 lb (1.36 kg) mackeral each – M, W, Fr in PM; T/Th chicken necks each along with diet; minnows, crayfish every 1 – 2 weeks. Fed on display together; separated only by food placement.”
Diet does not vary seasonally but, older animals are fed less.

PB “ 2 lbs (907 g) Feline diet per animal per day in AM. 1 ½ lbs (680 g) fish in exhibit pool in PM. Fed together two times per day.”
Diet does not vary seasonally or with age/reproductive status.

RI Current diet: “ Each animal receives daily – ¼ lb (113 g) Nebraska Brand Carnivore diet; ¾ cup dry Purina dog chow; ¼ lb (113 g) trout or smelt (frozen and thawed); goldfish and crawdads are offered on an intermittent basis, preferably 2 – 3 times per week, presented live in the pools.

“ We began feeding the above diet on the recommendation of a nutritionist in late 1996. Up until then we had been feeding an “otter recipe” diet which consisted of the following: 42 oz (1.19 kg) dry oatmeal, 24 carrots (pureed), 16 cups bran, 24 oranges (peeled & pureed), 32 cups dry cat food, 24 eggs, 10 lbs (4.5 kg) beef liver, 50 lbs (22.68 kg) carnivore diet, 24 tomatoes (pureed), 32 tsp. Cod liver oil, 32 tsp. wheat germ oil, 32 cups dry milk, 32 cups water. All the ingredients were mixed together and bagged in 2 ½ - 3 lb (1.1 – 1.3 kg) bags. Each otter was fed one bag/day in two feedings. Each batch made approximately 60 bags of food which was kept frozen.

“ The animals are fed individually in holding off exhibit. The are fed morning and night. We decrease the amount of food given in spring and summer due to decreased energy requirements.

“ We monitor the animal’s age, weight, activity level, reproductive status, and adjust the diet amount accordingly.”

SE “ We offer 1 ½ lbs (680 g) of Nebraska Brand Feline diet to our pair per day, divided into AM and PM feedings. Also mixed in with the feline diet is Mazuri Brand Omnivore pellets that have been soaked in water (½ cup). 1 lbs (453 g) of live fish (perch, minnows) fed in afternoon, when live fish is not available frozen smelt that have been thawed are put in the diet in the evening. We use earthworms as enrichment on land.

“ The AM diet is fed on exhibit as a group, but the evening diet is fed in holding in separate pans but they still have access to one another. Half of the diet is fed in the AM and the other is fed in the PM at closing.

“ Our otters’ appetites decrease during the winter so we decrease their diet by ½ lb., but in the summer their appetite increases so it is bumped back to 1 ½ lbs (680 g)”

SF “ Nebraska Brand Feline diet fed. Male receives 1 lb. feline diet, 8 oz (227 g) fish (herring or smelt), 3 oz (5 g) of vegetables (carrot, greens, apple) daily. Female receives 12 oz (340 g) feline diet, 6 oz (170 g) fish (herring or smelt), 2 oz (57 g) vegetables (carrot, greens, apple) daily. Live goldfish daily approximately 8 each. Enrichment fish Popsicles, squid (one each), chicks (2 each), horsemeat (1 oz (28 g) each).

“ Live fish and enrichment on exhibit as a group – mid-day. AM feeding in holding together. PM feeding in holding together. This is a revised diet implemented in October 1996.”

SN “Animals have access to wild trout, eels and aquatic invertebrates. Diet consists of 1 kg (2.2 lbs) fish per animal per day plus 500gr (18 oz) fur farm wetmeal (locally produced) per animal per day. Animals are fed as a group twice daily.

“ Species of fish varies by season. usually herring in the winter and codfish in summer.”

Diet does not vary with age/reproductive status.

SP “ For one animal: 1/3 – ½ can ZuPreem feline diet, grated carrot, 1 tsp. Linatone, & 1 tsp. vegetable oil offered AM and PM; 10 – 11 thawed frozen trout offered mid-day; 1 hard-boiled egg offered in PM only. Fed on exhibit three times per day.”

Diet does not vary with season or age/reproductive status.

ST “ Nebraska Brand Feline diet – ¾ lb (340 g) per individual once a day and one small herring per individual once a day. Fed together on exhibit twice a day.”

Diet does not vary seasonally or with age/reproductive status.

SU “ Diet for 1.1 otters: AM 300 g (10.5 oz) of smelt; PM 450 g (16 oz) feline, 50 g (2 oz) small pieces beef liver, ¼ cup dry milk, ¼ cup bran, ¼ rolled oats, ½ diced carrot, 1/3 diced tomato, ½ diced orange, ½ tsp. cod liver oil, ½ tsp. wheat germ oil, 1 hard-boiled egg – mix ingredients into a ball and add 1 cup cat chow. On Wed. substitute 1200 g (42 oz) smelt. Male gets about 60% and female about 40% of this mixture. Occasionally given live fish, crayfish.

“ Fed as a group in several places. Keeper tosses food to be sure each gets their allotted amount. Fed two times per day, staple in the evening.”

Diet does not vary seasonally but would vary with reproductive status.

SZ “ Approximately 6 trout in morning and 4 to 6 trout in the evening. Given ZuPreem feline diet daily. Fed together with the fish usually scattered around the exhibit area. Fed twice daily.

“ Fed a little more in fall and winter and a little less in summer. Given live fish when available.”

TS Fed three times per day.

“ Feeding 1: 150 – 250 g (5 – 9 oz) (avg.) of fish per otter, depending on the otter’s weight. We feed around 8:00am; feed capelin, herring, smooth sardines; some do not eat the fish heads.

“ Feeding 2: @ about 2pm feed fish in “otter-pops”, and hide throughout the exhibit. Food is not weighed out for each otter – they find various amounts; avg. = 150 g (5 oz)

“ Feeding 3: after 4pm; Nebraska feline diet; this varies according to the animal’s weight and time of year (they eat less in the summer months); avg. = 150 – 250 g (5 – 9 oz) On this food we will add 100 mg. B1 and 3 tsp. Linatone.

“ Some of the otters like fruit (strawberries, blueberries, banana, apples) and vegetables (squash, carrots, cucumber). These were fed as “treats” and in small amounts; no digestive problems. We used to feed live crawfish occasionally, but stopped after the discovery of a perforated intestine on “Icky” (found during necropsy; he had eaten crawfish about 1 month prior to death).”

TT “ AM – 250 g (oz) feline per otter with 2 tablespoons vegetable oil, ½ scoop Pet tabs and 1 Vitamin E tab. PM – 300g (10.5 oz) feline per otter, 2 tablespoons vegetable oil, ½ scoop Pet tabs and 3 – 4 fish (capelin) in exhibit.

“Fed on exhibit in the morning together and inside holding at night in separate nest boxes.”

Diet does not vary seasonally.

TZ Three animals fed 2x/day (100 g (3.5 oz) feline diet AM/200 g (7 oz) feline diet PM) and young 4 month old male fed three times per day (150 g (5 oz) feline diet each feeding). In addition to feline, each animal is offered 2 capelin, day old chicks (2x/wk), and beef heart (1x/wk).

“ Enrichment food items include fish Popsicle, apples, minnows, gold fish, cow bones, live crawfish, crickets, whole fruits, and vegetables.”

Animals are fed in holding for ease of getting them in.

Diet is varied seasonally with an increase in winter and young animals are fed more, and more often.

WO “ Three medium trout and ½ lb (227 g) Nebraska Canine diet daily. Twice weekly a rat and/or chicken head and neck.

“ The lone male is of course fed alone. The young pair do well together. Live trout is fed as enrichment in the exhibit pool two or more times daily.

“ A little more is offered in the winter. In the summer (with more visiting public) they are fed a few more times with fewer live trout to keep them visible and somewhat active.”

WP “ 2 lbs. meat each. Fed 1 lb (453 g) in AM and 1 lb (453 g) in PM. Feed Nebraska Brand feline diet or Animal Food Service Carnivore diet. Animals are fed 2 times per day on exhibit in individual pans in summer and inside in winter. Diet may vary from 1 ½ lbs. to 2 lbs (680 – 907 g); they eat less in the winter.”

Diet does not vary with age/reproductive status.

ZA “ Animals fed on exhibit two times per day. AM – 8 to 10 oz (227 – 283 g) Nebraska Brand feline diet and 4 to 6 oz (113 – 170 g) capelin; PM – 6 oz (170 g) Nebraska Brand feline diet or 1 chicken leg or thigh.

“ Additional ounces are added in winter months.”

Diet does not vary with age/reproductive status.

ZG “ Diet: AM – One herring per animal; PM – 4 herring per animal 4 days/wk; 20 smelt per animal 2 day/wk; 7 mice or 4 chicks 1 day/wk.

“ The animals are fed twice a day in the exhibit. The keepers throw the food to each animal to ensure each gets the proper amount.”

Diet does not vary seasonally or with age/reproductive status.

List any supplements, and amounts, added to the diet. Why are these supplements added?

(Main diet ingredient is included as an indicator only; please see previous section for accurate diet.)

AK “ Linatone, only when coat is rough, not oily...and does not bead off water properly.”
(Main diet – Nebraska feline)

AR “ The male gets 50 mg. Vitamin B¹ with smelt (1x/wk). The Vitamin B¹ has been destroyed by freezing so we supplement it.” (Main diet – Purina dog chow, feline diet)

AS Sea Tabs are added to the diet (daily) for dietary health. (Main diet – fish, dog/cat chow, bird of prey)

BA No supplements added. (Main diet – feline/mink chow mix, dog chow, monkey chow, fish)

BG “ Chaparral Zoological Vitamins, Mazuri Vitamin blend sprinkled on fish (daily) to provide vitamins A & E as recommended by AZA accreditation team.” (Main diet – fish and fresh chicken)

BR “ Vita Sol Vitamins with vitamin E oil.” (Assumed to be daily.) (Main diet – feline diet, capelin)

BU “ Nutriderm to enhance coat quality.” (Assumed to be daily.) (Main diet – canine diet, fish, dog chow)

BV No supplements added. (Main diet – feline diet, chicken or fish or rodents)

BW No supplements added. (Main diet – feline diet, fish, omnivore biscuits)

CA “Fort Dodge Clovite is added (daily) for their coat. We took them off clovite once, their hair started looking dull and falling out.” (Main diet – canine & feline diet)

CF “Added vitamin E and Thiamine to male juvenile’s diet; he received 400iu vitamin E ~ 2/wk; 1cc Thiamine 1x/wk.” This was done to “improve skin/coat condition, Thiamine was supplemented while the otter was receiving dead fish in the diet.” (Main diet – feline diet)

CG No supplements added. (Main diet – fish, chicken heads)

CM “The otters are given one tablet of Derm Caps, DVM Pharmaceuticals, Inc., every other day. We also give out otters anti-oxidants, Matola, and they are given ½ tablet every day. Both offered under the advice of our staff veterinarian.” (Main diet – feline light formula, capelin, night smelt)

CP “Vitamin E and B¹ added per dieticians orders.” (Assumed daily.) (Main diet – feline diet, fish)

DA No supplements added. (Main diet – feline diet)

DE No supplements added. (Main diet – feline diet, dog chow, fish)

DI “50cc of cod liver oil is added to the meat daily for water resistance of their coats.” (Main diet – feline diet, fish)

EL “Cod liver oil is added for poor coat condition that occurs in female every spring.” (Main diet – feline diet, fish)

HO 1.5cc Smith Kline Beecham Lixotonic is added 2x/week. “Good results – excellent coat, overall physical condition good; no scientific proof, just visual.” (Main diet – zoo carnivore diet, cat chow, dog food, fish)

HR “1tsp. Vionate or Pet Tabs granules and raw egg (1x/day). Egg for coat maintenance and vitamins as a nutritional supplement.” (Main diet – fish, feline diet)

JB No supplements added. (Main diet – feline diet)

KX No supplements added. (Main diet – feline diet, ferret diet)

LI No supplements are added. (Main diet – feline diet, Spectrum Polar Bear diet)

LO 1tbsp. Cod liver oil (4x/wk) and ½ oz. Zoovite (4x/wk) are added. (Main diet – feline, fish)

LP “Thiamine Hydrochloride (Vit. B¹) 100mg. given 3x/week; 1 ½ tablets per otter. This is done as a preventative measure due to the feeding of certain fish.” (Main diet – feline diet, feline dry food, fish)

LR No supplements added. (Main diet – canine diet, dog chow)

MI No supplements added. (Main diet – feline diet, fish)

MP Given Vitamin E, B-complex and B¹ daily. “The vitamins offered are not found in abundance in fish. However, we feed fish because they have a normal otter stool and their teeth are much improved over a red meat diet.” (Main diet – fish)

MT “Thiamine tablets 1x/day; 50mg. Vitamin E (50 iu/g) – 1 tsp. daily. Thiamine added due to the fish being frozen.” (Main diet – fish, carnivore mix)

NC “Mazuri Vita-Zu 5m25, 1 tablet per ½ lb (227 g) of fish, 3 tablets (daily). Given per recommendation of vets due to fish diet and quality of fish.” (Main diet – fish, dog chow)

NT “Powdered multi-vitamin/mineral supplement sprinkled over carnivore diet.” (Main diet – feline diet)

- NZ** “*B¹ tabs in fish; ¼ tsp. cod liver oil added to meat daily.*” Done for vitamin supplement and coat conditioning. *(Main diet – feline diet, fish)*
- OA** “*1/2 tsp. of Diaglo S.A. is added 2x/day and 1 tsp. wheat bran 3x/day. Diaglo as a coat conditioner; bran to add fiber and enhance stool consistency.*” *(Main diet – feline diet)*
- OH** No supplements added. *(Main diet – carnivore diet)*
- PB** Vionate and Osteoform are added. *(Main diet – feline diet, fish)*
- RI** No supplements added. *(Main diet – carnivore diet, fish, dog chow)*
- SE** No supplements added. *(Main diet – feline diet, fish, omnivore pellets)*
- SF** No supplements added. *(Main diet – feline diet, fish)*
- SN** “*Vitamin B¹ added to wetmeal when herring used (thiaminase enzyme present in herring).*” *(Main diet – fish, fur farm wetmeal)*
- SP** 1 tsp. Linatone and 1 tsp. vegetable oil added daily. “*This is done for coat water resistance but in an out-dated part of the diet and may be changed in the future.*” *(Main diet – feline diet, fish)*
- ST** No supplements added. *(Main diet – feline diet, fish)*
- SU** “*½ tsp. cod liver oil, ¼ cup bran and ½ tsp. wheat germ oil added daily per vet recommendation.*” *(Main diet – feline diet, beef liver)*
- SZ** No supplements added. *(Main diet – fish, feline diet)*
- TS** 100mg. B¹ and 3 tsp. Linatone added daily. *(Main diet – fish, feline diet)*
- TT** 2 T vegetable oil (2x/day), ½ scoop Pet Tabs (2x/day), 1 vitamin E, clovite, yeast, D-Ca-Fos (all daily). Added for coat and general health. *(Main diet – feline diet)*
- TZ** “*Calcium, B¹ and Vionate are added daily to replenish destroyed vitamins/minerals in the freezing process.*” *(Main diet – feline diet, fish)*
- WO** “*1 to 2 tsp. Nutriderm daily as a coat conditioner.*” *(Main diet – fish, canine diet)*
- WP** “*General vitamin supplement added daily just in case it is needed.*” *(Main diet – feline or carnivore diet)*
- ZA** No supplements added. *(Main diet – feline diet, fish)*
- ZG** Thiamine put in the fish daily. *(Main diet – fish)*

Supplements are listed as given by the submitting institutions. M = multi-vitamins/minerals, including Mazuri Vit. Blend, Vita Sol, & Chaparral Zoological Vit.; ST = Sea Tabs; P = Pet Tabs; Ca = Calcium; Vi = Vionate; Di = Diaglo S. A.; Cl = Clovite; De = Derm Cap; Os = Osteoform; Li = Lixotonic; Nu = Nutriderm; Lin = Linatone; Ve = Vegetable Oil; Cod = Cod Liver Oil; Br = Bran; Y = Yeast; Wh = Wheat Germ Oil; Ao = Anti-oxidants; D-Ca-Fos split in to D, Ca, Pho; No = None. * Indicates supplements given only sporadically.

Dietary Supplements Table																											
1997 N. A. River Otter Husbandry Survey																											
Inst.	B ₁	E	B	M	ST	P	Ca	D	Pho	Di	Vi	Os	Li	Nu	Ve	Wh	Br	Cod	Lin	Cl	De	Ao	No				
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(Information from questions #10 Have you N. A. river otters bred? and #11, Describe how your otters are managed to encourage breeding, is contained in the Reproduction Section and in the 1997 printed survey results.)

Have you observed a false, or pseudo pregnancy? Have you observed something that was believed to be a pregnancy but turned out to be something else? If yes, please describe. (Negative answers have been left out.)

BA *“We have seen an unusually larger weight gain in the females during two winters but it was just weight gain.”*

CF *“Yes, female displayed signs of pregnancy for several years prior to her death. The onset of behavior usually began in January. Female would drag debris into her denning area. She would become aggressive to the male and spend most of her time in the den. She was often observed holding her front paw in her mouth while walking into the den (interpreted as “carrying a pup” into the den). During the winter months we provided both otters materials such as; hay, pine needles, pieces of burlap, to provide warmth as their dens were not heated. We were never sure if this “encouraged” her nesting behavior. There were two occasions that I recall her nipples became enlarged as well. Her nesting behavior would continue for a couple months. (I believe otter breeding season in Florida is from December to March; her behavior seemed to correlate with this.)”* Please note this is historic information.

DE *Yes, “our female was believed to be pregnant this spring, but was not. Mid-March Rosie (female) began hiding most of the day from Rataxis (male), and became much more aggressive than normal with section keepers (she is normally a very friendly animal) and also with the male. A bloody stool was reported on 3/23 and mucus on the vulva was reported twice. Her appetite also decreased. The male was first separated 24 hours a day from the female (female in holding, male on exhibit) on 4/3, and then moved out of the exhibit on 4/8. By 5/27 her behavior and appetite had become closer to normal so the male was returned. They fought on and off for about a week (they were still separated at night). They are now back to their normal routine and are together days and nights. her friendliness to keepers has also returned.”*

HR *“Yes, our female has had one false pregnancy three years ago. Her mate at the time was a 17 year old wild caught male. Breeding activity was observed prior to they symptoms.”*

JB *Yes, our female experienced what is believed to have been a false pregnancy in 1997. One of her yearling pups was caught on video attempting to breed her on 04 May 1996 (this occurred on at least one other occasion); at the time she was exhibited with the adult male and her three yearling male pups. In early April 1997 she began showing weight gain; by mid-April she was spending more time in her nest box and her nipples appeared somewhat engorged. She also became a little more aggressive to the adult male (all three pups had been sent to other institutions by this time), keeping him out of her den area during the day (these animals are always separated at night). Her appetite also increased as it normally does during pregnancy.*

This female normally whelps in the last half of April; by the first part of June her behavior was returning to normal. Breeding was observed on 28 May; 12, 16 & 23 June 1997.

LO *“Yes, gained weight and was aggressive to the males.”*

MP *“Yes, the female was about 7 years old and went through nesting behavior and keeping the male at a distance. We even heard what we thought was a pup cry, but nothing when the box was checked several weeks later.”*

MT *“Yes, a couple of times the female built a small nest and got bigger in the abdominal region. Vulvar swelling was seen. Shortly after it was determined she was ill and treatment was started for a bladder infection both times. The second time there were complications and she died March 26, 1997.”*

OA *Yes.*

TS Yes.

(* As of January 2000 I had heard of at least eight other females that were thought to be pregnant but did not produce pups. Two of these definitely had bladder/uterine infections. It is not known if the others were really false pregnancies, if pups were produced than consumed, or if these females were also ill. Urogenital infections can cause vaginal discharge, loss of appetite, lethargy, and distension of the abdominal area – all but the first, symptoms associated with pregnancy. If definite breeding has not been observed, or a vaginal discharge is seen, the female should be closely monitored for infection.)

Please describe any chronic or frequently seen ailments or health problems.

(Negative answers have been left in for this question. This has been done to aid any future inquiries into health issues.)

AK Foot pad abrasions are the only frequently seen problem. They reported a “spurt of Strongyloides-like infection” and that there had been problems with distemper.

AR No health problems.

AS -----

BA *“0.2 otters have had several colds!? Always begins with the otter holding one eye closed followed by runny eyes and nose, then white or yellow mucous from the nose.”*

BG *“None”*

BR -----

BU *“Majority of health problems have been age related.”*

BV *“None”*

BW *“Male had some problems with his coat – patchy bald spots, matted areas when we were using chlorine. Has not had any bald patches since changing to Bromine tablets.”*

CA A preventative step taken is Ivomec once a month as a guard against heartworm. *“We did have a problem with coat looking dull; clovite and mackerel help.”*

CF Historic information: *“Had problems with the adult male’s coat in the spring. When he would shed, his guard hairs would often break and he would get bare patches along his back and sides; I believe we treated him on several occasions, but this problem would clear up on its own. (Treatment = Septra). There were a couple of occasions in the years before his death when he would have bad diarrhea during these bad sheds. This is probably why he was treated with Septra.”*

CG -----

CM *“None observed.”*

CP *“None”*

DA -----

DE None.

DI *“Abscess on female’s jaw from breeding wounds.”*

EL *“In the female, bright red blood (6 – 8 drops) are seen near feces, not in it. Diet has been changed to add more roughage and blood was drawn and a T₃ & T₄ test was done. Results were inconclusive. Animal is currently receiving Soloxin.*

“Female had round worms years ago and had an inner ear infection in 1995.”

HO *“None.”* An otter they sent to another facility was reported to have been found to have a thin-walled heart upon necropsy.

HR -----

JB *“Our eight year old male has required dental work, including a root canal and canine extraction. A wild born, hand-reared female was reported to have required two root canals at the facility she was sent to from here. since this time we have added rib bones to our diet but, I am not convinced this has solved our problem, particularly for the male.”* (Current 2000 information – The male has not required additional dental work but he has recently stopped eating his rib bones. A better solution to the dental problem may be the feeding of day-old chicks, chicken necks, more whole fish, or something similar.)

“This same male experienced unexplained seizures on 25 April 1992, 06 June 1993, 03 August 1994 and 06 May 1996. Each episode lasted a few minutes and left him disoriented for a brief period; he would quickly recover after about a half an hour.” (Current 2000 information: This male had additional seizures on 12 June 1998, 23 April 1999, 27 August 2000 ; the 1999 one occurred in the water and took him several hours to fully recover from, which could have been due to water inhalation. It has become apparent that there is an associated hair loss in an oblong pattern on each forearm with at least some of these seizure episodes. Our current working theory is that he is allergic to some sort of tree or grass pollen that peaks in the spring to early summer [this does not account for the August seizure]. The seizure in 2000 was not preceded by the hair loss on the forearms noted in 1999, earlier in the summer he had started to show some thinning of the hair in this area but it never became completely bald. When he had the seizure the area was fully furred. On December 10, 2000 he was found dead in his night holding den. At the time of writing the necropsy had not been performed.)

“We had foot pad abrasion problems with our female but these were resolved by giving the otters straw in their night dens and their exhibit holt year around.

“On occasion up to three spots of bright red blood have been seen near the stool (depositing animal has not been identified, but thought to be the female). This has never been tied to any behavioral abnormalities, particular dietary items, time of year, or physiological changes. The animals never give any indication that anything is wrong so it remains unexplained.” (Current 2000 information – We continue to sporadically see these spots of bright red blood, mostly on exhibit, but once or twice in the female’s night dens. There appears to be a superficial correlation between the appearance of these spots and feeding the otters frozen fish.)

“The female was treated for what was believed to be an inner ear infection and both animals have had periodic colds.” Current 2000 information – We have not had any “colds” since 1997 but, both otters have runny noses sometimes and more rarely runny eyes. The fluid is clear and has cleared up by itself every time.”

“Several years ago the female began carrying her left front foot in her mouth after a minor foot injury. She still does this periodically, particularly soon after she goes out in the morning , late in the day and when locked in her night dens. However, she does not do this at all when she has pups (until they are about one year old).”

KX *“Oral abscess, nasal discharge, cellulitis.”*

LI *“None”*

LO -----

LP *“Both our otters are very healthy however, the female has had some dental problems over the last two years. Teeth (mostly molar type) were removed.”*

LR *“N/A”*

MI -----

MP *"We used to have chronic teeth problems until going to a fish diet. They are annually anesthetized and vaccinated and given a thorough physical, there has been no need to clean teeth since the fish diet."*

MT *"Bladder infection"*

NC *"Female has blood droplets in stool area"*

NT *"None"*

NZ *"Occasional facial wounds from fighting. These wounds frequently get infected and require antibiotic treatment."*

OA *"Male has had bouts of alopecia with skin irritation on tail and forefeet due to stereotypical behavior (sucks tail, bites feet). Has been treated with antibiotics in the past, but has had no problem in the past 3 years."*

OH *"None"*

PB *"Some stereotypical self-grooming is frequently observed in the male."*

RI *"Our female died of a uterine infection (this was not chronic or frequent, but I thought it might be pertinent)." * This is an area worthy of further study – i.e. bladder or uterine infections have been reported to me from some five or six institutions and references are found in the literature.*

"Our male occasionally has a runny nose and sneezes frequently. This usually clears up on its own, but if his appetite decreases we will treat him with antibiotics and it clears up."

SE *"The male otter has a recurring bare spot on his back and abdomen that will lose hair and then regrow it, usually one time each year."*

SF *"Both animals are in good health."*

SN *"None encountered."*

SP *"Very loose stool."*

ST None

SU None

SZ *"None so far."*

TS A severe bladder infection in one female (she was bloated and at first thought to be pregnant.) An older female experienced what was finally decided to be a false pregnancy.

Males have suffered varying degrees of hair loss. Two had hair loss from around the eyes; this was thought to be caused by a possible allergic reaction to a palm tree in their exhibit they liked to rub their faces in and on. A third male has had recurring problems since 1996. Spring of that year he showed small patches of fur loss; suspected fungal infection. Treated with Fulvicin (about 2 days) and hair grew back. Loss experienced again in fall of '96; Fulvicin treatment resulted in hair re-growth. Hair loss began again in Feb. '97 starting on the hind legs, then the front forearms, then the tail. A variety of treatments have been tried; ozonator turned off, and behavioral causes ruled out with no result; hair loss continues. The animal continues to eat and socialize with the other animals without any problems.

- TT** *“Coat – mats up, otters not grooming one another.”*
- TZ** *“N/A”*
- WO** *“When exhibit first opened we had some foot pad and underside of tail abrasions but, we seemed to have solved that problem. Nothing as of now.”*
- WP** *“None”*
- ZA** *“Very few problems with otters.”*
- ZG** *“None.”*

What type of water treatment do you use? What problems have you had with this method of water treatment?

- AK** *“Sand filter and diatomaceous earth.” Problems have been: “...keeping water clear; otters filled skimmers with rocks; debris carried into pool and clogging filter.”*
- AR** *“D. E. – no chemicals – will switch to sand filter soon.” Problems have been: “...disposal of filtration medium.”*
- AS** *“Planning sand filter, wet-dry filter (bioballs), UV sterilizer. Formerly had problems with water clarity using only sand filter.”*
- BA** *“Exhibit pool is treated with Bromine, filtered through a sand system and has a recently updated ozone. Indoor pool is drained and scrubbed every other day, no filter. Most of the trouble is in regulating the Bromine and ph levels in the water. Water seems to grow algae faster with Bromine than our pools treated with chlorine. The sand seems to backwash into the bottom of the pools making cleaning more difficult.”*
- BG** *“None, the exhibit is in a brackish water tidal swamp. Everything is natural.”*
- BR** *“None, pool is bleached one time per week.” No problems with this method.*
- BU** *“Sand filter is used on one tank with re-circulation, second pool is continuous fresh water fill.” No problems with this system.*
- BV** *“Sand filter.” No problems with this system.*
- BW** *“Sand filter Bromine tablets. Super See Clear water clarifier. Sand filter has trouble keeping up with the amount of dirt sometimes. Different type of filter may clean water better.”*
- CA** *“We use city water that has chlorine in it.” They are using a Little Giant Submersible Sewage Ejector Pump, filter mediums for these systems can be Activated Carbon, Birm, Filter-Ag, Corosex, or filter Sand; it was not specified which medium is being used.
“This system does not keep the pond clean. It backwashes itself. Our old system kept the pond cleaner, but it was a lot more maintenance than this one.”*
- CF** *Historic information. “No water treatment was done. Pool was drained and cleaned daily.”*
- CG** *“Sand filter and constant flow.” No problems with this system.*
- CM** *“Sand filters and chlorine.” No problems with this system at this time.*
- CP** *No problems with water system.*

DE Sand filter used. *“1. Grate from pool to filter has mesh that is too large and allows too much debris into the filter. 2. Whole sand system had to be replaced after only 4 – 5 years. 3. Piping is underground, which makes repair difficult. 4. Cracks in pipes allow air into the system so backwashes must be run very frequently to get it out.”*

DI *“Sand filters with beneficial bacteria and aerator. Unable to prevent algae growth during the summer months.”*

EL They do daily water changes and have had no problems with this system.

HO *“Natural spring fed waterway. The walls of the enclosure are non-porous, there are six screen vents allowing inadequate flow; we have an algae problem.”*

HR *“Sand filters for pools. Must keep chlorine levels low to prevent eye irritation. If chlorine levels are too high, keepers have observed the otters squinting their eyes.”*

JB A sand filtration system is used. Twice a week one cup of Sta Clor (chlorine) is added to each pool at night; pools are tested before the otters are let out in the morning to make sure chlorine is no higher than .05ppm (we have not had any coat problems keeping chlorine at this level). Pools are vacuumed twice a week and completely drained four to six times a year. There is a constant low inflow of water to the pools.

This system does not keep the water as clear as an ozone system but does a fairly decent job of keeping the water clear enough for visitor viewing through underwater window. It is time consuming (i.e. vacuuming and skimming), but overall the system works pretty well. Algae growth on walls and window is a problem in warmer months.

2000 – We are investigating switching to something other than chlorine, possibly Bromine. The addition of higher volumes of fresh water to the pools in winter (our municipal water department adds chlorine to the water) has lead to higher reading of chlorine than we consider acceptable. In the future we plan on switching to an air bubbler to keep the water from freezing and eliminate the high volume of fresh water introduced each day.

KX *“Sand filtration with city water.”* They have a problem with water clarity.

LI *“Pools are emptied, cleaned and refilled daily.”* No problems with this system.

LO *“Sand filter and chlorine. Take chlorine readings daily; it has damaged otter coats when too high. Keep it below 1ppm.”*

LP *“None, our exhibit does not have recirculating water. We simply empty, clean and refill the exhibit pool three times per week.”* No problems with this system.

LR *“Swimming pool filter.”* No problems.

MI *“D-E filter.”* No problems.

MP *“None, there is a recirculating pump and fresh water coming in at a slow rate. No problems other than the need for greater pool cleaning.”*

MT *“None at the moment, but considering chlorine or Bromine.”* Have had a problem with large algal build-up.

NC *“Two high-rate sand filters; exhibit is topped off with fresh water.”* Have a problem with rapid algae growth in water.

- NT** *“We change water two times per week and run thru sand filter.”* No problems with this system. *“We used to use chlorine but stopped because of the damage it did to the otter’s coats.”*
- NZ** Sand filter, no problems.
- OA** *“Water is not treated, but is circulated. Pool is cleaned and re-filled daily.”* No problems with this system.
- OH** *“Sand filter; drain pool two times per week to clean.”*
- PB** *“Sand filter; no problems.”*
- RI** No water treatment used.
- SE** *“We use ozone for our water filtration. Sometimes does not seem to clear up fast enough, does not kill algae that grows on sides and bottom of pool.”*
- SF** *“Sand filter, pool is dropped and cleaned once a week.”*
- SN** *“Natural flowing water.”*
- SP** Use a basket filter with no problems.
- ST** Sand filter used with no problems.
- SU** Continual flow of fresh water. No problems.
- SZ** *“We don’t have underwater viewing so no water treatment is done.”*
- TS** Were using an ozone system, turned off when hair loss problems occurred. However, this does not seem to have been the cause of the hair loss problem.
- TT** No water treatment system.
- TZ** Use a sand filter system. Have found this does not keep the water clear and they have to change the water weekly.
- WO** Use a sand filter and ozone injection system. No problems with the otters’ pool.
- WP** Pool water is changed.
- ZA** Use a sand filter. *“Doesn’t always keep the pool clear especially in the fall when lots of leaves are falling.”*

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CHAPTER 8

HAND-REARING

GENERAL INFORMATION

As Ellis-Joseph points out in the AZA Infant Diet Notebook (1994), *“With the decision to hand rear come two basic responsibilities: 1) to ensure the healthful survival of the young animal; and 2) to provide an environment that fosters “normal” development and expression of species-typical tendencies.”*

Once the decision has been made to hand-rear a litter, or pup, there are some general, and specific, pointers to keep in mind.

“Many factors relating to the feeding process are important and can influence the success of the hand rearing attempt. Among these are formula composition; feeding frequency; amount fed; formula preparation; feeding technique; nipple/bottle type; stimulation before, during, and after feeding; formation of social bonds, and behavior learned in association with feeding; introduction of solid food; and transition to adult life.” (Meier 1985)

Accurate, complete records of objective (i.e. weight, consumption, stool amount and consistency, urine output, coat condition, physical development, etc.), and subjective (i.e. social development, play behavior, development of species-specific behavior, etc.) should be kept.

Pups must be kept in a warm, secure place. If the skin becomes dry, the humidity may be too low. A warm, damp cloth can be used to wipe down an animal after feeding to clean any spilled formula and help keep the skin moist.

Pups should be weighed daily at the same time, preferably before feeding.

Neonates and very young pups need to be stimulated to defecate and urinate. Again, a damp cloth or piece of cotton is appropriate for this purpose.

Any formula should be adjusted until it fits the animal’s needs; the animal should not be forced to adapt to the formula.

If an animal is weak, or is not interested in nursing, stimulation of the lips, face, throat or anal area may elicit a suckling response. Use a finger-tip or piece of moist, warm cotton to do this.

Carnivores, in general, are usually offered 20 – 40% of their body weight daily. (Meier 1985) Lowry Park Zoo used 30% of the pups body weight as their guideline. (1994 JBZ Survey) This total daily amount should be divided by the number of feedings given in a 24 hour period. Be careful of gastric over-load. A too full tummy can cause vomiting up to several hours after feeding.

Wallach & Boever (1983) give 85°F (29.4°C) and a minimum 50% humidity as the desired incubator setting for mustelids. Meier (1986) suggests 29.4° to 32°C (85° to 90°F) and 50% to 60% humidity. The temperature should be gradually reduced to room temperature (roughly 21.2° to 23.9°C (70° to 75°F) over

the course of about three weeks (unless the neonate becomes ill). If the ambient temperature is too high it may cause hair loss.

“Neonates are obligate nose breathers. They cannot breath through their mouths and nurse at the same time.” “Respiratory infections cause a great deal of trouble because they not only interfere with breathing but they also make nursing difficult or impossible.” (Meier 1985) Aspirated formula is frequently a contributing factor to neonatal respiratory infections; to avoid this be sure to select the appropriate nipple. The nipples hole needs to suit the neonate’s sucking reflex. Also, if a nipple is too stiff, the pup may tire and refuse to nurse.

Hold the pup in the correct nursing position; ventrally or sternally recumbent (tummy down please, not on its back), with the head up. Place the hand holding the bottle in such a way that it provides a surface for the pup to push against with its front feet. If milk comes through their nose the nipples hole may be too large or the pup may be trying to eat too quickly.

“If the neonate does appear to inhale formula, an immediate response may minimize the damage. The young animal should be placed in ventral recumbency in the palm of the caretaker’s hand. The animal’s head should be supported by the caretaker’s fingers and its body should be supported by the wrist and forearm. The caretaker’s other hand should be placed over the neonate’s back and head. The neonate should then be swung forcibly downward several times; this action is followed by three to four gentle blows on the back. If foreign material is actually obstructing the airway, abdominal thrust should be used as well.” (Meier 1986) For “blows” keep the word tap in mind.

If there appears to be a dietary problem, change only one thing at a time. *“If several items are changed simultaneously, it is difficult to analyze problems. The formula itself may not be creating the illness—formula concentration, feeding frequency, gastric overload, and rapid changes can also produce gastrointestinal signs. Over feeding and extremely rapid feedings should be avoided.”* (Meier 1985)

A variety of products have been used for bottle feeding otter pups, including; premie nipples, pet-nip nursers, syringes, and eye droppers. Select your feeding apparatus based on size of the pup and what works best for you.

Like all young animals, river otter pups will require more and more stimulation, diversions, play objects as they get older. It is important to their natural development that they are kept stimulated. The pups will need to be taught to swim. This should be done gradually, in lukewarm water at about seven to eight weeks of age. Start by putting them in a shallow tub or small bowl of water for a few minutes, gradually lengthening the swimming lesson as their confidence and ability improve. Once the swimming lesson is over be sure to dry the animal off.

See Health Care Section for vaccination information.

YOUNG ANIMAL HEALTH CONCERNS

Otter pups can develop health issues suddenly, and they must be carefully watched for any change in behavior. Some problems that have developed in young hand-reared pups are listed below with suggested first-step solutions or treatments. The following recommendations and cautions come from Blum, P. (unpublished Florida Aquarium data).

- Dehydration/emaciation: Give subcutaneous or oral (only if sucking well) electrolytes. Lactated Ringers Solution (LRS) with 2.5% dextrose or sodium chloride (0.8% NaCl) are recommended. Oral fluids are given at the dose of 5% body weight per feeding. The dose for subcutaneous fluids is determined by the level of dehydration, and should be determined by a veterinarian.

- Diarrhea/constipation: Digestive upset is a common issue with hand-reared neonates, and may be associated with several factors (Meier 1985): a) inappropriate milk formula; b) feeding frequency; c) overfilling the stomach which can cause bloating; and d) rapid changes in the diet. When digestive upset occurs, characterized by diarrhea, bloating, inappetance, and/or extreme disorientation, it is recommended that one factor is analyzed and/or changed at a time. The veterinarian should be consulted immediately in the case of diarrhea, as the condition of very young animals can deteriorate rapidly.

Diarrhea related to diet changes may be treated with Kaopectate[®] with veterinary approval. It should be noted that Kaopectate[®] now contains salicylic acid (aspirin), as does Pepto-Bismol[®], and gastrointestinal bleeding may result from frequent doses. Persistent diarrhea, or loose stool accompanied with inappetance requires continuous veterinary care. Bacterial infections or parasites, such as Coccidia may be the cause of the problem and require specific medication. Osmann (personal communication) recommends the administration of *Lactobacillus spp.* into the formula for *P. brasiliensis* pups with diarrhea, or after antibiotic treatment. Veterinarians should consider this for all otter species.

Constipation may be treated by diluting the formula to half-strength for 24 hours, and gradually increasing back to full-strength over a period of 48 hours. The pup also can be given oral electrolyte fluids at the rate of 5% body weight in between feedings, and 1-2 times over a 24-hour period. The pup's back end can be soaked for a few minutes in warm water (make sure to dry off completely) accompanied by gentle stimulation, but care should be exercised that the anal area is not irritated.

- Upper respiratory infections: Pups that have been eating normally and suddenly start chewing on the bottle or seem uninterested in the bottle may have an upper respiratory infection. They cannot nurse properly when congested. Upper respiratory infections need to be treated immediately. Newborn pups can die within 24 hours of the first symptom. Antibiotics should be started at the first sign of infection.

Antibiotics can be given orally or injected. Care should be taken with the location of injections to avoid the sciatic nerve in their rear limbs (in two cases where limb mobility was affected due to injection site, the lameness/paralysis was resolved over time). Pups on antibiotics may also develop GI problems and/or get dehydrated, and this should be treated accordingly. Antibiotics that have been used successfully for upper respiratory infections are listed below. Antibiotics should not be given without consulting a veterinarian first.

Enrofloxacin: injectable at 5mg/kg BID IM

Amoxicillin: 20mg/kg BID PO

Penicillin G Procaine: 40,000-44,000 IU/kg q24 hr IM

- Bloat: Some otter pups have developed bloat. Care must be taken to ensure that there is no air in the formula or any leaks in the bottles. The amount of formula fed at each feeding should be re-evaluated as the pup may be receiving too much. Reducing the amount fed per feeding and adding another feeding should be considered. Watch for respiratory distress as respiration may become labored with severe abdominal distention. Treatment options for bloat include passing tubing to decompress, or the use of over-the-counter medication. Infant gas drops have been tried with no effect. Care should be taken with the use of certain gastric coating agents, such as bismuth subsalicylate (Pepto-Bismol[®]), as some ingredients may create more problems.
- Fungal infections: Caretakers should look for hair loss and discoloration of skin, and should pull hair samples and culture for fungus using commercially available fungal culture media. At first appearance, fungal infections can be treated with shampoos and creams, and shaving the affected areas can also help. Severe infections may need to be treated with oral/injectable medication.

- **Parasites:** Fecal samples should be taken regularly from otter pups (specifically hand-reared pups), even if they are negative. Pups should be dewormed as needed, and treatment started immediately to avoid any weight loss.
- **Bite/puncture wounds:** Any bite or puncture wounds should first be cleaned and flushed with fluids, and then treated with topical antibiotic and systemic antibiotics if necessary.

OTTER MILK, MILK REPLACER AND SELECTING A FORMULA

“It should be noted that artificial milk replacer cannot be expected to perform as well as mother’s milk. Rather, the goal is to produce a positive growth rate to enable the neonate to wean itself to a solid diet.

“In order to provide a neonate with proper nutrition and, hence, facilitate its growth while it is being fed an artificial milk replacer, one should remember the following concepts: (1) Protein, fat, carbohydrates, energy, vitamins, and minerals must be supplied in amounts and proportions that support a positive growth rate. (2) The amount fed at each feeding should not exceed the maximum comfortable stomach capacity. (3) The number of feedings per day should be adequate to supply daily energy requirements considering the finite amount that can be delivered at each feeding. (4) Every effort should be made to promote weaning to a complete and balanced solid diet when physiologically possible.” (Evans 1985)

There have been a number of formulas used over the years to hand-raise otters. This chapter will cover a selection of these. Keep in mind that the dams milk composition is presumed to change over the course of lactation and that, as of this writing, we do not know when these changes occur. For this reason, when hand-rearing otters it is important to closely monitor the pups’ progress and re-evaluate the number of feedings and formula offered on a case by case basis.

Otter Milk Composition

Water: 62% Fat: 24.0% Protein: 11% Carbohydrates: 0.1% Ash: 0.75%
(Ben Shaul 1962)

Solids: 38% Fat: 23.9% Protein: 11% Carbohydrates: 0.1% Ash: 0.75%
Energy(KCAL/ML): 2.83 (Evans 1985)

Solids: 38% Fat: 63% Protein: 28.9% Lactose: 0.3%
(Pet Ag, Inc. 1993 Zoological Nutritional Components Milk Matrix Formulation & Mixing Guide. From: Jenness R. & R. E. Sloan 1970)

It should be noted that no data is available as to when during the process of lactation milk samples were collected. Further, it has been pointed out that sample size and how the data was collected is not specified resulting, possibly, in a high margin of error. However, Evans (1985) comments: *“Despite the sources of error, practical experience has shown that these data generally are adequate for formulation of artificial milk replacers.”*

Milk Replacer & Formula Options

General Formulas

Esbilac and Milk Matrix 30/55 (also known as Multi-Milk available from Zoologic® a division of PetAg®, 261 Keyes, Hampshire, IL 60140, 800-323-0877), combinations of these, and combinations of these formulas with other additives have all been used. (Foster-Turley 1985, Lowry Park Zoo pers. com., Cain-Stage 1992, and many others). In Great Britain, a product called Lactol has been used successfully. (Johnstone 1978)

Davis (1983, unpublished)

This information comes from a conversation between Joe Davis, IUCN/SSC Otter Specialist Group Advisor, and Joan Ryskamp, John Ball Zoo (6/22/83)

“He recommended Esbilac at a mixture of 1 part Esbilac powder to 3 parts water. Of the reconstituted Esbilac he suggested 2 tbsp. of liquid per 4 oz. of body weight, or, 1 fluid ounce of liquid per 4 oz (113 g) of body weight. For every pound of weight gain increase daily amount offered by 4 oz. He apparently did not recommend offering more than 6 oz (170 g) per feeding.

“Mr. Davis suggested using a rubber ear syringe for feeding because it is stronger than a regular nipple, it won't collapse, and it can be forced into the mouth if necessary.

“As solids are offered, he suggested adding rendered chicken fat and powdered Esbilac to Nebraska Feline diet. The additives are required because the feline diet does not have enough calories. For 1 lb (453 g) of feline add, 2 tbsp. of rendered chicken fat and 3 to 4 tbsp. of powdered Esbilac. If meat mix will not be consumed quickly he strongly suggested adding 2 tbsp. of active cultured yogurt to prevent rancidity.

“Pups should be pot-bellied, if they appear lean, increase milk.

“Wean at four months. If a weight loss is seen for two days there could be a severe problem.”

Cain-Stage (1992) This formula was first published in the Wildlife Health News, 1992. M. Cain-Stage works with the rehabilitation center H.A.W.K.E., Inc. in St. Augustine, FL

*“Multi-milk (one part powder:2 parts water)
½ oz (15 ml) liquid whole milk whipping cream
½ tsp. white Karo syrup
One egg yolk
½ eye dropper of liquid HiVite multi-vitamins*

“Formula is made fresh daily and heated portions should not be reheated. The formula is mixed in a blender and stored in the refrigerator until used.

*“A composition more like the natural milk can be achieved using Multi-milk, Esbilac, and heavy whipping cream. The ration is as follows:
one part powdered Esbilac
two parts water
one part Multi-milk
one part heavy whipping cream*

“...river otters have also been successfully raised using Esbilac mixed as shown on the carton.”

Diana Sevin from the Bayou Otter Farm provided this formula that she uses for raising young otters:

½ c. Fowl starter/grower crumbles
½ c. Rice cereal
Mix with 1 c. Esbilac & 1 tsp. cod liver oil

Feeding Older Pups (six to ten weeks and older)

Frequently, young animals found in the wild have been orphaned when the dam was killed by cars or dogs. Usually these animals are old enough to be following mom so should require minimal formula feeding. With animals in this age range (six to ten weeks) it is important to wean them onto solid foods as soon as possible. Watch the animals coat condition, fecal output and consistency. See Do's and Don'ts under Feeding Young Pups.

Ben Shaul (1962)

“Some of litter removed at six weeks (when mature there is no difference in size, weight, or condition when compared with naturally reared companions). To each 8 oz (237 ml) of Carnation or homogenized milk, add 1 drop of Tri-vi-sol, yolk of one egg, 1 teaspoon lime water. Feed every 4 hours at blood heat from 6 weeks of age, then on demand. Shavings of lean horse-meat offered from start.” (Jeremy Harris, Oxnead Hall, Norwich, Great Britain)

Harris (1968)

Harris provided the same formula listed in Ben Shaul.

(The specific zoo/aquarium information was taken from the responses to the 1994 John Ball Zoo North American River Otter Breeding Survey unless otherwise noted.)

Audubon Park Zoo

The pups came in at about 2 ½ to 3 months old. At first they were given thinned Esbilac using a standard baby bottle and nipple. They were quickly switched to Esbilac mixed with baby cereal. The next progression was mixing meat baby food with the Esbilac.

Baton Rouge Zoo

The pups came in at about 6 weeks old. They were fed 2oz (59 ml) Esbilac and three to four whole smelt twice a day for about one week. a standard baby bottle and nipple were used. No problem getting the pups to nurse and the pups ate the smelt well. After about the first week, the adult diet (finely ground) was offered and their milk intake was gradually reduced over the next week. No additional supplements were added.

Metro Toronto Zoo

One animal was hand reared from about six weeks of age. Initially, he was fed five times a day (7am, 11am, 3pm, 7pm, 11pm). The formula was an Esbilac/2% milk combination; 1 ½ Tbsp. Esbilac to 3 ½ Tbsp. 2% milk. He also was fed finely ground carnivore mix in meatballs and smelt filets. *“As he got older, the number of feeds per day was reduced. At two months of age he was fed twice a day.”*

Analysis of Commercial Animal Milk Replacers (KCAL/ML) – Table

Product	Solids	Fat	Protein	Carbohydrates	Ash	Energy
Esbilac						
Undiluted powder	95.00	40.00	33.00	15.80	6.00	6.20
Diluted 1:3*	15.00	6.00	4.95	2.38	0.90	0.93
Diluted 1:1.5*	30.00	12.00	9.90	4.76	1.80	1.86
Liquid product	15.00	6.00	4.95	2.38	0.90	0.93
KMR						
Undiluted powder	95.00	25.00	42.00	26.00	7.00	5.77
Diluted 1:3*	18.00	4.50	7.56	4.68	1.26	1.04
Diluted 1:1.5*	36.00	9.00	15.12	9.36	2.52	2.07
Liquid product	18.00	4.50	7.56	4.68	1.26	1.04
Multi-Milk						
Undiluted powder	97.50	53.00	34.50	0	6.63	6.85
Diluted 1:1*	22.70	12.00	7.83	0	1.51	1.55
Diluted 1.5:1*	36.00	19.59	12.75	0	2.54	2.47
Evaporated Milk						
Undiluted product	22.00	7.00	7.90	9.70	0.70	1.49
Multi-Milk:KMR+						
1:1*	22.81	8.93	8.71	3.20	1.55	1.45
3:1*	22.90	10.97	8.63	1.54	1.59	1.57
4:1*	22.90	10.90	8.27	1.17	1.50	1.51
1:3*	22.70	7.28	9.10	4.39	2.30	1.37
1:4*	22.60	6.95	9.16	4.68	1.57	1.36
Multi-Milk:KMR++						
1:1*	34.22	13.40	13.07	4.80	2.33	2.18
3:1*	34.55	16.46	13.03	2.31	2.39	2.36
4:1*	34.55	16.35	12.41	1.76	2.25	2.28
1:3*	34.05	10.92	13.65	6.59	3.45	2.06
1:4*	33.90	10.43	13.74	7.02	2.36	2.04
Multi-Milk:Esbilac+						
1:1*	22.81	10.63	7.70	1.78	1.44	1.49
3:1*	22.93	11.63	8.00	0.89	1.52	1.56
4:1*	22.90	11.60	7.86	0.71	1.49	1.55
1:3*	22.70	9.81	8.75	2.67	2.13	1.51
1:4*	22.60	9.65	7.54	2.84	1.39	1.43
Multi-Milk:Esbilac++						
1:1*	34.22	15.95	11.55	2.67	2.16	2.24
3:1*	34.40	17.45	12.00	1.34	2.28	2.33
4:1*	34.35	17.40	11.79	1.07	2.24	2.33
1:3*	34.05	14.72	13.13	4.01	3.20	2.28
1:4*	33.90	14.48	11.31	4.26	2.09	2.15

* Ratio of powder to water.

+ Ratio of powder to powder, diluted 1 part powder to 1 part water.

++ Ratio of powder to powder, diluted 1.5 parts powder to 1 part water.

(from: Evans 1985)

Feeding Young Pups (Neonates to six or ten weeks)

(The specific zoo/aquarium information was taken from the responses to the 1994 John Ball Zoo North American River Otter Breeding Survey unless otherwise noted.)

Very young pups are more difficult to raise. It is preferable that neonates, in particular, are raised by experienced personnel. Care must be taken to closely monitor the animal's growth, development, and coat condition. **Do not** over feed, feed too quickly, bottle feed holding the pup on its back, forget to stimulate to urinate and defecate, allow severe diarrhea to continue, or change more than one formula/diet item at a time when trying to resolve a problem. **Do** keep the pup warm, clean, feed the age/weight appropriate amounts (frequent, small feedings for very young animals), wean to solids as soon as possible, keep detailed records, groom and maintain the pups coat, and teach the pup to swim.

Lowry Park Zoo

In 1994/95 Lowry Park hand raised a number of pups. Their guideline was to offer no more than 30% of the pups body weight (in formula) in a 24 hour period. Weight data can be found later in this section.

Week 1:	Pups fed 8 – 10 times per day (every 2 –3 hours). 3 – 5ml. were offered at each feeding. Started with Pedialyte then offered Milk Matrix 30/55. The specific gravity (SG) of their urine was tested to monitor the pup's hydration. A SG value of 1.020 is considered normal for adults and 1.012 for juveniles; if it is higher the animal was considered to be dehydrated.
Week 2:	On day 10 switched to 1:1 Esbilac: Pedialyte; on day 11 full strength Esbilac was offered. Consumption at each feeding ranged from 5 – 9ml.
Week 3:	Pups were taking about 7 – 15ml. at each feeding.
Week 4:	Mid-week one feeding dropped so they are now fed seven times in 24 hours. 11 – 20ml. offered at each feeding.
Week 5:	20 – 30ml. offered per feeding
Week 6:	Up to 55ml. offered per feeding.
Week 7:	Same.
Week 8:	Chicken baby food was added on day 54. Pups still being fed seven times per 24 hours. ½ to 1 teaspoon of baby food offered each feeding.
Week 9:	Fed six times per day. 60ml. of Esbilac and 1 Tablespoon to 1/3 jar of chicken baby food was offered at each feeding.
Week 10:	Feedings were gradually reduced to four times per day. They continued to offer 60ml. of Esbilac at each feeding supplemented with chicken baby food which was then switched to a mix of liver baby food and feline diet.

L. canadensis : Hand-reared versus Mother-reared Pup Weights - Table

Age in Days	LO*	LO*	LO*	LO**	LO**	LR	LR	LR	LR	LR	JBZ	JBZ	JBZ	JBZ	JBZ***
	100645	100646	100647	100651	100652	3762	3763	3764	4177	4178	301165	301169	301561	301560	females
1	110.0g	118.0g	110.0g		170.0g	170.0g	170.0g	168.0g	168.0g	168.0g					
2	106.0g	120.0g	109.0g	177.0g	184.0g	177.0g	190.0g	179.0g	182.0g						
3	103.7g	119.7g	114.3g	220.0g	220.0g	198.0g	204.0g	193.0g	193.0g						
4	107.6g	123.7g	115.3g	241.0g	241.0g	213.0g	221.0g	204.0g	213.0g						
5	111.4g	127.0g	116.5g	276.0g	255.0g	248.0g	263.0g	241.0g	249.0g						
6	113.5g	135.5g	123.5g	298.0g	291.0g	262.0g	291.0g	249.0g	272.0g						
7	113.7g	138.0g	115.0g	333.0g	326.0g	298.0g	322.0g	266.0g	286.0g						
8	113.2g	137.4g	124.4g	354.0g	354.0g	333.0g	344.0g	288.0g	308.0g						
9	110.5g	135.8g	122.5g	376.0g	376.0g	347.0g	372.0g	325.0g	347.0g						
10	111.6g	142.4g	135.6g	404.0g	404.0g	383.0g	397.0g	353.0g	364.0g						
11	115.3g	145.7g	137.0g	425.0g	418.0g	397.0g	412.0g	364.0g	378.0g						
12	123.0g	165.5g	152.5g	453.0g	446.0g	411.0g	445.0g	398.0g	414.0g						
13	122.0g	173.2g	159.4g	475.0g	467.0g	439.0g	473.0g	414.0g	431.0g						
14	136.0g	195.0g	176.2g	496.0g	496.0g	454.0g	459.0g	428.0g	448.0g						
15	147.0g	223.0g	200.5g	539.0g	531.0g	489.0g	498.0g	437.0g	462.0g						
16	152.5g	240.0g	220.0g	574.0g	560.0g	517.0g	554.0g	454.0g	468.0g	499.0g			533.0g	672.0g	
17	171.5g	256.0g	240.5g	595.0g	595.0g	546.0g	560.0g	473.0g	512.0g	532.0g					
18	183.6g	296.5g	271.5g	624.0g	617.0g	560.0g	599.0g	496.0g	526.0g						
19	199.5g	321.0g	290.0g	645.0g	624.0g	609.0g	633.0g	515.0g	535.0g						
20	218.5g	346.0g	305.5g	680.0g	666.0g	637.0g	636.0g	549.0g	568.0g						
21	233.0g	367.0g	330.0g	440.0g	450.0g	687.0g	687.0g	652.0g	672.0g	566.0g					
22	252.0g	397.0g	352.0g	483.8g	478.5g	780.0g	765.0g	723.0g	694.0g	619.0g			721.0g	912.0g	
23	280.0g	429.0g	388.0g	484.0g	492.0g	808.0g	780.0g	723.0g	734.0g	622.0g					
24	309.0g	467.0g	388.0g	520.0g	515.5g	843.0g	822.0g	758.0g	756.0g	644.0g					
25	343.0g	500.0g	453.0g	575.0g	543.0g	858.0g	822.0g	772.0g	806.0g	669.0g					
26	346.0g	490.6g	473.4g	570.5g	545.5g	872.0g	829.0g	772.0g	829.0g	711.0g					
27	367.0g	530.0g	483.5g	594.0g	565.1g	872.0g	850.0g	794.0g	871.0g	736.0g					
28	372.0g	535.0g	484.5g	621.6g	592.1g	886.0g	865.0g	815.0g	890.0g	756.0g	862.0g	907.0g			
29	412.0g	595.0g	560.0g	658.0g	610.0g	921.0g	907.0g	872.0g	913.0g	840.0g			952.0g	1.18kg	
30	448.0g	643.0g	553.0g	665.0g	637.0g	978.0g	935.0g	907.0g	969.0g	879.0g					
31	473.2g	660.6g	607.0g	725.0g	680.0g	999.0g	971.0g	928.0g	1.00kg	935.0g					
32	491.0g	652.8g	622.3g	733.6g	690.5g	1.04kg	992.0g	971.0g	1.04kg	969.0g					
33	510.0g	676.0g	632.1g	753.0g	725.0g	1.09kg	1.00kg	921.0g	998.0g	1.09kg	953.0g	1.09kg			
34	543.0g	735.0g	658.5g	801.2g	796.0g	1.11kg	1.08kg	1.01kg	1.13kg	1.04kg					

* Hand raised ** Wild born then hand raised, estimate as to age. *** Weights for four female pups born at JBZ, lightest weight recorded for that particular day, may be from different pups. All four pups survived to adulthood. There is no indication why the LO** pups show such a drastic weight change on day 21

***L. canadensis* : Hand-reared versus Mother-reared Pup Weights – Table (cont.)**

Age in Days	LO*	LO*	LO*	LO**	LO**	LR	LR	LR	LR	LR	JBZ	JBZ	JBZ	JBZ	JBZ***
	100645	100646	100647	100651	100652	3762	3763	3764	4177	4178	301165	301169	301561	301560	females
35	564.0g	733.0g	688.0g	808.0g	783.0g	1.14kg	1.11kg	1.05kg	1.15kg	1.06kg	998.0g	998.0g			
36	595.0g	771.0g	725.5g	878.0g	838.0g	1.18kg	1.13kg	1.06kg	1.20kg	1.09kg			1.23kg	1.53kg	
37	625.0g	802.0g	760.0g	913.5g	903.5g	1.19kg	1.16kg	1.09kg	1.22kg	1.14kg					
38	654.2g	828.7g	814.0g	957.0g	898.0g	1.25kg	1.21kg	1.13kg	1.28kg	1.18kg					
39	678.6g	820.0g	827.7g	998.0g	916.0g	1.28kg	1.23kg	1.15kg	1.33kg	1.20kg					
40	677.2g	844.8g	813.5g	1.01kg	951.0g	1.34kg	1.28kg	1.23kg	1.37kg	1.26kg					
41	700.0g	926.8g	865.9g	1.08kg	977.7g	1.37kg	1.35kg	1.28kg	1.39kg	1.25kg	1.20kg	1.30kg			
42	736.9g	972.6g	918.7g	1.11kg	1.02kg	1.41kg	1.32kg	1.25kg	1.43kg	1.29kg					
43	754.8g	980.0g	900.8g	1.12kg	1.07kg	1.39kg	1.35kg	1.28kg	1.46kg	1.31kg					
44	802.0g	1.05kg	981.0g	1.18kg	1.09kg	1.43kg	1.40kg	1.35kg	1.49kg	1.33kg					
45	856.5g	1.09kg	997.0g	1.21kg	1.12kg	1.57kg	1.45kg	1.39kg	1.55kg	1.39kg	1.32kg	1.45kg			
46	852.4g	1.14kg	1.04kg	1.20kg	1.25kg	1.61kg	1.51kg	1.43kg	1.42kg	1.42kg					
47	837.6g	1.15kg	1.08kg	1.29kg	1.61kg	1.54kg	1.47kg	1.62kg	1.45kg	1.39kg					
48	853.7g	1.20kg	1.15kg	1.38kg	1.30kg	1.69kg	1.59kg	1.59kg	1.62kg	1.46kg					
49	917.5g	1.23kg	1.19kg	1.40kg	1.30kg	1.68kg	1.59kg	1.59kg	1.65kg	1.50kg					
50	952.5g	1.23kg	1.19kg	1.41kg	1.32kg	1.79kg	1.69kg	1.61kg	1.69kg	1.53kg					
51	1.01kg	1.32kg	1.26kg	1.47kg	1.39kg	1.74kg	1.62kg	1.56kg	1.77kg	1.59kg			1.76kg	2.07kg	
52	1.07kg	1.34kg	1.27kg	1.12kg	1.87kg	1.67kg	1.53kg	1.80kg	1.62kg	1.60kg					
53	1.09kg	1.73kg	1.61kg	1.84kg	1.63kg	1.65kg									
54	1.09kg	1.38kg	1.28kg	1.50kg	1.40kg	1.92kg	1.74kg	1.64kg	1.85kg	1.68kg					
55	1.08kg	1.48kg	1.38kg	1.46kg	1.46kg	1.96kg	1.71kg	1.81kg	1.90kg	1.72kg	1.63kg	1.72kg			
56	1.20kg	1.48kg	1.39kg	1.80kg	1.51kg				1.90kg	1.74kg	1.54kg	1.68kg			
57	1.26kg	1.53kg	1.44kg	1.48kg	1.48kg	2.03kg	1.72kg	1.93kg	1.93kg	1.78kg	1.59kg	1.72kg	2.04kg	2.27kg	
58	1.29kg	1.58kg	1.48kg			2.10kg	1.87kg	1.76kg							
59	1.04kg	1.34kg	1.34kg	2.09kg	1.90kg	1.80kg	1.63kg	1.81kg			1.633kg	1.81kg			
60	980.0g	1.48kg	1.46kg	1.80kg	1.70kg	2.12kg	1.93kg	1.86kg							
61	1.10kg	1.54kg	1.48kg	1.90kg	1.80kg	2.15kg	2.00kg	1.84kg							
62	1.34kg	1.51kg	1.40kg	1.90kg	1.85kg	2.24kg	1.95kg	1.88kg							
63	1.50kg	1.90kg	1.12kg	1.90kg	1.90kg	2.25kg	1.20kg	1.91kg	1.59kg	1.81kg	1.59kg	1.81kg			
64	1.60kg	1.80kg	2.0kg	1.90kg	2.26kg	2.00kg	1.93kg						2.04kg	2.27kg	
65	1.60kg	1.90kg	1.80kg	2.0kg	1.90kg	2.23kg	2.01kg	1.96kg	1.66kg	1.81kg	1.66kg	1.81kg			

* Hand raised ** Wild born then hand raised, estimate as to age. *** Weights for four female pups born at JBZ, lightest weight recorded for that particular day, may be from different pups. All four pups survived to adulthood. There is no indication why the LO** pups show such a drastic weight change on day 21

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CHAPTER 9

FEEDING and NUTRITION

by: Sue Crissey Ph.D., Jan Reed-Smith

See also: 1997 JBZ N. A. River Otter Husbandry Survey in Captive Management Section. Dietary Supplements Table.

“Wild animals require the same basic nutrients as their domestic counterparts. For many exotic species that have closely related domestic counterparts (e.g. ...mustelids...), nutrient requirements established by the National Research Council (NRC) for domestic and laboratory animals can be a guide to minimum nutrient concentrations in the diet. Although less directly applicable to other species, NRC requirements can still serve as a useful general reference for evaluating the nutritional adequacy of diets for any bird or mammal.” (Merck 1991)

GENERAL GUIDELINES

It is essential that good quality foods be offered. Long storage times of frozen foods (over 6 – 12 months depending on the food item) should be avoided. Bagged feeds should be stored less than one year. (Merck 1991). Specific guidelines for the inspection and handling of fish and/or meat products can be found in the UDSA publications: Crissey and Spencer, 1998 and Crissey et al., in press.

Clean, fresh drinking water should be available at all times.

In general, otters are very active animals and as such require nutrient dense diets. Fats are an important source of energy for these animals (Wallach & Boever 1983). Given the rapid transit time of food through their intestinal tract (see below), and the generally high activity level of otters, frequent, smaller feedings will help encourage activity, and eliminate concerns over food spoiling before it is consumed.

The questions over the effect of fish high in thiaminase and its influence on the uptake of thiamine has never really been answered for otters. It could just be “zoo voodoo”, or it could be valid. If thawed, previously frozen fish high in thiaminase are fed regularly, (to include carp, bullheads, smelt and ocean herring), it should be offered two hours before, or after, other dietary items as a precaution. This allows the body to metabolize the thiamine contained in the other food sources.

The one, best captive diet for river otters has not been found. It is important to provide roughage, adequate vitamin & mineral content, fatty acids for coat maintenance, and hard foodstuffs for dental health. When the first N. A. River Otter Husbandry Notebook was published in 1994/95 most facilities fed a diet based primarily on meat with fish as a secondary component. This is still true today, but there are a few more facilities that have gone to an all fish diet supplemented with day-old chicks or chicken necks. It should be noted that most European facilities feed fish, chicken, and/or rabbit. If an all fish diet is fed it should be supplemented with vitamins and minerals.

If an otter refuses two or more meals consecutively, they should be monitored for potential health problems.

Wild Feeding Habits

Free-ranging North American river otters are reported to spend 41-62% of their time engaged in foraging and feeding activities (Hoover and Tyler 1986) in a primarily aquatic habitat. As a general rule, otters will first prey on those species easiest to catch and stay in shallow waters or near the shore. (Sheldon & Toll 1964, Knudsen & Hale 1968, Toweill & Tabor 1982)

N. A. otters are predominantly piscivorous. Researchers have found that the bulk of their diet consists of fish, secondarily they rely on crustaceans (crayfish), amphibia (frogs, salamanders, newts and mud-puppies), and birds (most frequently ducks and divers). (Chanin 1985) The percentage of these secondary items varies seasonally and with geographic location. (Chanin 1985, Toweill & Tabor 1982)

Also see: Feeding Behavior under Natural History.

GI-tract morphology

Otters are semi-aquatic carnivores. As in other mustelids, they possess a simple stomach. They may have a somewhat elongated small intestine like the mink. They do not have a cecum. (Steven and Hume, 1996)

Digestion

Davis et. al. (1992) and Spelman et al. (1997) report that gastrointestinal transit time for a fish meal took anywhere from 2 to 4 hours with a mean of 202 minutes. In 1951, Liers tested otters previously fed a bland diet and found that the exoskeletal remains of crayfish were passed about one hour after consumption.

Pregnant/Lactating Female's Diet

A pregnant female's diet should be monitored closely and increased as necessary to maintain the dam's condition. The pregnant female requires more energy than the non-pregnant female. These requirements may increase up to 17 to 32% (Robbins 1993).

Tumarov and Sorina (1997) have supported the use of high energy diets for lactating female mustelids. Considering that fat is the most concentrated source of energy in the diet, the fat content of the diet for lactating females can be increased. During the last trimester of gestation and through lactation, diet increases of 30% to three times maintenance may be necessary to maintain adequate growth of the pups and body weight of the dam (Reed-Smith 1994). Energy requirements will differ based on numerous variables (exhibit size, environmental temperature, individual activity patterns, stage of gestation/lactation, etc.), thus it is recommended that goal weights be established, animals weighed on a regular basis, if possible, and diet adjustments made based on observed body weight changes.

NUTRIENT OVERVIEW

This section is not intended to explain in depth the science of nutrition but, to introduce the essential dietary elements. Without these essential nutrients in the required quantities, the animal will become ill, cease to reproduce, and depending on the severity of the deficiency, may die because of the deficiency. Though it is *very important to obtain essential nutrients from the diet, more is not better. There are also maximum tolerances and safe levels for each nutrient.* Some nutrients can be very toxic to certain animals while others may be harmful to a lesser extent (NRC, 1980). Nothing can be considered completely safe and all nutrients must be considered in relationship to interactions with other nutrients. (Robbins, 1993).

Energy

Protein, carbohydrate and fat all provide energy to the animal. When any of these is fed in excess to energy needs, the animal will become fat. It is difficult to determine in a practical manner, the energy requirement of any one animal. Energy utilization is a combination of basal metabolic rate (BMR), the energy it takes to digest food, and the energy needed for activity and reproduction (gestation and lactation), and the energy

needed for growth (maximum cell division). There are some basic measurements which allow calculations for energy demand (Miller and Koes, 1988). BMR for many mammals equals $70 \times \text{Body mass in kg to } 0.75 \text{ power}$ however, Iversen determined that the BMR of otters can be expressed by the equation: $M = 84.6W^{0.78} (+0.15)$. $M = \text{basal metabolic rate in kcal/day and } W = \text{body weight in kg.}$ "This is about 20% higher than expected from the mammalian standard curve described by $M = 70 W^{0.75}$." (Iversen 1972; Toweill & Tabor 1982; Kruuk 1995; Estes 1989)

In controlled feeding experiments on captive *L. lutra*, Erlinge (1968) reported that the animals were satiated after consuming about 900 to 1000 grams of live food; Toweill (1982) cites unpublished data of his that, "...recorded similar volumes of food in moderately distended northern river otter stomachs containing food." Harris (1968) reports that otters in captivity required about 700 to 900 grams of food.

Klieber outlined energy requirements for a number of species. This is a simplistic approach to a complex issue (Thompson, 1996). Additionally, it is very difficult to determine energy needed for activity, since in many cases, every animal differs in its activity level. So far, the most non-invasive method to measure whether the diet is providing the appropriate amount of energy (measured in kcals) is to weigh the animal periodically and look for changes (Gettys et al., 1988). Additionally, if the diet consumed is accurately measured, one can calculate energy consumed.

Protein and amino acids

Protein is comprised of amino acids (Robbins, 1993). The actual requirement for animals is for amino acids not protein as such. However all amino acids must be present in adequate amounts. Not all of the 20 common amino acids are required in the diet of all animals. Some animals can produce some amino acids to a greater or lesser extent from essential dietary amino acids. These are non-essential amino acids. Simple stomach species generally require ten essential amino acids: arginine, histidine, isoleucine, leucine, threonine, lysine, methionine, phenylalanine, tryptophan, and valine (Robbins, 1993). Cats, being obligate carnivores with simplistic GI-intestinal tracts, require an array of pre-formed amino acids from the diet with additional needs such as taurine (Morris, et al., 1991). The amino acid requirements of otters remains unknown.

Utilization of protein from the diet begins with digestion which depends on sequential cleavage of amino acids from the protein molecule. The cleavage is performed by digestive enzymes. There are many mechanisms for transport of these amino acids through the intestinal cells into the body. Once in the body, some amino acids are metabolized and converted as needed into other amino acids. As needed, proteins are made by the body and comprise muscle, hair, enzymes, hormones, etc. The requirement for protein in the diet is somewhat based on the animal's ability to digest whole protein and utilize protein from sources such as muscle meat, cereals and microorganisms. The animal must receive an adequate compliment of essential amino acids, regardless of the source (Nutrition Reviews, 1985).

Young, growing animals require more protein than adult animals. In general, adult carnivores require a dietary protein level of 18 to 30% whereas a weaned kitten needs approximately 35% and young mink or foxes require 25 to 38%. (Robbins 1993)

Often requirements are expressed as crude protein. This is actually a calculation based on an average nitrogen content of various proteins of (16% nitrogen). To determine crude protein content of a food item the nitrogen content is multiplied by 6.25 (or $100/16$). There is error in this estimate since not all plant or animal nitrogen is in the form of protein, for example chitin in insects (Robbins, 1993; Bernard and Allen, 1997b). Animal protein requirement estimates are difficult to make because the quality of dietary protein depends on its amino acid composition, the ratio of protein to energy, and the total amount of food consumed. Additionally, amino acids if not needed as body protein, can be broken down and used as an energy source. Thus, protein needs and energy should be considered together (Robbins, 1993).

Water

Water is sometimes the "forgotten" nutrient but the most important. Water is needed by all animals. Some animals need continuous supplies of drinking water. For safety sake, fresh water should be available at all times. Many otter exhibits have potable water provided via running water and/or pools. Some institutions offer water in separate tubs for drinking (Maslanka and Crissey, 1998). Neonatal mammals have a water concentration of between 71 and 88% of their body weight. Adult animals of normal weight have a concentration of between 50 and 65% (Robbins 1993).

Minerals

Minerals have been classified into two groups: major (or macro) minerals and trace (micro) minerals. Many minerals, approximately 26, are known to be essential for life. It is not known why certain elements are essential for life while others may not be. It is quite possible that future study will find links and requirements for other minerals. All elements are toxic if ingested or inhaled at sufficiently high levels for long enough periods (NRC, 1980). Sometimes there is a relatively fine line between the biological level of need for a mineral and a toxic level. It should be remembered that the level of a mineral found in any source is, in part, directly related to soil. Plants for example can provide deficient or excess levels of minerals such as selenium depending on the soil in which the plant is grown. Various geographic regions are known for their deficiencies or excesses of minerals (Maynard, et al., 1979).

The major elements are: Carbon, hydrogen, oxygen, nitrogen, sulfur, calcium, phosphorous, potassium, sodium, chlorine, and magnesium. Since carbon, hydrogen, oxygen, nitrogen, and sulfur are major constituents of many molecules, these are not considered with respect to essential nutrient intake. However, calcium, phosphorous, potassium, sodium, chlorine, and magnesium are considered essential dietary nutrients. This category contains minerals present in large quantities in the body (Maynard, et al., 1979; Robbins, 1993).

The trace elements considered in nutrition are: iron, zinc, copper, manganese, nickel, cobalt, molybdenum, selenium, chromium, iodine, fluorine, tin, silicon, vanadium, and arsenic. Each of these is needed in very small amounts. The role of some of these in metabolism is not fully determined. Interactions among minerals are many and each should be considered in light of the other (Miller, et al., 1991).

The form of the mineral in the diet affects its absorption. Some forms are absorbed to a much greater extent than others. For example, it is thought that iron is not absorbed well from the GI-tract, in general. Inorganic sources may be absorbed at only about 5-15%. Heme sources however (associated with animal tissues) are better absorbed. Additionally, many factors may affect absorption of minerals. The example with iron shows that dietary vitamin C and sugars can increase inorganic iron absorption (Smith, 1997). Additionally some animals may have evolved ways to obtain nutrients when evolving either in nutrient toxic or deficient habitats and may not fall in line with the general statements (Kincaid and Stoskopf, 1987).

Vitamins

Vitamins have been defined as a group of organic substances present in minute quantities in foods which are essential to normal metabolism and lack of which in the diet causes deficiency diseases (Robbins, 1993). Scientists have categorized vitamins as fat soluble and water soluble. Fat soluble vitamins can be stored in the body whereas water soluble vitamins have very limited storage and when fed in excess are primarily excreted (Machlin, 1984). As we learn more about vitamins, we find that animals utilize different forms of the vitamins differently. This can have a profound affect on nutritional status (Papas, et al., 1991).

The fat soluble vitamins are A, D, E, and K. Since these vitamins are stored by the body, toxicities may occur when fed in excess. Vitamin E is considered relatively non-toxic while vitamins A and D are known to cause toxicity symptoms in animals studied (Rucker and Morris, 1997). The toxicity of vitamin K depends on the source of vitamin K utilized.

The water soluble vitamins are vitamin C and "B" vitamins, including Thiamin, Riboflavin, Niacin, Biotin, Pantothenic Acid, Pyridoxin, Folic acid, Vitamin B12, Choline and Carnitine. These vitamins are utilized by the body for many metabolic processes. Each acts in a different way to provide for normal function of metabolism. Since these vitamins are not usually stored in the body for long periods, it is felt that daily intakes are preferred. Excess of these substances are usually excreted in the normal healthy animal and thus are considered somewhat non-toxic (Machlin, 1984; Rucker and Morris, 1997).

Fat-soluble Vitamins – General Functions & Reported Deficiency Symptoms		
Vitamin	Major Functions	Deficiency Signs
A (Retinol, retinal, and retinoic acid)	In eye pigment For maintenance, differentiation & proliferation of epithelial tissue..	Reduced fertility or sterility, birth defects, reduced growth or loss of weight, oral & nasal pustules, weakness, night blindness, impaired eyesight because eye problems, bone and teeth deformities, unsteady gait and incoordination, ruffled-droopy appearance.
D (D ₂ -ergocalciferol; D ₃ -cholecalciferol)	Needed for calcium absorption and metabolism.	Rickets in young, osteomalacia in adults.
E (Tocopherol)	Antioxidant functions	Yellow fat disease (steatitis) sudden death with stress, lumpiness of subcutaneous fat, severe edema, nutritional muscular dystrophy, severe hemolytic anemia, reproductive failure
K (Phylloquinone & menaquinone)	Necessary for blood clotting	hemorrhaging.

(Adapted from: Robbins 1993)

Two vitamins are especially important when animals are fed a large proportion of fish in the diet. This is because these vitamins degrade relatively quickly in killed fish. Diets that contain high levels of marine products may not only predispose individuals to thiamin deficiency, but also to vitamin E deficiency if not adequately supplemented (Engberg, et al 1993).

Thiamin –fish eating animals including dolphins, polar bears, mink, foxes, sea lions, grebes, and gulls have been reported to have had thiamin deficiencies (Robbins, 1993). Many species of fish and shellfish contain the enzyme group called thiaminases that breaks down thiamin in the killed fish (Robbins 1993; Bernard and Allen, 1997a) Robbins (1993) also reports that thiaminase occurs in newly hatched chicks.

Supplementing otters consuming a large proportion of fish in their diet should be performed to ensure adequate thiamin status. The recommended supplementation regime for fish eating animals is 25-30 mg of thiamin per kg of fish fed (fresh weight basis; Bernard and Allen, 1997a)

Vitamin E –Vitamin E deficiencies are most frequently seen in species fed fish-based diets. Marine products contain high levels of poly- and mono-unsaturated fatty acids. Because vitamin E functions as an antioxidant, the breakdown of these oils during storage causes vitamin E destruction. For this reason, it is recommended that a vitamin E supplement be fed to otters on a fish only diet or a diet comprised of a large proportion of fish. (Crissey & Maslanka contribution IUCN Otter Specialist Group Otter Action Plan, in press) The recommended supplementation regime for fish eating animals is 100 IU of vitamin E per kg of fish fed (fresh weight basis; Bernard and Allen, 1997a). Similarly, the recommended supplementation level is 400 IU vitamin E / kg of *dry* diet (Engelhardt and Geraci 1978).

If a fish-based only diet is offered, supplementation with a multivitamin is recommended. Nutritional deficiencies have been reported in commercially farmed mustelids (hypovitaminoses A and E, thiamin deficiency, calcium deficiency; Wallach and Boever 1983, NRC 1982). Fish composition can change based on species, season of harvest, duration of storage, etc., and addition of multivitamin may provide some consistency in the nutrients contained in the diet. However, the diet should be analyzed to determine nutrient levels prior to supplementation in order to minimize the chance of over-supplementation and toxicity (especially of fat-soluble vitamins).

Water-soluble vitamins – General Functions & Reported Deficiency Signs		
Vitamins	Major Functions	Deficiency Signs
Thiamin (vitamin B ₁)	Needed in carbohydrate metabolism.	Anorexia, weight loss, weakness, lethargy, unsteady gait, diarrhea, seizures, and other neurological disorders, “star-gazing”.
Riboflavin (vitamin B ₂)	Needed in carbohydrate metabolism	Anorexia, weight loss, poor hair coat, atrophy of hair follicles, diarrhea, leg paralysis, reduced fertility.
Niacin (nicotinic acid & nicotinamide)	Functions in metabolism (in NAD and NADP)	Retarded growth, , anorexia, diarrhea, dermatitis, drooling & tongue discoloration,
Vitamin B ₆ (pyridoxine, pyridoxamine, & pyridoxal)	Needed in protein metabolism	Testicular atrophy, sterility, anorexia, retarded growth, poor hair coat, muscular incoordination, neurological disorders.
Pantothenic acid	Needed for fat, carbohydrate, & amino acid metabolism	Skin lesions, crusty scabs about the eyes, emaciation, degeneration of the liver, kidney problems, reproductive failure, death.
Biotin	Needed in metabolism	Fur discoloration, hair loss, degenerative changes in the hair follicles, thickened & scaly skin, conjunctivitis,
Folicin (folic acid)	Needed in metabolism	Anorexia, retarded growth, diarrhea, profuse salivation, convulsions, adrenal hemorrhages, , anemia
Vitamin B ₁₂ (cyanocobalamin)	Needed in carbon & carbohydrate metabolism	Anorexia, weight loss, pernicious anemia neurological & locomotion disorders.
Choline	Nerve functioning	Liver damage, reduced growth of the leg bones, awkward gait, growth retardation, weakness, lowered hematocrit.
Vitamin C (ascorbic acid)	Not required by many species. Needed for bone & collagen formation	Scurvy, severe necrotic stomatitis, anorexia, weight loss, gingivitis, glossitis, pharyngitis, hemorrhages

(Adapted from: Robbins 1993)

Fat and Essential Fatty Acids (EFAs)

Fats and oils (lipids) are utilized by animals as energy. Lipids are comprised mainly of glycerol and fatty acids. The energy value of fat is considered to be at least double that of protein or carbohydrates. Dietary fat is also the source of essential fatty acids which are required by animals. Thus the dietary requirement for fat in the diet is actually an energy requirement and the requirement for essential fatty acids. In general, the essential fatty acids include linoleic, linolenic and arachidonic acids or their metabolic derivatives. Some animals may have specific needs different from others (Rouvinen and Niemela, 1992; Stanton, et al., 1989). Essential fatty acids can be converted in the body to other important fatty acids. Some animals can convert these essential dietary fatty acids better than other animals. Obligate carnivores such as cats require not only linoleic acid but also, pre-formed arachidonic acid as they can not convert the other essential fatty acids to this nutrient.(Burger, 1993). This may apply to otters too.

Much research is being conducted with respect to fatty acids. Of special interest is the work being done with omega-3 fatty acids in both humans and domestic animals. This work could prove very important to fish eating animals in particular (March, 1993).

Deficiencies of essential fatty acids include poor reproduction, kidney problems, poor wound healing, poor coat condition, and possibly dehydration, liver degeneration, and immune system failure.

Arachidonic acid is present in animal matter but not in plants. Good sources of arachidonic acid are meat, liver, and some seafoods. Linolenic acid is found in linseed, soybean, rapeseed oils, and marine fish oils. Omega-3 fatty acids are found in marine fish as well as trout. Oily fish, such as sardines, anchovies, and herring, are much better sources of EFAs than non-oily fish (Robbins, 1993)

Carbohydrates

Sugars, starches and fiber are carbohydrates. Carbohydrate is broken down to simple sugars before it is absorbed from the GI-tract in to the body. It is utilized by animals for energy. Some animals possess the ability to utilize different sources of carbohydrate to a greater or lesser extent (Yokota, et al., 1992; Kienzle, 1993). Carbohydrates play a minor role in the nutrition of otters (Wallach & Boever 1983). Animals that harbor large quantities of microorganisms in their GI-tract, like ruminants, can digest fiber to a greater extent than those with a more simple tract like most carnivores (Bonhomme-Florentin, 1990; Graham and Aman, 1991).

There is, in general, no definitive requirement for carbohydrate, including fiber, in the diets of animals. However, it is well know that fiber allows proper functioning of the GI-tract for many animals and should be included in the diet based on the species and its GI-tract morphology (Shaver, et al., 1988; Milton and Demment, 1988).

Target dietary nutrient values for a fish-eating species.

Much of this information is similar to that reported for Asian small-clawed otters (Maslanka and Crissey, 1998). Target values for otters are based on several sources. The cat is typically used to establish nutrient guidelines for carnivorous animals. The NRC (1986), AAFCO (1994), and Waltham Center for Pet Nutrition (Earle and Smith, 1993) have provided recommendations for cats. A limited amount of information is provided by the NRC publication for mink and foxes (1982), which represents the requirements of another mustelid species. The target nutrient values presented here (Table 1; Maslanka and Crissey, 1998) are a range of values reported from various references. As new information becomes available, these ranges will change to reflect knowledge gained.

Free-ranging North American river otters are reported to spend 41-62% of their time engaged in foraging and feeding activities (Hoover and Tyler 1986) in a primarily aquatic habitat. Energy requirements for otters have not been determined specifically, however dietary energy target values can be based on diets

successfully used to maintain captive otters (Table 1). According to survey information (Reed-Smith 1997), most institutions offer food two or more times per day. Where seasonal dietary alterations occur (in approximately one half of the responding institutions), most involve diet increases during the winter months.

Nutrient content of typical diet ingredients.

As mentioned previously, several basic diet items (including fish and commercially available dry, canned, and frozen diets) have been used to maintain otters in captivity. Meat-based diets have been used in most institutions for growth, maintenance, and breeding. There is a variety of products upon which the diet may be based. Following are tables that describe nutrient concentrations in some commonly used manufactured products that are intended to be nutritionally complete (Maslanka and Crissey, 1998).

Target dietary nutrient ranges for North American River Otters.

Item	Target Nutrient Range*
Energy, kcal/g	3.6-4.0
Crude Protein, %	24-32.5
Fat, %	15-30**
Vitamin A, IU/g	3.3-10***
Vitamin D, IU/g	0.5-1.0
Vitamin E, mg/kg	30-120 (α)
Thiamin, mg/kg	1-5 (α)
Riboflavin, mg/kg	3.7-4.0
Pantothenic Acid, mg/kg	5-7.4
Niacin, mg/kg	9.6-40
Pyridoxine, mg/kg	1.8-4.0
Folic Acid, mg/kg	0.2-1.3
Biotin, mg/kg	0.07-0.08
Vitamin B12, mg/kg	0.02-0.025
Choline, mg/kg	1000-3000
Calcium, %	0.6-0.8 (β)
Phosphorus, %	0.6 (β)
Potassium, %	0.2-0.4
Sodium, %	0.04-0.06
Magnesium, %	0.04-0.07
Zinc, mg/kg	50-94
Copper, mg/kg	5.0-6.25
Manganese, mg/kg	5-9
Iron, mg/kg	80-114
Iodine, mg/kg	1.4-4.0

* Target nutrient ranges expressed on a dry matter basis derived from requirements for domestic cats (NRC 1986), AAFCO recommendations (1994), Waltham Center for Pet Nutrition recommendations (Earle and Smith 1993), and requirements for mink and foxes (NRC 1982).

** The fat content of fish commercially available in North America typically ranges from 5-40% (Maslanka and Crissey 1998), and North American river otters have been maintained on diets containing 24-30% fat (Reed-Smith 1994), thus an appropriate range for fat appears to fall between 15-30%.

*** The vitamin A requirement for cats is 10 IU/g (dry matter basis; NRC 1985), which represents the upper bound of the range. However, free-ranging North American river otters may consume a higher proportion of fish and may have a higher tolerance for vitamin A due to the high levels which may occur in their natural diet.

(α) When mostly fish diets are offered, the presence of unsaturated fatty acids and thiaminases causes the breakdown of these vitamins. Thus, dietary levels of 400 IU vitamin E / kg of dry diet and 100-120 mg thiamin / kg of dry diet are recommended (Engelhardt and Geraci 1978; Bernard and Allen, 1997).

(β) The recommended Ca:P ratio is between 1:1 and 2:1.

**Nutrient content of several commonly used meat/nutritionally complete food items
(dry matter basis).^a**

Nutrient	Ground horsemeat	Nebraska Feline ®
Crude protein, %	51.7	50.0
Fat, %	19.7	31.6
Vitamin A, IU/g	-	97.1
Vitamin D, IU/g	-	1.2
Vitamin E, mg/kg	-	42.4
Ca, %	-	1.6
P, %	-	1.3
Mg, %	-	0.05

^a Values from manufacturers' guaranteed analysis and analyses performed at or for Brookfield Zoo.

Nutrient	Toronto Zoo Feline Diet*	Toronto Carnivore Diet	Dallas Crown Diet
Protein % (min.)	50	50	30, 56 expected(exp)
Fat % (min.)	20	25	10, 20% exp., 40 max.
Crude Fibre % (max.)	6	4	3
Calcium % (min.)	0.8	0.7	1.3
Phosphorus % (min.)	0.7	0.6	1.2
Magnesium %	0.09	0.07	0.09
Iron ppm.	160	190	80, exp. 183
Zinc ppm.	120	170	110
Taurine %	0.2		0.3
Vit. A IU/kg	11,000	18,000	14,000
Vit. E IU/kg	200	170	470
Vit. D IU/kg	2,160	3,540	2400

* Manufactured by: Milliken Meat Products, Ltd. of Ontario, Canada. ^ Manufactured by Dallas Crown, Inc., Kaufman, Texas.

**Nutrient content of several commercially available fish species and marine products
(dry matter basis).^a**

Nutrient	Capelin	Herring	Oyster shell	Shrimp ^{17,19}	Smelt	Trout
Dry matter, %	18.8	27.7	100	24.1	22.7	23.7
GE, kcal/g	5.5	6.3	-	2.3	7.0	6.5
Crude protein, %	59.8	45.3	0	20.5-44.2	70.4	55.8
Fat, %	14.8	34.0	0	1.8-4.3	16.6	34.5
Vitamin A, IU/g	44	56	0	-	-	58
Vitamin E, IU/g	0.024	0.034	0	-	-	0.32
Ca, %	1.7	1.7	38.0	10.8	1.4	2.1
P, %	1.7(1.2-1.4) ^b	1.3	0.07	2.1	1.6	1.5

^aAnalyses from Bernard and Ullrey³, Minnesota Zoo, and Brookfield Zoo, unless otherwise noted.

^bUnpublished data from the Brookfield Zoo and Minnesota Zoo.

SAMPLE DIETS

The diets of several institutions are listed below. This is just a sampling of diets being fed *L. canadensis*. Where available, comments on palatability to the otters, any associated dietary problems and observed physical condition of the animals are noted.

Liers' diet (1951)

His mixture was: "74% ground horse meat, ½% ground raw liver, 2% bone meal, 8% bran, ½% grated carrots, tomatoes, or lemon or orange juice, 10% raw rolled oats, and 5% commercial mink meal. To this I add one teaspoonful of cod liver oil per day per otter, one ounce of brewers yeast per day per ten otters, one egg a day for each two otters. The entire concoction is mixed thoroughly with enough whole liquid milk to make a soft mash." When fresh food was available, such as frogs, crayfish or fish, they were fed as well.

Duplaix-Hall (1975)

Due to their high metabolic rate and rapid digestion, otters "...eat up to 20 per cent of their own weight daily." Because an adult will normally eat no more than 500 g (17.5 oz) of food at a time, otters should be fed at least twice, preferably three times a day. She suggests feeding day-old chicks, and some fish to supply the necessary roughage. The following amounts are given by her as the food requirements per otter per day:

Chopped raw beef or horse meat	1500g.	Dog meal	200g.
Osteo-calcium	1 tablet	Halibut liver oil	4 drops
Soluble multi- vitamins	3 drops	Bone meal	50g.
Bran	50g.	Raw carrot	50g.
Vegetable oil or margarine	50g.	Day-old chicks	4
Fish (6 – 10") or eels	4		

John Ball Zoo

(Jan Reed-Smith)

Amounts are per animal.

Fed at least three times a day, sometimes four or five times per day. These additional feedings are fish, rib bones, hard-boiled eggs (female only will eat them), mice, or live fish as enrichment items offered on a limited basis above and beyond their normal diet. The amount of feline diet is increased only when the female is lactating (for her), or rarely, as an enrichment treat hidden around the exhibit or frozen in small meat balls.

142 g (5 oz) Nebraska Feline Diet – 2x/day, 7x/week.

½ medium carrot – 1x/day scattered on exhibit.

2 rib bones – 1 to 2x/week.

1 medium sized trout – 4x/week.

Anecdotally, it has been found that the addition of extra fish (the diet was fish 2x/week) has improved their coats' water repellency but not caused them to add weight.

Miller Park Zoo

(1993 NYWC N. A. River Otter Survey)

Daily: 3 – 3 ½ lbs. capelin or smelt, Vitamins B, E, and Pet Tabs added.

The respondent stated after switching to this diet, from a diet of meat and pellets, their animals no longer had any dental problems.

Clinch Park

(Tracy)

Their otters are fed a diet of fish (approximately 75%), and Nebraska Brand Feline Diet (approximately 25%). No supplements are added. The coats of both animals show good water repellency, the otter that generally refuses most of the feline has consistently had better dental hygiene.

Columbus Zoo

(Kelly Vineyard)

Per otter, divided into two feedings

0.65 lbs (295 g) Dallas Crown and 0.65 lbs (295 g) Lake Smelt.

One or two milk bones each per day for training sessions.

Dakota Zoo

(survey response)

2lbs (907 g) Nebraska Feline per animal divided into two feedings daily. Substitute fresh fish weekly for meat and live fish given as enrichment when available.

Knoxville Zoo

(Lisa Drummer New)

1.2 otters fed Dallas Crown (1/8 lb) with Prime 26 Dog food (Kibble for oral health). Also fed rib bones, carrots and dog biscuits for dental health. 1 1/3 Capelin used for training daily. (One female has had a history of oral abscesses.)

Minnesota Zoo

(Chris Kline)

Amounts vary with the animals weight.

Toronto Diet:

200 to 300g (7 – 10.5 oz) per feeding (400 - 600g (14 – 21 oz) per day) mostly in the bottom half of that range (400 - 500g (14 – 17.5 oz) per day).

Mackerel: One, every-other-day.

Derm-Caps

National Zoo

(Linda Moore)

60% Toronto Feline Diet

40% fish (butterfish, capelin, herring or spot)

Daily they receive one or more of the following: mice, chicks, live fish, carrot, sweet potato, apple, hard-boiled egg.

Amounts vary with the condition and weight of the animal. Generally an adult diet is: "... about 1 1/4 cup meat daily along with 4 capelin and 2 butterfish or herring. The otters are weighed weekly and amounts adjusted if needed. Usually one chick, one mouse, one egg each for the additional items. We give them 100iu vitamin E and 25 mg Vit B-1 every third day."

South Carolina Aquarium

(Rachel Metz)

The female is given 22 oz (624 g) of food per day. Primarily a mixture of lake smelt, capelin, herring and Nebraska canine diet. The ratio fish to canine diet 60:40. The male is given the same foods, 24 oz (680 g) They are also given cod liver oil and a canine/feline multivitamin as a supplement.

Virginia Marine Science Museum

(Chip Harshaw)

"I consider fish to be critical. I have seen many facilities offer otters only feline meat product with some vitamin supplements. We feed our otters whole smelt as their primary food source. They each also get two chicken breasts a day, and two whole mice. This provides a variety of items that mimics their natural diet. On top of that we add vitamins. (Mazuri Marine Mammal vitamins). This combination has provided our river otters with excellent coats. During random times of the day, other food items are occasionally given to the otters to promote behavioral enrichment. This could be in the form of live minnows, fiddler crabs from our salt marsh, some fruits or veggies frozen in ice, etc...."

Clearwater Marine Aquarium

(Angie Gabbert)

Amount fed differs for each animal, based on weight and age. Amounts given are the total for a 24 hour period, animals are fed four times a day. Two to three feedings per day are training sessions, at least one is a "free feed".

1.0 adult, weight: approximately 22 lb.
7 oz (198.5 g) Hill's Science Diet-Feline Light
½ lb (227 g) Capelin
¾ lb (340 g) Lake smelt
4 baby carrots & ½ medium carrot
1 *Nature Made* Antioxidant capsule
(this is given once daily)
1 *Derm Cap* every other day

0.1 7 ½ months, weight: approximately 14 lbs.
4 oz (113 g) Hill's Science Diet – Feline Light
¾ lb (340 g) Capelin
¾ lb (340 g) Lake smelt
4 baby carrots

Nature Made Antioxidant formula capsules: Information available @ 1-800-276-2878 or www.naturemade.com

Derm Cap: DVM Pharmaceuticals, Inc., Miami, Florida

645mg. per capsule:	crude protein	not less than 7%
	crude fat	not less than 90%
	crude fiber	not less than 1%
	moisture	not less than 2%
	Vit. E	75 IU
	Linoleic Acid	71%
	Gamma Linolenic Acid	2%
	Eicosapentaenoic Acid (EPA)	4%
	Docosahexaenoic Acid (DHE)	3%

Colorado Ocean Journey

(Pete Davey)

Amounts vary with the weight of the animal which varied from 8.7 to 9.7kg for the diets listed below. Listed here are the total amounts which are divided each day into three to six feedings and/or training sessions. Enrichment items are not given here.

Smelt	.7kg.	.8kg.	.7kg.
Clam	.3kg.	.4kg.	.3kg.
Shrimp	.3kg.	.3kg.	.2kg.

2 Mazuri Bird vitamin tablets per day.

Other nutritional issues

Use of supplements for coat maintenance

Over one half of the 1997 N. A. River Otter Husbandry Survey respondents indicated use of some type of supplement for maintenance of coat condition in North American river otters (Reed-Smith, 1997). Poor coat condition (i.e. dry, dull appearance, hair loss, etc.) can be a manifestation of multiple disorders (Muller, et al. 1983). Parasitic or bacterial infections can cause poor coat condition in captive mustelids (Wallach and Boever 1983). Nutritionally, fatty acid deficiency, protein deficiency, vitamin A deficiency or toxicity, vitamin E deficiency, vitamin B complex deficiencies, vitamin C deficiency, or several mineral deficiencies can all be manifested in poor coat condition (Muller, et al. 1983). For this reason, the clinical signs of poor coat quality are crucial in determining the cause and treatment of poor coat quality. The diet should be analyzed. If deficiencies or toxicities are noted, and appear to be the cause of the observed coat condition, adjustments should be made. Acute treatment may be necessary if the insult has occurred for an extended period of time, however, if diet appears the principle cause, adjustment should be paired with that treatment.

Dental problems

Dental problems are of concern in otters. Merck's Veterinary Manual (1991) and Petrini (1992) suggest offering rib bones one to two times per week for maintenance of dental hygiene. Other options are crunchy dry foods and some whole prey items including fish. Whatever is selected, it is very important that these animals be given something hard to maintain good dental hygiene

Roughage

As the natural diet of otters may contain some roughage, Duplaix-Hall (1975) and others have stressed the need for roughage in the diet fed to otters. Fish and other whole prey items, and crunchy vegetables are some of the items added to supply this roughage.

Nutritional related disease

Few reports of calculi are documented, thus this does not appear to be a problem in this species.

Further research

As with many species, further work is necessary to more accurately delineate target nutrient values for the North American river otter. Closer examination of the diets offered to captive otters may reveal the combination(s) of nutritional factors that may lead to poor coat quality and may shed more light upon the metabolic energy requirements of this active species.

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CHAPTER 10

HEALTH CARE

by: **Kris Petrini, D.V.M., Lucy Spelman, D.V.M., Jan Reed-Smith**

(See also: 1997 JBZ N. A. River Otter Husbandry Survey in Captive Management Section.)

This section is intended as an overview of health care, not as a guide to diagnosis or treatment. The intent is to help the keeper or curator understand the basic health needs of captive river otters and some of the diseases these animals are susceptible to. (For the reader's convenience, there is a limited glossary of medical terms used at the end of this chapter.)

As is true for many small mammals, otters may be hit with serious disease with little or no warning. The only way to mitigate a potentially life threatening illness is through keeper awareness and familiarity with the animals in their charge. Always take the time to observe, and record, how the animals are behaving; eating; performing bodily functions; using their exhibit; interacting with exhibit mates, and their general physical appearance. A good daily record keeping system can be vital if an animal becomes ill; or, the attention to detail can alert you to a problem before it becomes too severe. If an animal is exhibiting signs of illness call the veterinarian, do not treat it without professional assistance.

Some of this material is generalized to all mustelids and its application to river otters is assumed. For additional information the bibliography contains a number of excellent references. A glossary of terms can be found after the bibliography.

Weight Ranges

4.5kg – 11.3kg. (10 lbs. – 25 lbs.) Harris 1968
5kg. – 15kg. (11 lbs. – 33 lbs.) Hall 1981

Melquist & Hornocker (1983) found that adult males, on average, were 17% heavier than adult females. They cite an average weight of 7.9 kg. (17.4 lbs.) for females. Every animal will have its own “good weight”. Diets should be adjusted as needed to maintain a healthy weight and normal activity pattern. (Not every female should weigh the average and not all males are larger than females.)

Weights of Captive N. A. river otters (<i>Lontra canadensis</i>) (ISIS, 1999)							
Weight	Units	Mean	St. Dev.	Minimum Value	Maximum Value	Sample Size ^a	Animals ^b
Weight: 0-1 days age	Kg	.1242	.0147	.0950	.1450	12	10
Weight: 0.9-1.1 months age	Kg	.8669	.1488	.6890	1.160	8	8
Weight: 5.4-6.6 months age	Kg	6.038	1.315	3.900	8.020	10	10
Weight: 1.8-2.2 years age	Kg	8.701	1.629	4.540	10.75	21	11
Weight: 2.7-3.3 years age	Kg	9.033	2.115	5.780	12.50	32	15
Weight: 4.5-5.5 years age	Kg	10.68	1.61	6.818	13.18	21	8

^a Number of samples used to calculate the reference range.

^b Number of different individuals contributing to the reference values.

Life Span

Approximately 10 to 23 years with ten years being rare in the wild and 23 years a longevity record in captivity.

PHYSIOLOGICAL NORMS

Heart Rate

137 – 170 beats/minute (Grassmere Wildlife Park now Nashville Zoo @ Grassmere)

130 – 178 beats/minute; baseline = 152 beats/minute (Spelman 1999)

160 – 180 beats/minute; baseline = 174 ± 9 beats/minute (Hoover 1986)

EKG (Hoover 1986)

Rhythm: Normal sinus rhythm

Mean Electrical Axis (frontal): $54 \pm 13^\circ$

Lead II	Mean \pm SD	Range
P (sec)	0.051 ± 0.006	0.040 – 0.060
PR (sec)	0.086 ± 0.008	0.075 – 0.095
P (millivolt)	0.24 ± 0.6	0.15 – 0.30
QRS (sec)	1.82 ± 0.48	1.30 – 2.60
QT (sec)	0.184 ± 0.011	0.170 – 0.200
T (millivolt)	0.45 ± 0.11	0.30 – 0.60

Respiration Rate

When under anesthesia, the important factor is that the mucous membranes and mouth stay a pink color. Grassmere (Nashville Zoo) records show a respiratory rate range of 30 – 60 while under anesthesia.

Range: 10 – 60 breaths/minute; baseline = 31 breaths/minute (Spelman 1999)

Range: 20 - ~34 breaths/minute (Hoover & Jones 1986) These figures were obtained from otters during chemical immobilization and inhalation anesthesia.

Body Temperature

Body temperature range of 37.5° to 40°C (99.5° to 104°F) for otters involved in a translocation project (Serfass (1994). (The upper end of this spectrum should be considered pathologic if it continues very long. An animal's normal temperature may reach this height after the exertion and stress associated with being caught.)

Body temperature range: $38.1 - 38.7^\circ\text{C}$ (100.6 to 101.7°F); baseline = 38.4°C (101.1°F) (Spelman 1999)

Body Temperature of captive N. A. river otters (*Lontra canadensis*) during immobilization (ISIS, 1999)

Test	Units	Mean	St. Dev.	Minimum Value	Maximum Value	Sample Size ^a	Animals ^b
Body Temperature:	$^\circ\text{F}$	102.0	1.8	96.8	105.8	161	96

^a Number of samples used to calculate the reference range.

^b Number of different individuals contributing to the reference values.

Arterial Blood Pressure

Mean arterial blood pressure range: 31 – 77 mm Hg; baseline = 63 mm Hg (Spelman 1999)

Blood Values

Captive animals

Hematology Values for Captive North American River Otters (<i>Lontra canadensis</i>) (ISIS, 1999)							
Test	Units	Mean	St. Dev.	Minimum Value	Maximum Value	Sample Size ^a	Animals ^b
WHITE BLOOD CELL COUNT	*10 ³ /μl	7.935	4.138	1.980	32.30	236	130
RED BLOOD CELL COUNT	*10 ⁶ /μl	9.96	1.38	6.62	14.30	175	95
HEMOGLOBIN	g/dl	14.2	1.7	9.2	19.2	208	121
HEMATOCRIT	%	44.8	5.8	30.5	64.2	240	132
MEAN CORPUSCULAR VOLUME	fL	46.6	5.2	30.8	67.6	173	95
MEAN CORPUSCULAR HEMOGLOBIN	pg/cell	14.7	1.5	10.1	23.1	171	95
MEAN CORPUSCULAR HEMOGLOBIN CONCENTRATION	g/dl	31.8	2.3	23.5	41.3	206	121
PLATELET COUNT	*10 ³ /μl	489	137	190	810	74	45
NUCLEATED RED BLOOD CELLS	/100 WBC	0	0	0	1	25	19
RETICULOCYTES	%	0.3	0.2	0.0	0.9	19	16
SEGMENTED NEUTROPHILS	*10 ³ /μl	5.563	3.206	0.191	19.10	215	121
LYMPHOCYTES	*10 ³ /μl	1.606	0.935	0.035	5.630	224	126
MONOCYTES	*10 ³ /μl	0.214	0.227	0.000	1.292	185	111
EOSINOPHILS	*10 ³ /μl	0.536	0.699	0.000	4.608	194	117
BASOPHILS	*10 ³ /μl	0.021	0.044	0.000	0.182	36	28
NEUTROPHILIC BANDS	*10 ³ /μl	0.384	0.743	0.000	3.060	57	44
ERYTHROCYTE SEDIMENTATION RATE	mm/Hr	0	0	0	0	1	1

^a Number of samples used to calculate the reference range.

^b Number of different individuals contributing to the reference values.

Physiological reference ranges are calculated from samples submitted by 34 member institutions and are both sexes and all ages combined.

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Biochemistry Values for Captive North American River Otters (*Lontra canadensis*) (ISIS, 1999)

Test	Units	Mean	St. Dev.	Minimum	Maximum	Sample Size ^a	Animals ^b
CALCIUM	mg/dl	8.8	0.7	7.4	11.2	212	122
PHOSPHORUS	mg/dl	5.6	1.6	2.2	12.3	202	118
SODIUM	mEq/L	150	4	139	164	204	116
POTASSIUM	mEq/L	4.3	0.5	3.0	5.9	207	117
CHLORIDE	mEq/L	114	4	97	128	200	116
BICARBONATE	mEq/L	23.5	2.4	19.0	28.0	28	25
CARBON DIOXIDE	mEq/L	23.7	3.5	15.0	30.0	75	42
OSMOLARITY	mOsmol/L	303	14	287	328	14	11
IRON	µg/dl	175	62	77	359	48	32
MAGNESIUM	mg/dl	1.59	0.55	0.65	2.50	23	16
BLOOD UREA NITROGEN	mg/dl	28	8	13	56	220	126
CREATININE	mg/dl	0.6	0.2	0.3	1.8	205	115
URIC ACID	mg/dl	1.9	0.7	0.0	4.3	123	81
TOTAL BILIRUBIN	mg/dl	0.3	0.2	0.0	1.0	198	116
DIRECT BILIRUBIN	mg/dl	0.1	0.1	0.0	0.3	52	32
INDIRECT BILIRUBIN	mg/dl	0.2	0.1	0.0	0.4	51	32
GLUCOSE	mg/dl	96	33	35	247	218	123
CHOLESTEROL	mg/dl	233	67	99	421	213	123
TRIGLYCERIDE	mg/dl	47	37	4	201	136	81
CREATINE PHOSPHOKINASE	IU/L	509	446	99	2613	81	55
LACTATE DEHYDROGENASE	IU/L	524	1051	24	6200	129	83
ALKALINE PHOSPHATASE	IU/L	83	43	17	279	215	122
ALANINE AMINOTRANSFERASE	IU/L	106	67	32	449	196	112
ASPARTATE AMINOTRANSFERASE	IU/L	93	49	20	334	202	117
GAMMA GLUTAMYLTRANSFERASE	IU/L	12	11	3	83	102	65
AMYLASE	U/L	14	22	0	105	66	44
LIPASE	U/L	27	25	0	98	29	21
TOTAL PROTEIN (COLORIMETRY)	g/dl	6.6	0.6	5.2	8.3	205	119
GLOBULIN (COLORIMETRY)	g/dl	3.6	0.6	2.2	6.0	171	105
ALBUMIN (COLORIMETRY)	g/dl	2.9	0.3	2.0	3.8	171	105
ALBUMIN (ELECTROPHORESIS)	g/dl	2.8	0.1	2.7	2.8	2	2
TOTAL THYROXINE	µg/dl	2.1	0.1	2.0	2.2	3	3

^a Number of samples used to calculate the reference range.

^b Number of different individuals contributing to the reference values.

Physiological reference ranges are calculated from samples submitted by 34 member institutions and are both sexes and all ages combined.

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Wild animals

Hematology values for adult live-trapped river otters (<i>Lutra canadensis</i>) (Tocidlowski, 1997)					
Test	Units	Median	Minimum Value	Maximum Value	Sample Size
WHITE BLOOD CELL COUNT	*10 ³ /μl	11.3	4.7	33.2	132
RED BLOOD CELL COUNT	*10 ⁶ /μl	10.99	6.10	14.50	132
HEMOGLOBIN	g/dl	15.1	10.4	19.0	132
HEMATOCRIT	%	47.6	32.2	60.8	132
MEAN CORPUSCULAR VOLUME	fL	43.3	38.3	49.0	132
MEAN CORPUSCULAR HEMOGLOBIN	pg/cell	13.7	11.3	15.8	132
MEAN CORPUSCULAR HEMOGLOBIN CONCENTRATION	g/dl	31.4	27.8	39.2	132
PLATELET COUNT	*10 ³ /μl	565	298	931	132
SEGMENTED NEUTROPHILS	*10 ³ /μl	8878.5	3003.0	28220.0	132
LYMPHOCYTES	*10 ³ /μl	1254.0	123.0	4950.0	132
MONOCYTES	*10 ³ /μl	452.3	52.0	2380.0	132
EOSINOPHILS	*10 ³ /μl	312.0	0.0	1833.0	132
BASOPHILS	*10 ³ /μl	88.0	0.0	219.0	132
NEUTROPHILIC BANDS	*10 ³ /μl	94.0	0.0	486.0	132

Biochemistry values for adult live-trapped river otters (<i>Lutra canadensis</i>) (Tocidlowski, 1997)					
Test	Units	Median	Minimum Value	Maximum Value	Sample Size
CALCIUM	mg/dl	8.4	6.8	10.0	50
PHOSPHORUS	mg/dl	5.8	3.2	8.3	50
SODIUM	mEq/L	152	136	158	50
POTASSIUM	mEq/L	4.4	3.5	5.3	50
CHLORIDE	mEq/L	113	94	121	50
CARBON DIOXIDE	mEq/L	24	19	28	21
BLOOD UREA NITROGEN	mg/dl	31	17	56	50
CREATININE	mg/dl	0.5	0.4	0.8	50
TOTAL BILIRUBIN	mg/dl	0.2	0.1	0.5	50
GLUCOSE	mg/dl	130	56	225	50
CHOLESTEROL	mg/dl	152	63	279	29
TRIGLYCERIDE	mg/dl	31	9	72	29
CREATINE PHOSPHOKINASE	IU/L	219	67	1300	50
LACTATE DEHYDROGENASE	IU/L	149	36	10820	21
ALKALINE PHOSPHATASE	IU/L	85	29	282	50
ALANINE AMINOTRANSFERASE	IU/L	194	46	990	50
ASPARTATE AMINOTRANSFERASE	IU/L	85	34	1260	50
GAMMA GLUTAMYLTRANSFERASE	IU/L	19	8	38	29
AMYLASE	U/L	12	2	22	21
TOTAL PROTEIN (COLORIMETRY)	g/dl	7.3	5.7	9.0	50
GLOBULIN (COLORIMETRY)	g/dl	4.0	2.9	5.8	50
ALBUMIN (COLORIMETRY)	g/dl	3.3	2.4	4.1	50

Hematology/Blood Chemistry – Serfass, 1994 – Pennsylvania River Otter Reintroduction

Range	
Hematocrit gm/dl	34 – 59%
Red Blood Cell Count	9.4 – 11.9/mm
Segmented Neutrophils	61 – 87%
Basophils	0
Mean Corpuscular Hemoglobin (MCH)	14.2 – 16.9pg
Blood Urea Nitrogen (BUN)	26. 45 mg./dl
BUN/Creatinine mg/dl ratio	41 – 130
Triglyceride meg/l	20 – 128 mg/dl
Total Protein gm/dl	6.3 – 7.2 gm/dl
Globulin	3.4 – 4.3 gm/dl

Range	
Hemoglobin	13.0 – 18.5
WBC	7.0 – 16.1/mm
Band Neutrophils	0 – 5%
Lymphocytes	5 – 20%
Glucose	74 – 148 mg/dl
Creatinine	0.3 – 0.6 mg/dl
Cholesterol	108 – 242
Sodium	148 – 153
Albumin	2.7 – 3.0
Alkaline Phosphatase	81 – 193 I.U./L

Range	
Alanine Aminotransferase (ALT)	77 – 321 I.U./L
Aspartate Aminotransferase (SGOT)	0 – 1053 I.U./L
Monocytes	0 – 8%
Mean Corpuscular Volume (MCV)	38.6 – 52.3 u3
Potassium	3.9 – 4.9 meg/L
Bicarbonate	21 – 25 meg/L
Total Bilirubin	0.1 – 0.2 mg/dl
Ionized Calcium	3.9 – 4.1 mg/dl

Range	
Lactate Dehydrogenase (LDH)	73 – 390 I. U./L
Uric Acid	1.3 – 3.7 ug/ml
Eosinophils	0 – 14%
Mean Corpuscular Hemoglobin (MCHC)	29.3 – 40.2%
Chloride	108 – 114 meg/L
Iron	71 – 192 meg/L
Calcium	8.1 – 9.1 mg/dl
Phosphorus	4.5 – 7.5 mg/dl

PHYSICAL NORMS

Teeth

3/3 Incisors; 1/1 Canines; 4/3 Premolars; 1/2 Molars x 2 = 36 Total

Vertebrae

14 rib bearing; 7 cervical; 14 thoracic; 6 lumbar; 3 sacral; 22 caudal. The normal total is 52. (Toweill & Tabor 1982)

Mammae

Four, inguinal.

Feet

Webbing between all digits but, slightly more extensive on the hind feet. The claws are sharp and probably aid in gripping. The hind feet are generally larger than the fore and the hind legs are longer leading to the typical hump-backed gait when traveling across land. The soles of the feet have tufts of hair under the toes (in some subspecies). Plantar pads are found on the soles of the hind feet. Pentadactyl and plantigrade. Also see skeletal adaptations under Descriptions.

CAPTIVE CARE

Medical records

Thorough and accurate medical records are essential to learn and understand more about the medical problems of any of our captive species. Medical records should be systematic and entries should identify the history, physical findings, procedures performed, treatments administered, differential diagnosis, assessment, and future plans for treatment. A computerized medical record system, which can help track problems and can be easily transmitted from one institution to the next is extremely beneficial. The otter SSP encourages the use of Med ARKS (International Species Information System, 12101 Johnny Cake Ridge Road, Apple Valley, MN 55124, U.S.A.) as a universal medical record program. Many institutions already use this program making it easy to transfer information between them.

Identification

Transponder Chips:

The otter SSP recommends that all otters be identified as soon as possible after birth with a transponder chip placed subcutaneously above the bridge of the nose over the forehead. This location makes the chip easy to read when the animal comes to the front of the cage. Transponders placed in the shoulder or back can migrate and may be broken or lost during fighting and breeding attempts. However, many institutions use the long-established intra-scapular location for transponder placement. Whatever location is used, it should be recorded in the animal's permanent record.

Tattoos:

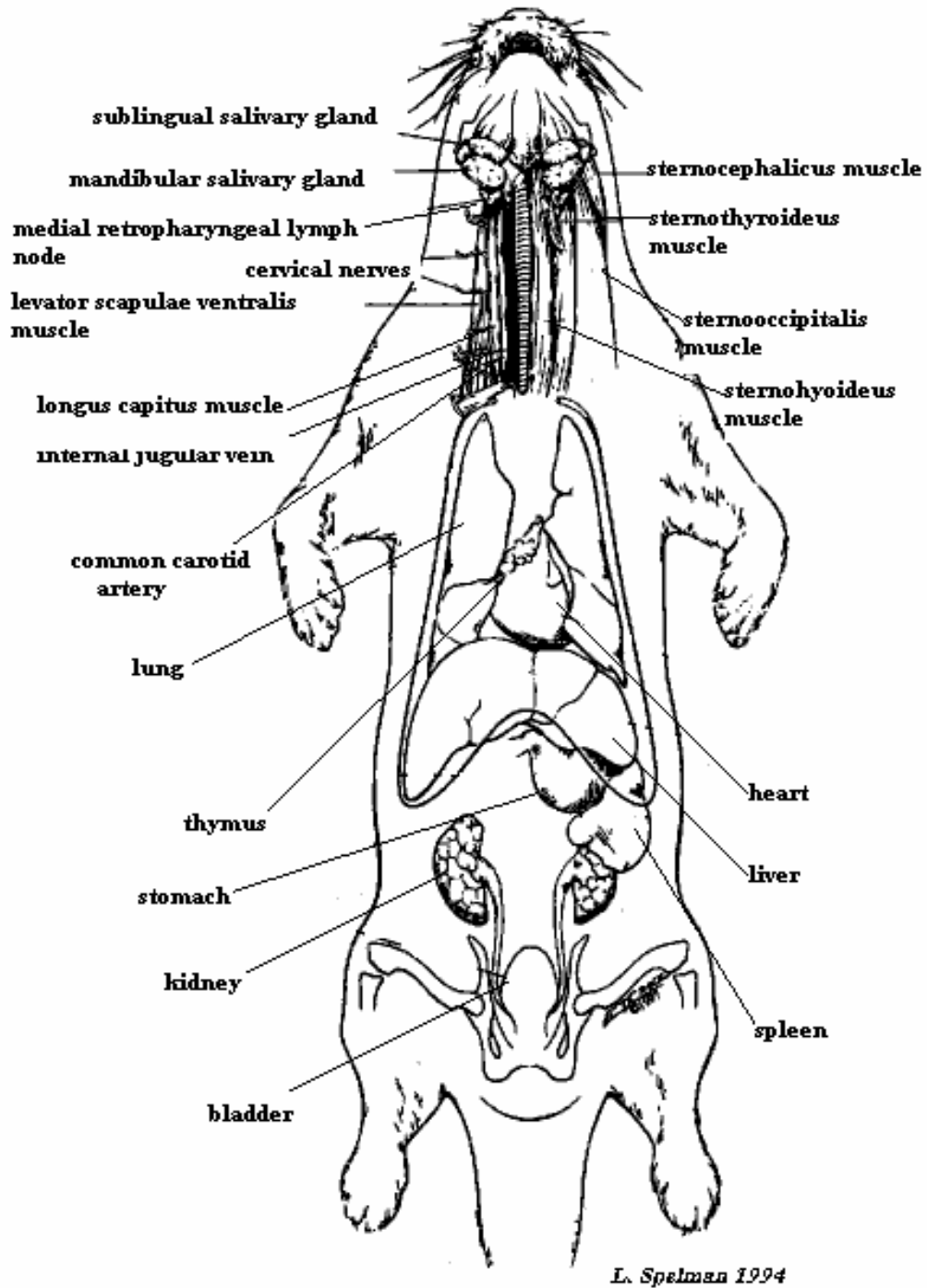
River otters should have their studbook number tattooed on the medial thigh as soon as they reach adult size. This should be applied to the left medial thigh for females and to the right medial thigh for males.

Preventative Health Care

Annual physical examinations

It is recommended that all animals have at least a biannual examination and, if possible, an annual examination during which the following procedures are performed:

- Transponders and/or tattoos should be checked and reapplied if they are not readable.
- Baseline physiological parameters (e.g., heart rate, weight, body temperature, respiratory rate) should be obtained & recorded.
- The oral cavity and all dentition should be examined. Teeth should be cleaned and polished if necessary. Any tooth that is fractured or in need of repair should be noted in the medical record and the condition corrected as soon as possible.
- The reproductive tract should be evaluated. Care should be taken to record any changes in the external genitalia, such as vulvar swelling or discharge, testicular enlargement, and mammary gland changes. Contraceptive hormone implants also should be checked to make sure they are in place, and not causing any local irritation.
- Radiographs taken to check for any abnormalities. If renal or cystic calculi are seen, then numbers, location, and approximate sizes should be noted in the records.
- Blood collection done, and complete blood count and chemistry profile performed.
- Blood serum frozen and banked when possible.
- Animals housed outside in heartworm endemic areas should be checked for heartworm disease by performing a heartworm ELISA antigen test, and the animal routinely given heartworm preventative treatment (see 'parasite control' section).
- Urine collected whenever possible by cystocentesis for a complete urinalysis.
- An annual fecal examination should be performed to check for internal parasites, and anthelmintics administered if necessary (see 'parasite control' section).
- Vaccines updated if necessary.



Immunizations

The following vaccination schedule is recommended by the AZA Otter SSP Veterinary Advisor. Vaccination product recommendations are based on clinical experience (as of 2006) in most cases, and not necessarily on controlled scientific study.

Distemper

Merial's new PureVax™ Ferret Distemper Vaccine currently on the market is a univalent, lyophilized product of a recombinant canary pox vector expressing canine distemper virus antigens. The vaccine cannot cause canine distemper under any circumstances, and its safety and immunogenicity have been demonstrated by vaccination and challenge tests. Otters should initially be given 1ml of reconstituted vaccine for a total of 2-3 injections at three-week intervals, followed by a yearly booster. This vaccine should be given IM instead of SQ in exotic carnivores for increased effectiveness. More information on PureVax™ Ferret Distemper Vaccine can be found at www.us.merial.com; Merial Ltd., 3239 Satellite Blvd., Duluth, GA 30096. An alternative vaccine that is available is Galaxy D (Schering-Plough Animal Health Corporation, P.O. Box 3113, Omaha, NE 68103), a modified-live canine distemper vaccine of primate kidney tissue cell origin, Onderstepoort type. Safety and efficacy of canine distemper vaccinations in exotic species of carnivores have been problematic. Vaccine-induced distemper has occurred in a variety of mustelids using modified-live vaccine, and killed vaccines have not provided long-lived protection and are not commercially available. However, to date there have been no cases of vaccine induced distemper in otters given the Galaxy product, and excellent seroconversion following vaccination using this product has been documented in young N.A. river otters (K.Petrini, unpublished data, 1986). The use of any modified-live canine distemper vaccine in exotic species should be done with care, especially with young animals and those that have not been vaccinated previously. The use of PureVax™ Ferret Distemper Vaccine is recommended where possible.

Parvovirus

The efficacy of feline and canine parvovirus vaccines has not been proven in otters. Otters should initially be given 1ml of vaccine IM for a total of 2-3 injections at three-week intervals followed by a yearly booster. Parvocine™ (Biocor Animal Health Inc., 2720 North 84th Street, Omaha, NE 68134) is a killed univalent parvovirus vaccine that has been used in otters. Using a univalent product such as Parvocine™ reduces the risk of vaccine allergic reactions.

Rabies

The efficacy of rabies vaccines has not been proven in *Lontra canadensis* or other exotic mustelids. Vaccinated otters that bite humans should not be considered protected from rabies. **Only killed** rabies products should be used in otters. One commonly used product is Imrab® 3 (Merial Ltd., 3239 Satellite Blvd., Duluth, GA 30096), which is a killed rabies vaccine that has been used extensively in small carnivores without apparent adverse effects. Otters should be given 1ml of vaccine IM once at 16 weeks of age followed by a yearly booster. PureVax™ Feline Rabies (Merial Ltd., 3239 Satellite Blvd., Duluth, GA 30096) is a live canarypox vectored, non-adjuvanted recombinant rabies vaccine that is currently being used at some institutions for small carnivores. Dose and route are the same as for Imrab® 3, but this vaccine can be given once at age 8 weeks or older, then annually.

Leptospirosis

The susceptibility of river otters to leptospirosis is debated in the literature, and the benefit of vaccination is unknown. Killed *Leptospira* bacterins are available and can be administered in areas where leptospirosis has been problematic. Initially two doses should be given at 3-4 week intervals. Vaccine efficacy and duration of immunity has not been studied in the otter and is an area where further study should be conducted.

Vaccination schedule

- Sub adults should be vaccinated with killed parvovirus at 8, 12, and 16 weeks. Vaccination should begin earlier in kits from unvaccinated dams.
- Veterinarians should **consider** vaccinating sub adults at 8, 12, and 16 weeks for distemper. **See discussion of distemper vaccines above.**
- Rabies vaccine should be given once at 8 or 16 weeks (product dependent) for animals at risk of contracting rabies.
- Adults should be vaccinated annually for all of the above.

Parasite control

Otters should have fecal examinations performed regularly. The frequency of these examinations depends on the incidence of parasitism in the geographic region and the animals' likelihood of exposure. Animals should also be screened for parasites before shipment and during quarantine. Fecal testing should include both a direct smear examination as well as fecal flotation and sedimentation techniques. Baermann fecal examination techniques help identify certain parasites such as lungworms that are otherwise difficult to detect. Heartworm ELISA antigen tests should be conducted annually in animals exposed to mosquitoes in heartworm endemic areas. External parasites such as ear mites, fleas, ticks, etc can be detected during a physical examination.

A list of some of the parasites that have been identified in river otters and other mustelids is included in the disease section of this chapter for reference.

Recommendations for parasite testing

Internal:

- Annual fecal examination should include a direct smear, fecal flotation, and sedimentation or Baermann.
- Preshipment fecal examinations, direct smear and floatation.
- Quarantine fecal examination, 3 direct smears, 3 fecal floatations, 3 sedimentations or Baermann.
- Heartworm elisa antigen tests should be conducted annually in animals exposed to mosquitoes in heartworm endemic areas. See parasite section for more information about microfilaria in otters.

External:

- Animals should be inspected for external parasites, including ear mites during any physical examination.

Anthelmintics

The following is a list of products that have been used safely in a variety of mustelids.

Fenbendazole:

50 mg/kg orally for 3-5 days

Pyrantel pamoate:

10 mg/kg orally

Ivermectin:

For heartworm prevention:

0.006 mg/kg orally once monthly

For treatment of intestinal nematodiasis:

0.2 to 0.4 mg/kg Subcutaneously or Orally

Praziquantel:

5 mg/kg SC or Orally

Preshipment examination recommendations

All otters should receive a thorough preshipment physical examination as outlined above in the preventative health care section. Ideally, a copy of the preshipment physical exam findings and laboratory work should be sent to the veterinarian at the receiving institution before the animal is transferred. If an otter has a current medical condition requiring ongoing treatment, the case should be discussed between the shipping and receiving institutions' veterinarians **before** the animal is moved. All animal shipments should be accompanied by a hard copy of the medical record, as well as a health certificate and the USDA acquisition, disposition, or transport form (APHIS form #7020). Institutions using MedARKS should provide the receiving institution with the medical records on a floppy disc or send them via E-mail.

Quarantine

"...every animal is capable of carrying infectious diseases in a quiescent state (sub-clinical infection), which can readily be reactivated by the stress of moving and change in regime. Such an animal may not necessarily become ill itself, but may begin shedding infectious agents which pose a risk to other animals in the collection. Freedom from disease or latent disease must never be assumed." (Lewis 1995)

All animals should undergo a 30-day quarantine stay at the receiving institution before being added to the rest of the collection. This allows time for the development of clinical signs of disease that may have been incubating before the animal was shipped. During the quarantine period the animal should be observed for signs that may be associated with disease, such as sneezing, coughing, vomiting, diarrhea, ocular or nasal discharge, etc. Three fecal examinations for parasites should be performed. The diet should be slowly adjusted over several weeks if there is to be a diet change.

Ideally, quarantine facilities should be isolated from the risk of cross-contaminating other carnivores already in the collection. If this is not possible, different keepers should be used, or strict rules of personal hygiene should be adopted and resident animals should be cared for first, then quarantine animals.

Balance between the necessity of keeping the quarantine pen clean and the needs of the animal can be tricky. There is some indication that many mustelids do *"...better isolated in enclosures as opposed to hospital-type quarantine pens."* (Lewis 1995) If this is not practical, or possible, a privacy box, climbing furniture, substrate suitable for rubbing/drying-off on, and a pool or water tub suitable for swimming should be provided. Whatever type holding facility is used, be sure it is otter-proof, they will climb, dig and chew.

There is much to be learned from a close physical examination (see below). In the case of otters, this requires putting the animal under a general anesthetic. The facility's policy on non-vital anesthesia should be followed, however, because otters are particularly adept at masking signs of illness, it is advised that a thorough physical exam be conducted before releasing the animal into the resident population.

Quarantine examinations

Initial exam:

Veterinarians should visually inspect otters as soon as possible after they have arrived in quarantine. If a preshipment physical examination has not been done before the animal was transferred it would be prudent to perform a complete examination during the first week of quarantine.

Final exam:

During the last week of quarantine, a thorough physical examination should be conducted as outlined in the preventative health care section above. **It is extremely important to take radiographs of the animal during this time even if they were done at the previous institution.** This gives the new institution its

own baseline film from which to compare future radiographs. This is especially important since radiographic techniques vary from facility to facility.

Control of Reproduction

Note: This information is taken from 2008 AZA Wildlife Contraception Center recommendations for contraception in otter species. Their website should always be checked for updated information.

In addition to reversible contraception, reproduction can be prevented by separating the sexes or by permanent sterilization. In general, reversible contraception is preferable because it allows natural social groups to be maintained while managing the genetic health of the population. Permanent sterilization may be considered for individuals that are genetically well-represented or for whom reproduction would pose health risks. The contraceptive methods most suitable for otters are outlined below. More details on products, application, and ordering information can be found on the AZA Wildlife Contraception Center (WCC) webpage: www.stlzoo.org/contraception.

The progestin-based melengestrol acetate (MGA) implant, previously the most widely used contraceptive in zoos, has been associated with uterine and mammary pathology in felids and suspected in other carnivore species (Munson 2006). Other progestins (e.g., Depo-Provera®, Ovaban®) are likely to have the same deleterious effects. For carnivores, the AZA Wildlife Contraception Center now recommends GnRH agonists, e.g., Suprelorin® (deslorelin) implants or Lupron Depot® (leuprolide acetate) as safer alternatives. Although it appears safe and effective, dosages and duration of efficacy have not been systematically evaluated for all species. GnRH agonists can be used in either females or males, and side effects are generally those associated with gonadectomy, especially weight gain, which should be managed through diet. Suprelorin® was developed for domestic dogs and has been used successfully in African clawless otters, North American river otters, Asian small clawed otters and sea otters.

Gonadotropin releasing hormone (GnRH) agonists [Suprelorin® implants, or Lupron Depot®]: GnRH agonists achieve contraception by reversibly suppressing the reproductive endocrine system, preventing production of pituitary (FSH and LH) and gonadal hormones (estradiol and progesterone in females and testosterone in males). The observed effects are similar to those following either ovariectomy in females or castration in males, but are reversible. GnRH agonists first stimulate the reproductive system, which can result in estrus and ovulation in females or temporary enhancement of testosterone and semen production in males. Then, down-regulation follows the initial stimulation. The stimulatory phase can be prevented in females by daily Ovaban administration for one week before and one week after implant placement (Wright et al. 2001).

GnRH agonists should not be used during pregnancy, since they may cause spontaneous abortion or prevent mammary development necessary for lactation. They may prevent initiation of lactation by inhibiting progesterone secretion, but effects on established lactation are less likely. New data from domestic cats have shown no effect on subsequent reproduction when treatment began before puberty; no research in prepubertal otters has been conducted.

A drawback of these products is that time of reversal cannot be controlled. Neither the implant (Suprelorin®) nor the depot vehicle (Lupron®) can be removed to shorten the duration of efficacy to time reversals. The most widely used formulations are designed to be effective either 6 or 12 months, but those are for the most part minimum durations, which can be longer in some individuals.

Although GnRH agonists can also be an effective contraceptive in males, they are more commonly used in females, because monitoring efficacy by suppression of estrous behavior or cyclic gonadal steroids in feces is usually easier than ensuring continued absence of sperm in males, since most institutions cannot perform regular semen collections. Suprelorin® has been tested primarily in domestic dogs, whereas Lupron Depot® has been used primarily in humans, but should be as effective as Suprelorin®, since the GnRH molecule is identical in all mammalian species.

If used in males, disappearance of sperm from the ejaculate following down-regulation of testosterone may take an additional 6 weeks, as with vasectomy. It should be easier to suppress the onset of spermatogenesis in seasonally breeding species, but that process begins at least 2 months before the first typical appearance of sperm. Thus, treatment should be initiated at least 2 months before the anticipated onset of breeding.

Progestins [Melengestrol acetate (MGA) implants, Depo-Provera® injections, Ovaban® pills] If progestins must be used, they should be administered for no more than 2 years and then discontinued to allow for a pregnancy. Discontinuing progestin contraception and allowing non-pregnant cycles does not substitute for a pregnancy. Use of progestins for more than a total of 4 years is not recommended. MGA implants last at least 2 years, and clearance of the hormone from the system occurs rapidly after implant removal. Progestins are considered safe to use during lactation.

Vaccines: The porcine zona pellucida (PZP) vaccine has not been tested in otters but may cause permanent sterility in many carnivore species after only one or two treatments. This approach is not recommended.

Ovariectomy or Ovariohysterectomy: Removal of ovaries is a safe and effective method to prevent reproduction for animals that are eligible for permanent sterilization. In general, ovariectomy is sufficient in young females, whereas, removal of the uterus as well as ovaries is preferable in older females, due to the increased likelihood of uterine pathology with age.

Vasectomy: Vasectomy of males will not prevent potential adverse effects to females that can result from prolonged, cyclic exposure to the endogenous progesterone associated with the pseudo-pregnancy that follows ovulation. This approach is not recommended for otters.

References:

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ANESTHESIA

Anesthesia Administration, Monitoring and Recovery

It is recommended that anesthesia be given intramuscularly (IM) in the cranial thigh (quadriceps), caudal thigh (semimembranosus-tendinosus), or paralumbar muscles. (Spelman 1999) Animals should be kept as quiet as possible. Generally restraint is accomplished using a net, squeeze cage, or capture box. The AZA Otter SSP recommends training animals to receive injections to minimize stress prior to all anesthesia events. A variety of agents have successfully been used in otter species for immobilization. These include Ketamine alone (not recommended), Ketamine with midazolam, Ketamine with diazepam, and Telazol®.

Otters have a large respiratory reserve, and so using gas induction chambers is often very time consuming (this can take up to 10 minutes in *A. cinereus*), but has been done successfully. Despite the method of induction, anesthesia can be maintained by entubating the animal and maintaining it on Isoflurane (Ohmeda Pharmaceutical Products Division Inc., P.O. Box 804, 110 Allen Rd., Liberty Corner, NJ 07938) or Halothane (Fort Dodge, 9401 Indian Creek Parkway, Ste. 1500, Overland Park, KS 66210) anesthesia. Otters are relatively easy to entubate, and this method is preferred when it is necessary for an animal to be immobilized for a lengthy procedure.

Careful monitoring of anesthetic depth and vital signs is important in any immobilization. Body temperature, respiratory rate and depth, heart rate and rhythm, and mucous membrane color and refill time should be assessed frequently. Pulse oximetry sites include the tongue, the lip at the commissure of the mouth, or in the rectum. Oxygen supplementation should be available and administered when indicated.

“Relative oxyhemoglobin saturation should be recorded in anesthetized otters in addition to heart rate, respiratory rate, and rectal temperature whenever possible. Respiratory depression (apnea, bradypnea, tachypnea, hypoxemia) was the most common complication associated with injectable anesthesia...” (Spelman 1999)

It is difficult to find a suitable probe site for pulse oximetry. Spelman found that a Nellcor D-25 probe (Nellcor, Inc.) *“...folded over the tongue or digits and secured with a paperclip, or a Nellcor RS-10 reflectance probe modified as an esophageal or rectal probe (or any comparable probe). indirect blood pressure can be readily measured with a small or neonatal cuff on the base of the tail.”* (Spelman 1999)

River Otter Short-term Anesthesia (max 25-30 mins.) - Table

Anesthetic combination (mg/kg)*	Comments
Ketamine (10), midazolam (0.25)	Highly recommended
Ketamine (2.5), medetomidine (0.025) (atipamezole 0.125)	May need higher dosages (Ket 3.5, Med 0.035) but respiratory depression more likely
Tiletamine-zolazepam (4) ** (flumazenil 0.08)	Recovery may be prolonged without flumazenil
Ketamine (10)	Expect muscle rigidity and variable duration
Ketamine (10), diazepam (0.5 – 1) Ketamine (5-10), xylazine (1-2) (yohimbine 0.125)	Prolonged recovery compared to ketamine, midazolam Variable effects from heavy sedation only to respiratory depression. Alternative dosages Ket (3-4), xyl (3-4)
Azaperone (0.1), fentanyl (0.1-0.2) (naloxone 0.04)	Not recommended

***Dosages given are based upon intramuscular administration.**

From: Spelman, Lucy DVM: Table 2 from EAZWV Proceedings May 1998, Recommended anesthetic dosages (including reversal agents, in brackets, where appropriate) for short term anesthesia (25-30 min) in North American river otters (*Lutra canadensis*).

** Petrini uses 8mg/kg Tiletamine-zolazepam (Telazol®) in *L. canadensis*

Physiologic Measures and the Effect of Anesthetic-Related Complications - Table

Physiologic Measure	Baseline (Range)	Increased	Decreased
Heart rate (beats/minute)	152 (130 – 178)	>180 (tachycardia)	<100 (bradycardia)
Respiratory rate (breaths/minute)	31 (10 – 60)	>40 (tachypnea)	<8 (bradypnea)
Relative oxyhemoglobin saturation (%)	97 (92 – 100)	NA	<80% (hypoxemia)
Mean arterial blood pressure (mm Hg)	63 (31 – 77)	<50 (hypotension)	>100 (hypertension)
Rectal temperature (°C)	38.4° (38.1 – 38.7°)	>40.1° (hyperthermia)	<36.7° (hypothermia)

From: L. Spelman 1999

Representative Arterial Blood Gas Results from 6 River Otters Anesthetized with Different Protocols

Anesthesia Combination	PO₂ (mm Hg)	PCO₂ (mm Hg)	pH	HCO₃⁻ (mEq/L)	SPO₂ (%)	SaO₂ (%)
Ketamine-midazolam	81.6	56.6	7.29	27.4	93	94.2
Tiletamine-zolazepam	69.3	51.9	7.32	27.2	93	91.8
Medetomidine-ketamine	68.8	54.2	7.29	26.4	93	90.9
Ketamine-diazepam	60.3	54.1	7.38	30.0	93	88.7
Fentanyl-midazolam	34.4	90.7	7.11	29.2	<50	44.6
Fentanyl-midazolam-azaperone	29.4	76.2	7.24	32.7	<50	42.0

From: L. Spelman 1999

Supplemental oxygen should always be available for administration, if necessary. For longer procedures, animals should be maintained on Isoflurane.

SIGNS OF ILLNESS

◀ It has been frequently repeated that an otter that skips one meal is worthy of concern; an otter that skips two meals is definitely ill. (An exception to this rule is a female that has just given birth; she may skip meals just prior to, and just after parturition. If this persists a veterinarian should be consulted.)

◀ Another excellent indicator of the state of an otter's health is the condition of its coat. It should be smooth, soft and shiny looking when dry. When wet, the coat should form spikes which allow the moisture to bead and run off upon emerging from the water. If it stays matted down, the coat is becoming saturated which is an indication there is something wrong. (This could be a sign of illness, poor nutrition or, an environmental problem such as caustic substances in the water, i.e. chlorine or an ozone system set too high.)

◀ If an animal is spending an excessive amount of time rubbing and rolling in an attempt to dry its coat.

◀ A reluctance to go in the water can mean an animal's coat is becoming drenched. Not only does this cause the animal to feel the cold but, also is an indication of a potential health problem.

◀ Loose or excessively soft stool. A healthy otter, receiving an appropriate diet, should have formed, soft stools.

◀ All of the non-species specific signals also should be watched for, i.e. swelling, lethargy, unusual behaviors, abnormal fluid drainage, etc.

COMMON INJURIES or AILMENTS

Vaginal Discharge and Urogenital Disorders

Captive otters are often noted to have a slightly bloody or even a reddish-brown vaginal discharge. The significance of this is as yet unknown. One author describes a slightly blood-tinged vaginal fluid as being normal during estrus in the river otter (Seager 1978). Other researchers suggest that bloody mucopurulent vaginal discharge is indicative of genitourinary disease (Hoover 1984, Hoover 1985). There have been reports of females with intermittent red to reddish-brown vaginal discharge that have appeared healthy, but other animals have had serious, even life-threatening urinary or uterine disease. Some otter caretakers believe that bloody vaginal discharge is seasonal and related to the estrous cycle. However, one captive otter with a persistent history of bloody vaginal discharge had an ovariohysterectomy performed, and although histopathology of the uterus supported mild endometrial disease, the bloody vaginal discharge returned after the surgery. This case suggests that the etiology of bloody vaginal discharge in this species is not simple and is probably multifactorial. Numerous organisms have been isolated from the vagina of otters with bloody discharge, including *Pseudomonas aeruginosa* and *Proteus mirabilis*. Since pyometras and other significant urinary and uterine infections do occur in otters, it is important to investigate any symptom that may indicate genitourinary disease. These symptoms may include a distended abdomen, increased water consumption, frequent urination, and genital rubbing, as well as vaginal discharge.

Poor Coat Condition

Hair coat problems are frequently reported in captive North American river otters. A healthy otter hair coat has guard hairs which form spikes when wet rather than becoming clumped or smooth. Water on the surface of a well waterproofed otter forms small droplets that do not penetrate the undercoat and are quickly removed with one good body shake. Indeed, the lighter colored undercoat should not be visible. (Duplaix-Hall, 1975). If the coat is in poor condition the otter may refuse to go in the water because it is becoming waterlogged. One of the causes of a poor coat is poor water quality either due to excessive organic debris or to chemicals used in pool filtration systems. High levels of chlorine pose a threat to the water repellent ability of an otter's coat. Chlorine levels should be monitored closely and not be allowed to go above 0.5 ppm for long periods of time. (See Captive Management section for chlorine discussion.) Another potential cause of poor coat quality is lack of appropriate dry surfaces for grooming. Sufficient land area, bedding material, exhibit furniture, and a variety of substrates are very important for the otter to maintain a healthy hair coat.

Over-grooming is another common cause of coat problems. Over-grooming is often associated with stress or overcrowding. It can either be self induced, or caused from an overzealous exhibit-mate.

Dietary imbalances and dermatological disease from fungi, bacteria, parasites, or allergies can also cause hair coat problems. A methodical approach to investigating the cause of poor coat condition is necessary to identify and correct the problem.

Alopecia

Seasonal coat changes and even a partial alopecia may occasionally occur in both males and females during the breeding season. The alopecia most commonly involves the tail and ventral abdomen and usually is bilaterally symmetrical. It resolves spontaneously at the end of the breeding season and is a normal hormonal phenomenon. In addition, pregnant females may occasionally pull hair from their abdominal region when parturition draws near.

Bite Wounds

Bite wounds caused by exhibit mates can become infected and form abscesses. These should be surgically drained and the wound flushed with antibacterial agents such as dilute Nolvasan® or Betadine®. Systemic antibiotic therapy is often indicated. Bacteria commonly found infecting bite wounds include *Pasturella sp.*, *Streptococcus sp.*, and *Staphylococcus sp.*

Foot Pad Abrasions

Abrasions, erosions, and ulcers of the feet are generally caused by the lack of a suitable substrate for the otter to adequately dry itself on, or continued pacing. If an exhibit consists primarily of concrete, or gunite, bedding of some type should be provided. When feet are chronically wet, the pads become soft and can be easily rubbed raw by rough surfaces.

Loose Stool/Diarrhea

Otter feces are normally softly formed. Loose stools or diarrhea can result from a variety of diseases, but often is simply the result of poor diet, overfeeding, abrupt dietary change, or consuming food that is spoiled or has become rancid. Many experienced otter rehabilitators report that diarrhea can be a problem when hand raising pups. Frequently this is the result of overfeeding or feeding an inappropriate diet. (See Hand Rearing and Nutrition sections for more information on these topics.) Clostridial enteritis is one of the most commonly reported diseases in both wild and captive North American river otters and can result in diarrhea, often with blood and mucus. See Bacterial Diseases for more details on *Clostridium*. Many other bacteria, viruses, and parasites can also cause loose stools or diarrhea.

Pneumonia

Pneumonia is relatively common in both captive and free-living otters (Madsen 1999, Chanin 1985, Duplaix-Hall 1975, Hoover 1984, Hoover 1985). Pneumonia and other respiratory disease can result from parasitic, bacterial, fungal, or viral disease. Often it is secondary to underlying problems such as stress, poor coat condition, extreme environmental conditions, or concurrent illnesses that have reduced the animal's immune capability. Treatment usually includes appropriate antimicrobial or antiparasitic agents, supportive care, and eliminating any underlying environmental or health problems. Symptoms of pneumonia include coughing, dyspnea, and rapid breathing. Otter pups are particularly susceptible to pneumonia and respiratory disease.

Stress

Foster (1986) defines stress as, "...a cumulative response, the result of an animal's interaction with its environment through receptors. This is an adaptive phenomenon. All responses are primarily directed at coping with environmental change, and behavioral repertoires may be dependent upon the stressful interaction of an animal with its environment."

Stressors can be somatic, psychological, behavioral or miscellaneous; all of which can lead to poor health. Signs of stress may include poor coat condition, lack of appetite, unusual behavior, and/or frequent screaming. Examples of stressors given by Foster (1986) are listed below:

- Somatic stressors include: strange sounds, sights, and odors; unexpected touches; changes in position, heat, cold, or pressure; abnormal stretching of muscles and tendons; or effects of chemicals or drugs.
- Behavioral stressors include: unfamiliar surroundings, overcrowding, territorial or hierarchical upsets; changes in biological rhythms; lack of social contact; lack of isolation; the lack of habitual or imprinted foods.

Many other sources of stress are also possible. The vigilant otter keeper should always be on the alert for potential sources of stress to animals in their care.

Dental Disease

Periodontal disease, fractured teeth, and apical abscesses are common problems in captive otters. Facial swelling is a common symptom of an abscessed tooth, but it is not uncommon for animals to have severe dental disease and show no clinical signs. Regular examinations can help identify problems before they become too severe. Prompt treatment of fractures and abscesses is extremely important. Endodontic procedures such as root canals and pulpotomies can be performed on diseased teeth following appropriate

antibiotic therapy. Alternatively, diseased teeth can be extracted. Animals with periodontal disease should have their teeth regularly cleaned and polished. Antibiotic therapy initiated several days before a dental cleaning and extended for 1-2 weeks following a procedure can help minimize bacterial embolism. Providing bones, such as knucklebones or neck bones from sheep or other large animals **twice** weekly, along with regular cleaning and polishing will help reduce periodontal problems.

COMMON CAUSES OF DEATH

Dr. Gwen Myers, AZA Otter SSP Veterinary Advisor conducted a review of all submitted necropsy reports for this species. Her findings (table below) indicate that the most frequent causes of *L. canadensis* deaths (excluding neonatal deaths) are:

Common Causes of Death in L. Canadensis	
(Unpublished research, G. Myers, DVM – Otter SSP Veterinary Advisor)	
2007	
Cause of death	Causal factor
Heart disease	- Heartworm/death from heartworm treatment - Acute myocarditis - Myofiber degeneration
Renal failure	- Etiology unknown - Amyloidosis - Pyelonephritis
Hepatic lipidosis	-
Adenocarcinoma	-
Transitional cell carcinoma (bladder)	-
Peritonitis	- Secondary to intestinal perforation from foreign body - Secondary to GI perforation from ulcers
Diarrhea	- Unknown etiology - Clostridial endotoxin - <i>Helicobacter</i> (also causing vomiting, weight loss) - <i>Salmonella</i>
Gastric dilatation with volvulus	-
Pneumonia	- Often without identifying underlying cause*
Anesthetic death	-

*Poor coat quality and other factors can lead to pneumonia. Poor coat quality is of concern when its water repellency is affected. If water does not form droplets, and cannot be easily shaken off the guard hairs (i.e., brown fur), the otters' guard hairs clump together resulting in a coat that looks slick and

saturated. This leads to water penetrating the guard hairs and exposure of the under-fur (gray/white under coat), which can then become waterlogged. An otter in this condition may not swim in an effort to remain as dry as possible. If the otter does swim, and it cannot keep dry, its body temperature will drop rapidly leading to observable shivering, even during sleep. Enteritis can develop in cases of extreme chilling. If measures are not taken, death can follow in a matter of days through pneumonia and/or gastro-intestinal complications (Duplaix-Hall 1972). Insufficient land vs. water area, and/or inappropriate enclosure substrates causing overly damp/wet conditions, were historically most often the reason for poor coat condition and the resulting health problems in river otters (Duplaix-Hall 1972, 1975).

GENERAL MUSTELID DISEASE

Viral Disease

Canine Distemper

Canine distemper has been confirmed in multiple species of mustelids, including the Eurasian otter, *Lutra lutra* (Madsen 1999, Geisel 1979, Loupal In Press). Antibody titers have been noted in *L. canadensis* (Kimber 2000), and recently a suspected case of distemper occurred in *L. canadensis* in Canada. Distemper could not be confirmed but clinical signs and distemper serology were supportive of the diagnosis. The animal survived without treatment (Sandra Black 2000, personal communication). In general, however, otters may be relatively resistant to canine distemper virus, compared to other mustelid species such as weasels and ferrets. In North America there have been many well-described epizootics of canine distemper in wild foxes and raccoons in areas where otters are common and there has been no corresponding mortality in otters. The clinical presentation of distemper in mustelids is similar to that in dogs. In addition to mucopurulent oculonasal discharge, respiratory disease, diarrhea, hyperkeratosis of the footpads, and C.N.S. signs; ferrets and mink also frequently get a rash under the chin and in the inguinal area. In the black-footed ferret intense pruritis and cutaneous hyperemia is common. Vaccine-induced distemper may have a slightly different clinical presentation, but has never been reported in the otter despite the use of a variety of modified-live products in this species.

Mink Enteritis Virus, Feline Panleukopenia, Canine Parvovirus

These closely related viruses have been shown to affect mink and the skunk. The domestic ferret is not susceptible to these viruses under natural circumstances. The disease in mustelids is similar to that in felids and includes diarrhea, vomiting, fever, and leukopenia. Several studies have reported positive antibody titers in wild river otters (Hoover 1985, Kimber 2000) and there has been at least one suspected case of parvovirus in a small-clawed otter housed in a United States zoo. However, viral particles were not found on histopathology and viral cultures and serology were not performed. "Feline enteritis/panleukopenia" was diagnosed in 18 out of 88 post mortems from a variety of zoos that were reviewed by one author (Duplaix-Hall), although the method of diagnosis was not described in these cases.

Aleutian disease (plasmacytosis)

Typically a disease of farm-raised mink, but has been found in feral mink, the domestic ferret, and the striped skunk. Aleutian disease viral antibody has been found in skunks, fishers, and the American marten (*Martes americana*). In one study, a river otter was challenged with Aleutian virus, but did not become clinically ill nor did it develop an antibody titer (Kenyon 1978). However, a disease resembling Aleutian disease was recently described in a wild European Otter (*L. lutra*), although no virus was actually isolated (Wells 1989). Aleutian Disease is an immune-mediated disease caused by a parvovirus of which there are several strains of varying pathogenicity. In mink, infection can range from unapparent to fatal. Generally, the course of the disease is slowly progressive over months to years. It is characterized by weight loss, hypergammaglobulinemia (greater than 20% of total serum protein), reproductive failure, and an immune-mediated glomerulonephritis. Some animals have hemorrhagic enteritis. Neonates may develop a fatal

interstitial pneumonia. Increased numbers of plasmacytes are found in the liver, kidney and other organs, hence the name plasmacytosis. Several methods of detecting the disease ante mortem are used including the rapid iodine agglutination test (IAT) and the counter immuno-electrophoresis (CIEP) test.

Rabies

The Center for Disease Control has records of at least 24 cases of rabid otters in North American. (Serfass 1995). Affected animals may remain calm and asymptomatic .

Coronavirus

Coronavirus has been implicated as the cause of epizootic catarrhal enteritis in both mink and ferrets (Williams 2000). There have been no confirmed cases of coronavirus enteritis in otters. In 1995-1996 thirty-eight river otters were tested for feline and canine coronavirus antibody. All were negative. In 1975, feline infectious peritonitis (FIP), a disease caused by a feline coronavirus, was suspected to have caused the death of 2 small-clawed otters, but the case was never confirmed with serology or viral isolation. (Van de Grift 1976).

Influenza

The domestic ferret is susceptible to certain strains of human influenza and is used as a research animal to study the disease. Symptoms in ferrets include sneezing, conjunctivitis, unilateral otitis, fever, and sometimes photophobia. The disease usually lasts 7-14 days. Avian influenza A virus was responsible for an outbreak of contagious interstitial pneumonia in mink in Sweden in 1984. Although it is not known whether other species of mustelids are susceptible to influenza, it would seem prudent for animal caretakers exhibiting signs of influenza to wear masks and disposable gloves when caring for mustelids. Infected ferrets can also transmit influenza to humans.

Rotavirus

A disease described in domestic ferrets as "ferret kit disease" is caused by a rotavirus. The disease usually affects kits from two to six weeks old causing diarrhea and resulting in high mortality. Histopathologic lesions include villous atrophy and vacuolation of villar epithelial cells in the small intestine. Direct electron microscopy is used to identify the virus in the feces. Serological tests are unreliable. Since secondary bacterial invaders may increase mortality, it has been recommended that affected individuals be treated with oral gentomycin and parenteral ampicillin. A syndrome in farmed mink known as "**3-day disease**", "**Utah disease**", or "**Epizootic Catarrhal Gastroenteritis**" may also be caused by a rotavirus. The disease is characterized by a short course of diarrhea, anorexia, and lethargy. It is rarely fatal.

Transmissible Mink Encephalopathy (TME)

TME is caused by a scrapie-like virus that occasionally causes disease in adult mink. Experimentally, striped skunks are also susceptible. It has a long incubation period lasting five to 12 months. Both morbidity and mortality are high. The main clinical signs can be attributed to lesions in the cerebrum and include behavioral changes, weakness, ataxia, and sometimes paralysis. Reproductive failure including stillbirths (often with anasarca) and congenital defects is also a feature of the disease. Diagnosis is based on histopathologic findings in the cerebrum.

Feline Leukemia Virus

Healthy domestic ferrets have tested positive to FeLV by ELISA, but the significance of this is unknown. It is possible that the test is cross-reacting with another retrovirus or that false positive results are occurring. To date, no immunodeficiency virus has been identified in otters.

Adenovirus (Infectious Canine Hepatitis)

This disease has been reported in the striped skunk, and there has been one river otter that died of symptoms suggestive of canine adenovirus, but the diagnosis was not confirmed by viral isolation (Kimber 2000). Antibody testing of wild, unvaccinated river otters has been negative for canine adenovirus in several studies (Hoover 1985, Kimber 2000).

Feline Rhinotracheitis (Feline Herpesvirus-1) and Feline Calicivirus

Upper respiratory disease suggestive of feline rhinotracheitis or calicivirus has not been reported in North American river otters. Sixty-four wild river otters from New York were serologically tested for antibody to feline herpesvirus-1 and feline calicivirus during a translocation study conducted in 1995-1996. All 64 animals were negative for antibody to both viruses. (Kimber 2000).

Herpesvirus

Herpesvirus-like intranuclear inclusion bodies were found in the oral, esophageal and corneal epithelial cells of a dead adult male sea otter (*Enhydra lutris*) found in Alaska (Harris 1990). Herpesvirus infections have been reported in both wild and captive sea otters. (Reimer 1998). Antibody titers to canine herpesvirus-1 have been reported in wild-caught otters. (Kimber 2000).

Herpes Necrotizing Encephalitis

Herpes necrotizing encephalitis is caused by a herpes simplex virus and has been reported in skunks. The virus causes necrotizing meningoencephalitis with necrosis and hemorrhage in the liver and adrenal gland. Clinical signs include salivation, tremors, and head bobbing. Diagnosis can be made from serology. (Wallach 1983).

Pseudorabies (Mad Itch)

This has been reported in several species of mustelids. Signs are similar to those of other carnivores and may include intense pruritis, ataxia, vomiting, salivation, dyspnea and death. (Wallach 1983).

Bacterial Disease

Bacterial pneumonia

Pneumonia has been frequently reported in otters (Duplax-Hall 1975, Madsen 1999, Hoover 1984, Hoover 1985). No one agent appears to be responsible, although bacterial cultures are not available for most of the cases reported. Signs of pneumonia may include nasal discharge, dyspnea, coughing, anorexia, and lethargy. Treatment involves appropriate antibiotic therapy. Viral infections, poor coat quality, and/or stress can predispose animals to bacterial pneumonia.

Pseudomonas pneumonia

Several serotypes of *Pseudomonas aeruginosa* cause hemorrhagic pneumonia in mink. The disease usually occurs in the autumn and can quickly spread through a ranch. Mortality rates vary from 0.1% to 50%. Animals die quickly, often without showing clinical signs. Occasionally dyspnea, a bloody nasal discharge, or convulsions are seen. The main post mortem lesion is hemorrhagic pneumonia with or without hemorrhagic pleural exudate. There is evidence that bacterial toxins may play a role in the pathogenesis of the disease. Concurrent infection with calicivirus or picornavirus, as well as poor air quality with high ammonia levels has been implicated as predisposing factors in the pathogenesis of the disease. This particular syndrome has not been reported in river otters.

Clostridial infections

Botulism--Most species of mustelids are susceptible to type C toxin (and to a lesser extent types A, B, and E) produced by *Clostridium botulinum*. Usually animals are found dead but some may exhibit paralysis and dyspnea before dying. There are no postmortem lesions. Eating cooked or uncooked meat contaminated by *Clostridium botulinum* spores found in the soil causes the disease. The prevalence of Clostridial organisms in the soil varies greatly from one geographic area to another. Animals not on a commercially prepared diet may benefit from annual vaccination, however eliminating soil contamination of food can also prevent the disease.

Clostridium perfringens enteritis—River otters appear to be particularly susceptible to overgrowth of *Clostridium perfringens* during periods of stress or dietary conversion. In a recent translocation study, a number of wild river otters became ill shortly after capture (Kollias 1998). These otters died anytime from

6 to 72 hours after capture. Clinical symptoms ranged from sudden death in some animals to mucoid watery diarrhea with or without blood to lethargy, anorexia, and hypothermia. Diagnosis is based on histopathological findings, anaerobic culture and the detection of Type A *Clostridium perfringens* exotoxin. Animals treated early in the course of the disease may respond to oral metronidazole (Kollias 1998) or parenteral trimethoprim-sulfa and *Clostridium perfringens* antitoxin (Kollias 1999), along with supportive care.

Tuberculosis

Many mustelids are susceptible to bovine, avian and human strains of tuberculosis. The disease has been reported in the domestic ferret, mink, otters, and the European badger. It is usually acquired by eating contaminated food, however in the European badger, transmission can occur from mother to cub, by aerosol, or through bite wounds. Clinical signs may include weight loss, enlarged lymph nodes, chronic respiratory disease, and mastitis. Tuberculin skin testing is unreliable. Serological tests used to identify European badgers with *Mycobacterium bovis* have also been unreliable.

Anthrax

Anthrax has been reported in the European badger, the honey badger (*Mellivora capensis*), and mink. Clinical signs include sudden death with blood draining from body cavities. Postmortem findings include subcutaneous and subserosal edema, hepatomegaly, and splenomegaly.

Campylobacteriosis

Diarrhea caused by *Campylobacter jejuni* and *Campylobacter coli* has been reported in domestic ferrets and mink (Petrini 1992). Fever and leucocytosis often accompany infections. Abortion and other reproductive problems occur in both mink and ferrets when they are inoculated with *C. jejuni* during pregnancy. Clinical disease is most common in animals less than six months of age, and asymptomatic carriers are not uncommon especially with adults. Special techniques are required to culture the organism from the feces. Humans are also susceptible to infections with *C. jejuni*. Erythromycin, the drug of choice in humans, does not eliminate the carrier state in ferrets. Raw meat diets appear to predispose mink to *C. jejuni* infection.

Helicobacter mustelae

Helicobacter mustelae is a bacterium that often colonizes the stomach of ferrets and causes a chronic, persistent gastritis, and sometimes leads to gastric or duodenal ulceration, and/or gastric cancer (Fox 1998). The organism is quite common in ferrets but infected animals are often asymptomatic, especially when they are young. Symptoms of disease such as vomiting, dark tarry stools, chronic weight loss, and anemia may occur if gastric ulceration or cancer develops. The diagnosis is made by special culture techniques of gastric biopsy or necropsy samples. Recently a serological assay has been developed (Fox 1998).

Proliferative Bowel Disease

This is a syndrome described in young, 4-6 month old domestic ferrets characterized by mucohemorrhagic diarrhea, weight loss, and partial prolapse of the rectum. The disease causes a profound thickening of the mucosa and muscular wall of the colon, which can be palpated per rectum. Pathological lesions are similar to those found in hamsters with "wet tail" and swine with proliferative ileitis, except lesions in the ferret are in the colon not the ileum. A Campylobacter-like organism closely related to *Desulfovibrio spp* causes the disease in ferrets. In swine and hamsters it is named *Lawsonia intracellularis* (Fox 1998). Diagnosis is based on the detection of the organism in histological sections of the colon stained with silver. Recently a PCR test has been developed as a diagnostic test.

***E. coli* mastitis**

Mastitis caused by *E. coli* is a rapidly progressive disease that has been reported in the domestic ferret. Toxemia occurs, and mortality can be quite high. Early, aggressive therapy involving amoxicillin with clavulanate, chloramphenicol, or gentamicin, along with surgical excision of the affected mammae has been successful (Fox 1998). The disease has also been seen in mink (Fox 1998). Other bacteria may also be associated with mastitis in mustelids.

Purulent Pleuritis

Pleuritis is an inflammation of the pleura, often accompanied by an accumulation of pus in the pleural space around the lungs. Purulent pleuritis involving several different bacteria has been commonly reported in mustelids including the European badger, mink, and a North American otter. *Bacteroides melanigenicus* was isolated from the pleural fluid in one case (Griffith 1983). In mink, it is often seen in conjunction with dental disease and severe gingivitis.

Purulent Peritonitis

Peritonitis is an inflammation of the lining of the abdomen (peritoneum). It can be caused by a variety of different bacteria, and is often accompanied by purulent liquid in the abdominal space. Invasion of the peritoneal cavity with bacteria is most often the result of a penetrating foreign object, either through the abdominal wall or through the intestine. However, blood-born septicemias can also result in peritonitis. In one river otter, the peritonitis was due to a pure growth of *Klebsiella pneumonia* with no evidence of underlying disease (Petrini, unpublished).

Brucellosis

Brucellosis is an infectious disease caused by one of several species of *Brucella*. Clinical signs usually included abortion and, sometimes, orchitis and infection of the accessory sex glands in males. An unidentified *Brucella sp.* was recently isolated from the lymph node of a European otter (*Lutra lutra*) which had been killed in a road traffic accident in Scotland (Foster 1996). The significance of this finding is unknown.

Leptospirosis

Wayre considered leptospirosis an important disease in otters (Chanin 1985), and it was suspected to be the cause of death in several otters in a review of postmortem reports from a variety of zoos (Duplaix-Hall 1975). However, Fairley in 1972 found no histologic evidence of leptospirosis in the kidneys of 15 otters (Chanin 1985), and it is rarely mentioned in the literature. Leptospirosis is a contagious disease that causes anorexia, fever, vomiting, lethargy, anemia, hemoglobinuria, icterus, abortion, or death. There are many serotypes of the virus and humans are also susceptible to infection. Transmission occurs via contact with water, moist soil, or vegetation contaminated with infected urine, or by direct contact with the infected animal. Rats are common carriers.

Listeriosis (Circling disease)

Listeriosis is a disease caused by infection with the bacteria *Listeria monocytogenes*. In most species it causes neurological symptoms such as ataxia and circling, and thus must be distinguished from rabies. The disease can also result in abortion, perinatal mortality, and septicemia. The disease has been reported in the ferret, sable and striped skunk. Some animals are asymptomatic carriers of the disease and shed the bacteria in their feces.

Pasteurellosis

Pasteurellosis can be caused by either *Pasteurella multocida* or *Pasteurella pseudotuberculosis*. Although this disease is most commonly seen in rodents and lagomorphs, it has been reported in several mustelid species including mink, marten, badger, otters, and ferrets (Wallach 1983). Clinical signs can vary and may include depression, septicemia, ataxia, anorexia, diarrhea, dyspnea, or acute death.

Salmonellosis

Salmonellosis is caused by one or many species of *Salmonella* and characterized clinically by one or more of three major syndromes – septicemia, acute enteritis, chronic enteritis. Although it can be treated with antibiotics, it is often difficult to rid the animal of the organism. *Salmonella spp.* have been isolated from the feces of clinically normal otters and does not always cause disease.

Tularemia

Tularemia is a bacterial disease caused by *Francisella tularensis* that results in small granulomas or abscesses throughout the lungs, liver, mesenteric lymph nodes, and spleen. It can infect a variety of species including free-ranging mustelids and ranch mink, as well as humans. Sudden death or acute onset of

anorexia is the most common clinical sign in mustelids. Animals are infected when they ingest carcasses of infected animals, particularly fish, rabbits or rodents.

Actinomycosis

Actinomycosis has been reported in the ferret and other mustelids. The infective agent, *Actinomyces sp.*, causes a disease known as “lumpy jaw”. The organism has a predilection for the cervical area and often results in the abscessation of the submandibular lymph nodes, although lymph nodes throughout the body can also be affected.

Mycotic Diseases

Fungal diseases have not been frequently reported in mustelids.

Dermatomycosis

Dermatomycosis is more commonly referred to as “ringworm”. The most common causative agents are members of the genera *Microsporum* and *Trichophyton*. Dermatomycosis has been reported in mink, domestic ferrets, and otters. Ringworm is contagious and potentially zoonotic. Although some cases are self-limiting, others require treatment with topical and/or oral anti-fungal agents.

Histoplasmosis

Histoplasmosis is a systemic fungal disease that results in variety of clinical signs including, lymphadenopathy, pneumonia, anorexia, weight loss, splenomegaly, and hepatomegaly. It is caused by the intracellular organism, *Histoplasma capsulatum*. Histoplasmosis has been reported in both domestic ferrets and striped skunks, and is most common in the central part of the United States where the organism can be found in the soil.

Cryptococcosis

Cryptococcosis is an infection caused by *Cryptococcus neoformans* and usually causes neurological signs as a result of meningoencephalitis. There have been several cases in the domestic ferret (Fox 1998).

Blastomycosis

Blastomycosis is a systemic fungal infection caused by the fungus *Blastomyces dermatidis*. It has been reported in the domestic ferret. Blastomycosis can affect both the lungs and skin causing pneumonia and/or cutaneous lesions. The disease occurs most commonly in the central and southeastern United States.

Coccidioidomycosis

Coccidioidomycosis is a fungal disease caused by *Coccidioides immitis* and is most common in the southwestern United States. The disease can cause respiratory disease as well as lymphadenopathy and occasionally osteomyelitis. Several cases of this disease have been reported in captive small-clawed otters from Arizona (Petrini 1992)

Mucormycosis

Mucormycosis is a fungal infection usually caused by *Absidia corymbifera (ramosa)*. It generally occurs in conjunction with the ear mite, *Otodectes cyanotes* and causes otitis media and meningoencephalitis. This disease has been reported in farmed ferrets.

Adiaspiromycosis

Adiaspiromycosis is a disease that causes granulomatous lesions in the lungs, and sometimes involves regional lymph nodes. Mustelids appear to be particularly susceptible, and there are several reports of the disease in European otters (Simpson 2000). The disease is caused by the fungus *Emmonsia crescens* (formerly *Chrysosporium crescens*).

Parasites

Numerous external and internal parasites have been identified in both wild and captive otters. Only a few will be covered here.

Microfilaria

Microfilaria are found frequently in the blood of wild North American river otters (Hoover 1984, Hoover 1985, Davis 1992, and Tociłdowski 1997). There are at least 2 species of microfilaria that have been identified in otters. *Dirofilaria lutrae* adults have been found in both the subcutaneous tissues (Hoover 1984 and Hoover 1985) and in the pulmonary arteries (Hoover 1985) of wild otters. A second *Dirofilaria* species has been identified from the pulmonary arteries as well (Hoover 1984.) In addition, there is one report of a North American river otter from Louisiana that had one male *Dirofilaria immitis* in its heart (Snyder 1989). *D. immitis* is the agent that causes heartworm disease in dogs, but in this case no pathology was attributed to the parasite. It is unclear whether *D. lutrae* or any of the other *Dirofilaria* sp. can cause clinical heartworm disease in otters, but since they can occupy the pulmonary arteries, it is possible. Many institutions housing otters outside in heartworm endemic areas keep their animals on heartworm preventative.

Respiratory Parasites

Lungworms are fairly common in wild otters. Several species affect mustelids including *Crenosoma spp.*, *Perostrongylus spp.*, and *Filaroides spp.* Clinical signs vary from cachexia and anemia to coughing, dyspnea, depression, and nasal discharge. Diagnosis is made by finding the first stage larvae in the feces. New York has reported ivermectin-resistant strains of *Crenosoma sp.* in *L. canadensis* and recommends treatment with fenbendazole (Kollias 1999). Baermann and direct fecal smear examination techniques are helpful in diagnosing these parasites.

Capillaria aerophila is another common nematode that causes respiratory disease in mustelids. The adult worms live in the trachea, bronchi, and bronchioles. Animals with mild infections may be asymptomatic but heavy infestations can result in coughing, respiratory difficulty, bronchopneumonia, nasal discharge and anorexia. *Capillaria* has been identified in the North American river otters (Hoover 1984, Hoover 1985, Kollias 1999). The ova, resembling a whipworm egg, are found in the feces or sputum.

Adult nematodes of the genus *Skrjabinogylus* are located in the frontal sinus and cause progressive damage to the skull and nasal turbinates. Clinically, nasal discharge and neurological signs may be seen. *Skrjabinogylus spp.* have been reported in mink, ermine, fishers, North American otters, striped skunks, and spotted-necked otters (*Lutra maculicollis*), as well as other mustelids. One study reported that as many as 13 % of wild North American river otters from Ontario were affected by the parasite (Addison 1988).

Lung flukes (*Paragonimus kellicotti*) have been reported in mustelids including mink, marten, badger, weasel, and skunk (Wallach 1983, Davis 1971). Infection results in a moist cough, sometimes with blood, elevated temperature, anemia, and difficulty breathing.

Kidney worm

Dioctophyma renale has been reported in a variety of mustelids including the North American otter. Mink appear to be the primary host in North America. The parasite causes weight loss, abdominal pain, and hematuria. Infection almost always involves the right kidney where a plate of bone often forms which is visible on radiographs. Diagnosis can be made from finding the ova in the urine. Another species of kidney worm, *Gnathostoma miyazakii*, is commonly found in *L. canadensis* in Virginia.

Acanthocephala (Thorny-headed worms)

Acanthocephalus spp. have been found in wild North American river otters (Kollars 1997, Hoberg 1997, Hoover 1984). One species has been identified as *Corynosoma strumosum* (Hoberg 1997). These relatively large worms can cause anemia and enteritis.

"Guinea worm"

Dracunculus insignis is a nematode that has been found in the subcutaneous tissues of several mustelid species including fishers, skunks, and mink. A separate species has been identified in the North American river otter. *Dracunculus* causes a varying degree of pruritis and local erythema. It is most commonly located on the legs. Removal of the adult parasite is curative (Petrini 1992).

Trichinosis

Trichinosis is a disease caused by the nematode *Trichinella spiralis*. The disease has been reported in the European otter and other mustelid species. Mustelids fed raw meat harboring viable trichina larvae are susceptible to the infection. Typical clinical signs include muscular pain, anorexia, and dyspnea. Heavy infestations are fatal.

Cestodes (Tapeworms)

Multiple species of cestodes have been identified in mustelids. Species that have been identified in North American river otters include *Ligula intestinalis* and *Diphyllobothrium* (questionable identification) (Chanin 1985), as well as *Schistocephalus solidus* (Hoberg 1997).

Miscellaneous nematodes

Several species of intestinal nematodes have been identified in North American river otters. One of the most commonly reported is *Strongyloides lutrae* (Kollias 1999, Hoover 1984, Hoover 1985, Hoberg 1997, Kollars 1997). Other species identified include *Ancylostoma sp* (Hoover 1985), and *Eustrongylides sp.* (Hoberg 1997). Some nematodes have been reported but not speciated. Many of the oocytes found in the feces of wild *L. canadensis* are considered incidental, and are actually fish or amphibian parasites whose eggs are being passed in the feces of the otter after consumption of the host.

Miscellaneous trematodes (Flukes)

Several kinds of intestinal flukes have been reported in mustelids. Species that have been reported in North American river otters include: *Euparyphium inerme* (Hoberg 1997), *Baschkirovitrema incrassatum* (Kollars 1997), *Enhydridiplostomum fosteri* (Hoover 1984), *Euparyphium melis* (Chanin 1985), and *Nanophyetus salmincola* (Schlegel 1968).

Protozoan

Coccidia

Heavy infestations of coccidia can cause mortality in young ferret and mink kits. Several species of *Isospora* have been reported in North American river otters (Hoover 1985), but clinical disease due to the parasite was not noted.

Toxoplasmosis

Toxoplasmosis can cause neonatal deaths and stunting in both ferrets and mink. A survey of North American river otters conducted in North Carolina showed that 45 % of the animals had positive titers to toxoplasma (Tocidowski 1997).

Cryptosporidia

Asymptomatic ferrets can shed *Cryptosporidia* and pose a zoonotic hazard. To date there are no reports of this parasite in the North American river otter.

Giardia

Giardia spp. has been seen in the feces of various mustelids.

Sarcocystis

Sarcocystis spp. have been found in fishers, mink, wolverines, badgers, and recently in a European otter (*Lutra lutra*). In this case, the sarcocysts were found in large numbers in the skeletal muscle, but there was no apparent pathology associated with their presence (Wahlstrom 1999). Ferrets can be infected

experimentally but remain asymptomatic (Fox 1998). *Sarcocystis* eggs can be passed in the feces and are easily mistaken for coccidia.

External parasites

External parasites are relatively uncommon in North American river otters (Serfass 1992) compared to other carnivores. However there are occasional reports of ticks, lice, and fleas.

Miscellaneous Diseases

Urolithiasis

Urolithiasis has been reported in a variety of otter species. Calcium oxalate stones are common in captive *Aonyx cinerea* (Petrini, 1996). And in one study, 10 out of 14 *Lutra lutra* carcasses submitted for pathological examination were affected with urolithiasis. These uroliths contained calcium phosphate, calcium urate, or ammonium urate (Keymer, 1981). Other pathological reports of *Lutra lutra* have also detected kidney stones (Madsen 1999, Chanin 1985, Simpson 1997). One of these reports identified the calculi in three otters as being composed of ammonium urate (Madsen 1999). Small uroliths are often seen on radiographic examination of *L. canadensis* at the Minnesota Zoological Garden, however clinical disease is rarely noted. Of 21 animals radiographed over the past 20 years, 10 have had uroliths. Both calcium oxalate and magnesium phosphate calculi have been detected at this institution (Petrini, unpublished).

Neonatal mortality

Neonatal mortality in otters is most commonly due to septicemia, but starvation and hypothermia are also common in the first four weeks of life. Trauma and cannibalism can also occur. Neonatal losses can be minimized by providing secluded nest boxes (at least two, offering the dam a choice), sufficient dry bedding, and insuring adequate nutrition for the dam.

Hypocalcemia, Milk Fever, Pregnancy Toxemia

Low serum calcium levels in lactating or late gestation females can cause weakness, rear leg paralysis, convulsions, and death. The disease can affect ferrets approximately 3-4 weeks postpartum but sometimes occurs in the late pregnancy (Petrini 1992). Poor nutrition has been implicated as a cause, but this is not proven. Post mortem findings usually include hepatic lipidosis. Prompt treatment with intravenous calcium can quickly reverse the condition.

Agalactia, "Nursing Sickness"

Both mink and ferrets are afflicted with a syndrome known as agalactia or "nursing sickness". This generally occurs 5-6 weeks postpartum before the kits are completely weaned, but it can occur even after weaning. Clinical signs include lethargy, weight loss, ataxia, weakness, and coma. Occasionally hemolytic anemia can occur. The cause of the disease is unknown, but diets high in polyunsaturated fats may predispose animals to the condition. Some authors believe the condition is due to a sodium chloride deficiency. Hepatic lipidosis is often seen on post mortem examination. Offering food and water to kits beginning at 2-3 weeks of age will help prevent the disease (Petrini 1992).

Gastric ulcers

Gastric ulcers can cause vomiting, halitosis, melena, anemia, and acute death in mink and domestic ferrets. It has also been seen in weaning age otter pups (Joe Davis 1985, unpublished). Although stress has usually been implicated as the etiology, *Helicobacter mustelae* has been shown to cause gastritis and ulcers in domestic ferrets (see Bacterial Diseases for more information). Cimetidine, amoxicillin, metronidazole, and bismuth subsalicylate are suggested treatments (Fox 1998). Gastric ulcers can also occur secondary to renal failure.

Gastric dilatation (Bloat)

Acute gastric dilatation has also been reported in ferrets. It is often associated with dietary changes or overeating, especially after a prolonged fast. *Clostridium welchii* has sometimes been isolated from bloated

ferrets. *Clostridium perfringens* enterotoxemia (see Bacterial Diseases for more details) may lead to gastric distention in North American river otters.

Diabetes mellitus

Diabetes mellitus has been described in the ferret and there has been at least one case in an Asian small-clawed otter and one case in a North American river otter (Petrini, unpublished).

Exertional Myopathy (Capture Myopathy)

Capture myopathy has been reported in translocated North American river otters (Hartup 1999). This disease is the result of excessive muscle exertion and stress and involves complex metabolic changes occurring 1-3 days after a stressful event. Animals typically show depression, anorexia, muscle weakness, ataxia, and pain.

Intervertebral disc disease

This is another common entity reported in ferrets, otters, and other mustelids. Exhibit space, housing, handling procedures and activity can predispose animals to vertebral problems and should be carefully evaluated.

Cancers

Numerous **neoplasias** have been reported in mustelids. Lymphosarcoma is the most commonly reported tumor type in the domestic ferret, followed by tumors of the reproductive tract and skin. In the mink, lymphoreticular tumors and anal sac carcinomas are commonly reported. Tumors resembling Hodgkin's Disease in humans have been reported from striped skunks.

Pulmonary Silicosis

Three North American river otters from one zoo died during or shortly after anesthetic procedures and were found to have pulmonary silicosis. Aluminum silicate was found in the lung tissue and also in the insulation material used in the nest box. It is likely that chronic inhalation of silica particles resulted in serious lung pathology and predisposed them to anesthetic complications (Suedmeyer 1999).

DIETARY ISSUES

North American river otters have a high metabolic rate compared to other mammals and will eat approximately 9 % of their body weight per day (wet weight basis) (Davis 1992). One study reported that river otters consume about 177 kcal of gross energy per kg body weight per day (Davis 1992). They also have a very short digestive tract compared to other mammals. It takes only about 3 hours for food to pass through the entire tract once it is consumed (Davis 1992). A diet high in protein and fat and low in carbohydrates fed two or preferably, three times daily is best suited for this type of animal. Frequent feeding of small meals also helps stimulate physical activity and reduces the likelihood that food will spoil and later be consumed.

General Nutrition

► **Protein** – Otters are for the most part dependent on animal protein sources.

► **Carbohydrates** – *“Carbohydrates are not as important as an energy source to the mustelids as are fats, and therefore low carbohydrate cat or mink diets are preferable to the high carbohydrate dog foods.”* (Wallach 1983)

► **Fats** – *“Fats are an important energy source for the mustelids. Rancid fats cause severe digestive problems and interfere with utilization of several nutrients, including vitamin A, vitamin E-selenium, calcium, and zinc.”* (Wallach 1983)

► **Vitamins and Minerals** – The omission of these important elements can lead to serious deficiencies. Although, most commercially prepared diets contain adequate amounts of these essential elements, **all dietary products should be researched and monitored for quality on a regular basis.**)

■ **Thiamine (B₁)** – Thiamine deficiency is also known as Chastek’s paralysis. Clinical signs include, anorexia, salivation, ataxia, incoordination, papillary dilatation, sluggish reflexes, and paralysis. Feeding certain types of raw fish that are particularly high in the enzyme thiaminase is the usual cause. Thiaminase destroys the thiamine present in the food and therefore results in a deficiency of this nutrient. Herring, smelt, and carp are only a few of the fish that contain high levels of thiaminase. Otters that are being fed fish should be supplemented with thiamine at the rate of 25-30 mg thiamine per kg of fish fed. (See the Diet/Nutrition Section for more details.)

■ **Vitamin E** – a deficiency of Vitamin E can cause yellow-fat disease, also known as steatitis. Clinical signs may include lethargy, lumpy subcutaneous fat, rear leg weakness, and death. Vitamin E deficiency can also cause fatty degeneration of the liver, hemolytic anemia, and anorexia. Young growing animals are particularly sensitive. Diets that are high in long-chain polyunsaturated fatty acids (common in fish oils), or rancid fats can cause vitamin E deficiency. Otters that are being fed fish should be supplemented with vitamin E at the rate of 100 I.U. of vitamin E per kg of fish fed.

■ **Vitamin A deficiency** – clinical signs include, poor growth, dry and dull hair coat, infertility and birth defects in young.

“...Mustelids do not convert b-carotene to vitamin A efficiently, (so), it should not be used as the sole source of vitamin A” (Petrini 1992).

■ **Biotin** – Biotin deficiency can be caused by feeding raw eggs; this is due to the biotinase content of albumin. Biotin deficiency results in pale fur and skin problems.

■ **Vitamin D** – a deficiency of Vitamin D will produce Rickets. Conversely, over supplementation of Vitamin D causes abnormal calcification of soft tissues.

Lactating Females

*“Energy demands during lactation are quite high in mustelids” (Petrini 1992). Although it is not known specifically for *L. canadensis*, “...in the American badger (*Taxidea taxus*), lactation demands 16 times more energy than gestation. This is approximately four times more than required by most mammals” (Petrini 1992). A gradual increase in diet during lactation to a level 30 to 40% over maintenance level is usually required for successful growth of the pups and maternal health.*

POST MORTEM EXAMINATIONS

The value of a thorough postmortem examination for disease surveillance of both wild and captive populations cannot be overemphasized. Animals should be necropsied as soon as possible after death. Bacterial overgrowth begins shortly after death making it difficult to isolate pathogens that may have been involved in the animal's demise. Carcasses should be refrigerated until the examination can be completed. This will retard bacterial growth and help slow down the autolysis of tissues. If it is not possible to complete the necropsy within about 5 days, the carcass should be frozen. This however, greatly changes the microscopic architecture of the tissues, rendering them useless for histological examination. Therefore, a great deal of valuable information will be lost if the carcass is frozen.

The ideal necropsy will include a complete gross examination of the carcass and internal organs, a parasitological exam, and histological examination of the individual tissues. In addition, cultures for pathogens such as bacteria, fungus, and viruses are often indicated.

Below is an example of a standardized necropsy protocol for otters as well as a necropsy report form.

Necropsy Protocol

Blood Collection

Antemortem blood collection for serum banking is recommended on any animal that is to be euthanized. Collect enough to obtain a minimum of 5 ml of serum. Post mortem blood collection may be possible on specimens that have recently died.

Radiographs

Ventral-dorsal and lateral abdominal radiograph should be taken on all otters that die. Urolithiasis (kidney and bladder stones) is relatively common in several species of otter. Radiographs can help document the degree (or lack thereof) of urolithiasis at the time of death. Although this is not believed to be as prevalent in *Lontra canadensis* radiographs should still be done.

Gross Post Mortem Examination

A veterinarian should perform a thorough post mortem examination as soon as possible after death. The standardized necropsy report included at the end of this section can be used for recording the results.

Handling Pathological Lesions

- Cultures: Cultures (aerobic, anaerobic, and fungal) should be taken of any lesions before they are contaminated.
- Freeze tissues: Samples of lesions should be frozen at -20° or -70° C.
- Histopathology: Make sure all lesions are saved for histopathology.

Formalin Fixed Tissues

Tissues should be collected and placed in 10% buffered formalin. All tissues may be placed together in a single container as long as the volume of formalin is at least 10 times the total volume of the tissues collected. Tissues should be no thicker than 0.5 cm. A checklist of tissues that should be preserved in formalin is attached. In addition, include sections of all lesions in formalin.

Histopathology

Fixed tissues should be sent to a pathologist, preferably one that is familiar with exotic species.

Frozen Tissues

3-5 cm sections of the following tissues should be frozen in plastic bags at -20 to -70 °C.

- Liver
- Brain
- Kidney
- Serum, (antemortem or postmortem) if possible.
- Sections of any lesions.

Neonates, Stillbirths, Abortions

In addition to the standard adult necropsy protocol, include the following:

- Weight, crown-rump length, and sex.
- Estimate degree of maturity (1st, 2nd, or 3rd trimester).
- Fix umbilical stump and surrounding tissues. Obtain bacterial cultures before fixing if there is evidence of infection.
- Check carefully for evidence of congenital deformities (cleft palate, deformed limbs, heart defects, anal atresia, etc).
- Assess hydration (tissue moistness) and evidence of nursing (milk in stomach).
- Determine if breathing occurred (do lungs float in formalin).
- Note whether there is meconium in the colon/rectum.
- Fix placenta if available. Culture first if indicated.

Tissues to be placed in 10 % formalin.

- Skin: full thickness of abdominal skin.
- Skeletal muscle: medial thigh, with sciatic nerve.
- Tongue: Cross section near tip including both mucosal surfaces.
- Trachea
- Thyroid/parathyroid
- Thymus: representative section.
- Lungs: section from several lobes including a major bronchus.
- Heart: Longitudinal section including atrium, ventricle and valves from both right and left heart. Include large vessels.
- Aorta
- Salivary gland
- Gastrointestinal tract: 2-3 cm long section of esophagus, stomach (cardia, antrum, pylorus), duodenum, jejunum, ileum, colon, omentum. Open carefully along the long axis.
- Lymph nodes: Cervical, bronchial, and mesenteric with a transverse cut.
- Liver: Sections from several lobes with capsule and gall bladder.
- Adrenal: Incise transversely.
- Reproductive tract: Entire uterus and ovaries with longitudinal cut into lumen. Entire testis with transverse cut, entire prostate with transverse cut.
- Pancreas: Representative sections from 2 areas.
- Spleen: Cross sections including capsule.
- Kidneys: Section from both kidneys (cortex, medulla, and pelvis).
- Urinary bladder/ureter/urethra: Cross section of bladder, 2-cm sections of ureters, cross section of urethra.
- Eyes: leave intact.
- Brain, include cerebrum and cerebellum: Sliced longitudinally along the midline.
- Pituitary gland: Submit entire gland including dura.
- Long bone: Submit ½ of femur.
- Mammary gland
- Diaphragm
- Spinal cord: 1-cm section from cervical cord.

OTTER NECROPSY REPORT

Institution where otter was housed or location where found: _____

Common name: _____ Genus / Species: _____

Identification or Accession #: _____ Necropsy #: _____ Studbook #: _____

Date of Birth: _____ Age: _____ Weight: _____ Kg Sex: _____

Length, tip of nose to base of tail: _____ Length, tip of nose to tip of tail: _____

Date of Death: _____ Date of Necropsy: _____

Gross exam performed by: _____

Histopathology performed by: _____

Pathology Accession # _____ Disposition of carcass: _____

Tissue saved: Yes 9 No 9

 Formalin 9

 Frozen 9

 Other 9

HISTORY (Include clinical signs, treatments, antemortem test results, diet, circumstances of death and quarantine status.

<p>Laboratory Studies: (List bacterial and viral cultures submitted. Attach results of any of the following:)</p>		
Hematology <input type="checkbox"/>	Chemistry <input type="checkbox"/>	Photography <input type="checkbox"/>
Cytology <input type="checkbox"/>	Fluid analysis <input type="checkbox"/>	Bacteriology <input type="checkbox"/>
Mycology <input type="checkbox"/>	Virology <input type="checkbox"/>	Urinalysis <input type="checkbox"/>
Parasitology <input type="checkbox"/>	Toxicology <input type="checkbox"/>	Urolith analysis <input type="checkbox"/>
Other <input type="checkbox"/>		
<p>Radiology:</p> <p>Urinary calculi Yes <input type="checkbox"/> No <input type="checkbox"/></p> <p>Left kidney: Number _____ Size _____</p> <p>Right kidney: Number _____ Size _____</p> <p>Urinary bladder: Number _____ Size _____</p>		
<p>Gross Diagnosis: (List each lesion separately. Include organ, lesion type, distribution, severity, etc.)</p> 		
<p>Histological Diagnosis: See attached report <input type="checkbox"/></p>		<p>Not done <input type="checkbox"/></p>
<p>Final Diagnosis:</p> <p>Summary / Comments:</p> 		

GROSS EXAMINATION

General Condition: (External appearance, condition of carcass, physical and nutritional condition, pelage, subcutaneous fat stores, body orifices, superficial lymph nodes.)

Musculoskeletal System: (Bone, joints, muscles)

Body Cavities: (Fat stores, abnormal fluids)

Hemolymphatic: (Spleen, lymph nodes, thymus,)

Respiratory System: (Nasal cavity, larynx, trachea, bronchi, lungs, regional lymph nodes)

Cardiovascular System: (Heart, pericardium, great vessels)

Digestive System: (Mouth, teeth, esophagus, stomach, intestines, liver and gall bladder, pancreas, mesenteric lymph nodes)

Urinary System: (Kidneys, ureters, urinary bladder, urethra)

Reproductive System: (Testis, ovary, uterus, oviduct, vagina, penis, prepuce, accessory sex glands, mammary glands, placenta)

Endocrine System: (Adrenals, thyroid, parathyroids, pituitary)

Nervous and Sensory Systems: (Brain, spinal cord, peripheral nerves, eyes, ears)

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HEALTH CARE GLOSSARY

Anasarca: Severe generalized edema. (Taber's Cyclopedic Medical Dictionary)

Anemia: A quantitative deficiency of the hemoglobin, often accompanied by a reduced number of red blood cells causing pallor, weakness, and breathlessness. A lack of vigor, creativity, forcefulness, or the like. (Webster's Unabridged Dictionary)

Apnea: Cessation of breathing.

Ataxia: Defective muscular coordination often manifested when voluntary muscular movements are attempted.

Autolysis: The self-dissolution or self-digestion that occurs in tissues or cells by enzymes in the cells themselves, such as occurs after death and in some pathological conditions. 2) Hemolysis of blood cells occurring as a result of the action of an animal's own serum or plasma. (Taber's Cyclopedic Medical Dictionary)

Bacteria: Any of numerous microscopic, spherical, rod-shaped, or spiral organisms of the class Schizomycetes, various species of which are concerned in fermentation and putrefaction, the production of disease, the fixing of atmospheric nitrogen, etc. (Webster's Unabridged Dictionary)

Bacterin: A vaccine that contains specific bacteria and is injected to increase immunity. (Webster's Unabridged Dictionary)

Cachexia: General ill health, with emaciation, due to a chronic disease, as cancer. (Webster's Unabridged Dictionary)

Catarrh: Term formerly applied to inflammation of mucous membranes, especially of head and throat. (Taber's Cyclopedic Medical Dictionary)

Catarrhal: Of the nature of or pertaining to catarrh.

Conjunctivitis: Inflammation of the mucous membrane that lines the inner surface of the eyelids. (Webster's Unabridged Dictionary)

Cutaneous: Pertaining to the skin. (Taber's Cyclopedic Medical Dictionary)

DHLPP: Canine vaccine. Sometimes called DA₂PL (A=adenovirus)

D = Canine Distemper
H = Hepatitis
L = Leptospira Bacteria
P = Parainfluenza-Adenovirus Type 2
P = Parvovirus vaccine

Dyspnea: Air hunger resulting in labored or difficult breathing, sometimes accompanied by pain. (Taber's Cyclopedic Medical Dictionary).

Enteritis: Inflammation of the intestines, especially the small intestines. (Webster's Unabridged Dictionary)

Erythema: Abnormal redness of the skin due to local congestion, as in inflammation. (Webster's Unabridged Dictionary)

FVRCP: Feline vaccine.

F = Feline distemper
V = Viral
R = Rhinotracheitis
C = Calici Virus
P = Panleukopenia

Hematuria: The presence of blood in the urine. (Webster's Unabridged Dictionary)

Hemorrhagic: Pertaining to or marked by hemorrhage.

Hyperemia: Congestion. An unusual amount of blood in a part. (Taber's Cyclopedic Medical Dictionary)

Hypergammaglobulinemia: Excess amount of gamma globulin in the blood. (Taber's Cyclopedic Medical Dictionary)

Hyperkeratosis: Overgrowth of the cornea. 2) Overgrowth of the horny layer of the epidermis. (Taber's Cyclopedic Medical Dictionary)

Hypostasis: Diminished blood flow or circulation. 2) Deposit of sediment due to decreased flow of body fluid such as blood or urine. (Taber's Cyclopedic Medical Dictionary)

Lacrimation: Tearing.

Leucocytes: Any of the small, colorless cells in the blood, lymph, and tissues, which move like amoebae and destroy organisms that cause disease; white blood corpuscle. (Webster's Unabridged Dictionary)

"Leukocytes, or white blood cells (WBC), in mammalian blood include segmented neutrophils, band (nonsegmented) neutrophils, lymphocytes, monocytes, eosinophils, and basophils. These cells vary in their site of production, duration of peripheral circulation, recirculation, and in the stimuli that affect their release into and migration out of the vascular bed. These factors also vary among species.

"Leukocytosis is an increase in the total number of circulating WBC: leukopenia is a decrease." (Merck 1991)

Leukopenia: A decrease in the number of leucocytes in the blood. (Webster's Unabridged Dictionary)

Mucopurulent: Consisting of mucous and pus. (Taber's Cyclopedic Medical Dictionary)

Mycosis: The growth of parasitic fungi in any part of the body. A disease caused by such fungi.

Mycotic: Pertaining to or caused by mycosis. (Webster's Unabridged Dictionary)

Nematode: Any unsegmented worm of the phylum or class nematoda, having an elongated, cylindrical body; roundworm. (Webster's Unabridged Dictionary)

Orchiditis: Inflammation of the testicles.

Otitis: Inflamed condition of the ear. (Taber's Cyclopedic Medical Dictionary)

Parasite: An animal or plant that lives on or in an organism of another species from whose body it obtains nutriment. (Webster's Unabridged Dictionary)

Plasmacyte: A plasma cell, one of those found in connective tissue, with an eccentrically placed round nucleus and filled with a chromatin mass that stains deeply. (Taber's Cyclopedic Medical Dictionary)

Pruritis: A severe itching. May be a symptom of a disease process such as allergic response, or be due to emotional factors. (Taber's Cyclopedic Medical Dictionary)

Purulent: Full of, containing, forming, or discharging pus; of the nature of or like pus. (Webster's Unabridged Dictionary)

Rhinitis: Inflammation of the nose or its mucous membrane. (Webster's Unabridged Dictionary)

Septicemia: The invasion and persistence of pathogenic bacteria in the blood stream. (Webster's Unabridged Dictionary)

Serology: The scientific study of serum. (Taber's Cyclopedic Medical Dictionary)

Seroconversion: Development of evidence of antibody response to a disease or vaccine.

Silicosis: A form of pneumoconiosis resulting from inhalation of silica (quartz) dust, characterized by formation of small discrete nodules. In advanced cases, a dense fibrosis and emphysema with impairment of respiratory function may develop.

Tachypnea: Rapid breathing.

Titer: Standard of strength per volume of a volumetric test solution. (Taber's Cyclopedic Medical Dictionary)

Vaccine: Any preparation of dead bacteria introduced in the body to produce immunity to a specific disease by causing the formation of antibodies. (Webster's Unabridged Dictionary)

Virus: An infectious agent, especially any of a group of ultramicroscopic, infectious agents that reproduce only in living cells. (Webster's Unabridged Dictionary)

CHAPTER 11

BEHAVIORAL and ENVIRONMENTAL ENRICHMENT

“What is an enriched environment? It is one that allows animals to perform natural behaviors, gives animals control over their lives, eliminates frustration, makes captive environments more interesting, gives animals more choice, and allows animals to be more active. Enrichment of the enclosure involves the physical environment including shape, size and complexity. Complexity consists of an animal environment such as visual barriers, climbing or traveling structures, substrates, rest/sleep areas and temporal complexity. Manipulable objects such as toys and vegetation, the opportunity to use five senses, and the social environment are all beneficial to the animal. The types of food offered, the frequency and presentation play a large role in enriching the lives of our captive charges.

(Grams, K. 2000. *Exhibitory and Enrichment of North American River Otters (*Lontra canadensis*) at The Arizona-Sonora Desert Museum*. Animal Keepers’ Forum, Vol. 27, No. 4. Quotation is referencing a presentation given by D. Shepherdson & J. Mellen at the First Environmental Enrichment Conference in Portland, Oregon, 1992.)

The Webster’s New Universal Unabridged Dictionary lists these definitions: *Behavior* – manner of behaving; conduct....it expresses external appearance or action. *Enrich* – to make rich or richer; to give greater value or importance to.

In his book, *Behavioral Enrichment in the Zoo*, H. Markowitz refers to zoos evolving into the “best possible facilities”, defining best as follows: “1) *The best possible home for animals that have been removed from their natural habitat.* 2) *The best educational recreational experiences for zoo visitors.* 3) *The best provision for research of all kinds beneficial to the resident species.*”

These are all definitions and goals easily agreed upon. How we achieve them is another matter, primarily because every animal is unique and will respond to different stimuli, and all zoo professionals are unique and will develop different solutions.

In the case of *Lontra canadensis*, zoos have a wonderful opportunity to teach our visitors about a native animal. Our enrichment goals should aid this education effort and create an environment that promotes good health and the otters natural high activity level, playfulness and curiosity.

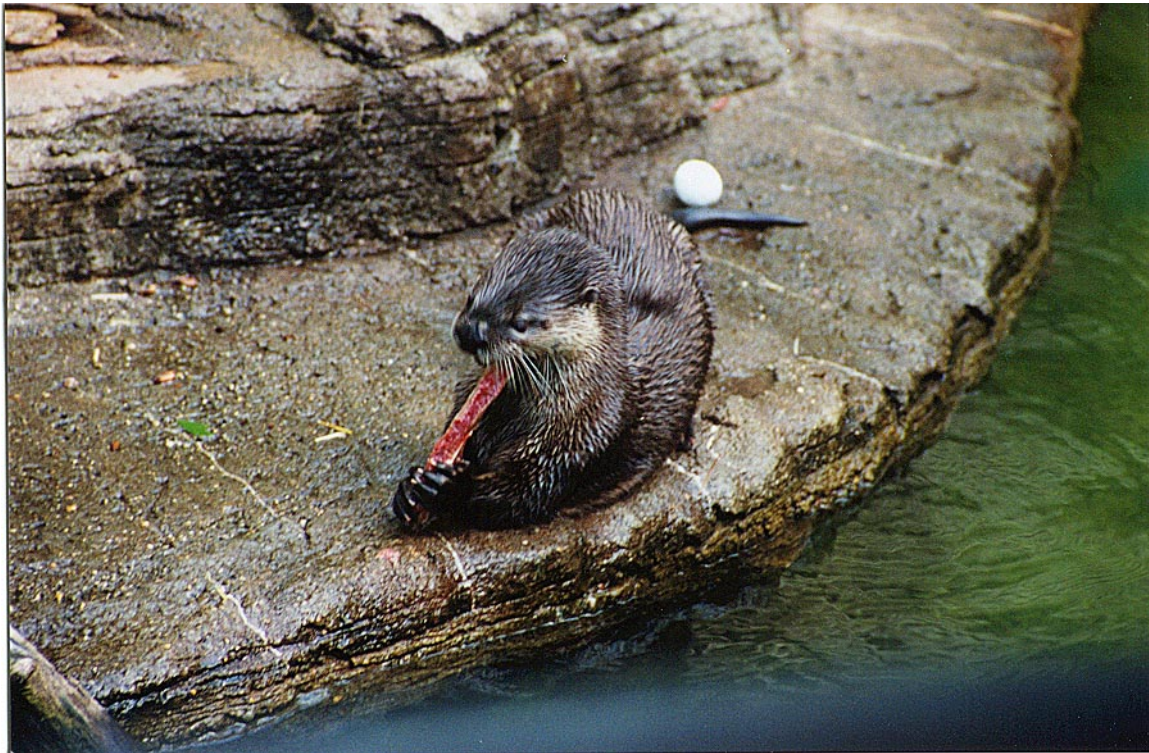
There are some general guidelines that should be kept in mind when designing an enrichment program for any animal: the target species (in this case, otters) natural history should be researched; goals and objectives should be identified in advance; aberrant or unnatural behaviors should not be promoted; any activity should be approved by the appropriate supervisory personnel; questions regarding toxicity/safety of an item should be reviewed with a veterinarian, nutritionist, chemist, curator, and/or botanist; responses should be documented to determine if an enrichment item/activity is successful, or not; treat delivery methods should not promote begging behavior; not all enrichment should be food, don’t forget smell, sight, sounds, and touch; and, remember, when it comes to enrichment, variety is truly the spice of life.

This chapter will cover some of the many enrichment items tried by contributing institutions; keep in mind: not all of them were successful, some were not successful at first but when introduced repeatedly over time they eventually elicited a response; if animals are introduced at a young age to novel situations and items, they will be more responsive to new things through adulthood; and, what may have proven safe for one animal could present a problem for another, vigilance is the key.

The first edition of the husbandry manual contained the results, institution by institution, of the Central Park Wildlife Center's North American River Otter Enrichment Survey circulated in 1993. This edition will list all of the items used, or tried, that were mentioned in that survey as well as some new ones. Items requiring explanations are listed separately.

ENRICHMENT ITEMS - Table				
Natural	Exhibit Furniture	Non-edible manmade	Live Food	Edibles
Soil, sand, mulch, etc.	Climbing areas (technically available in all exhibits, i.e. cliffs, ledges, etc.)	Boomer balls – all sizes & various products like the “spoolie” & “ice cube”	Fish (smelt, shiners, gold fish, trout, salmon, mackeral, tilapia)*others listed below	Ice blocks w/ fish, fish-sicles, fish cubes, etc. krill cubes, clam cubes, etc.
Grass, sedges, etc.	Logs (on land, submerged, floating; hollow &/or solid)	Ice blocks, cubes, pops, etc.	Crayfish	Frozen or thawed sand eels
Trees	Rocks (not artificial)	Natural snow & ice	Crickets	Fish pieces
Bushes	Waterfall	Dog chews, rawhide treats	Fly-in birds	Scattered carrot pieces
Vines, “vine hoops”	Stream	PVC cricket feeder	Giant mealworms	Chicken necks
Aquatic plants	Sticks	Buckets	Earthworms	Mice
Hay, straw, grass, leaves, wood wool as bedding	Browse (leafy branches on land &/or floating)	Blankets, burlap, hammock, non-fraying rags	Freshwater clams	Whole fish – frozen or thawed
Grass piles	Slides	Barrels of water Frisbees	Mussels	Whole apples/oranges
Leaf piles	Tunnels	Tubs of water Carpet over board	Krill	Fruit & berries (incl. grapes, blueberries, strawberries)
Rocks, all sizes for play & manipulation	Stream bed Running water	Rubber-coated heating pad*	Eels – naturally found	Small pumpkins/squash
Knot holes	Holts	Astro turf	Shrimp	Omnivore biscuits
Bark sheets	Jacuzzi-like jets in pool	Floating plastic toys	Aquatic insects – naturally found	Monkey chow
Pine cones		Phone Books		Pigs ears
Mud	Islands in pools	Swim through plastic ring	Mice – naturally found	Frozen blood blocks, cubes, etc.
Sod				
Bank over-hangs	Bridges made from logs, etc.	Kids puzzle balls, Frisbees, billiard balls, hard balls	Frogs – naturally found	Hard-boiled eggs
Floating wood blocks	Stumps	Diff. size pieces of PVC pipe & fittings	Grubs	Day-old chicks Crabs
Pine needles	Natural fiber mat	Kong chews	Chub	Melons
Other animal urines	Movable sand box	Metal bowls & pans	Minnnows	Coconuts
Powdered scents & herbs	Logs brought from other exhibits	Plastic containers & bottles*	Bluegill	Frozen feline balls
Fresh herbs	Log ladder	Bread tray	Clams	Milk bones
Extracts – i.e. vanilla, etc.	Non-sprayed Xmas trees	Kids plastic slide, house	Mud minnows	Screw pine nuts, unsalted peanuts
Grapevine balls	Moving soil pots	Stock tank		Krill patties
Shells	Hanging logs w/ holes for food	Hanging tub* Warm water hose		Hampster ball w/ treat
Turkey feathers				
Corn Stalks	Snow Piles	Vari-kennel		Gelatin Jigglers
Blowing bubbles into exhibit	Piles of ice cubes	Tubs w/ different substrates		Corn on the cob Chicken necks
Kudzu vines		PVC tube hung for climbing in.		Yogurt w/ fish
Cow Hooves				Unsalted ham

* Any item used from this list should be cleared with zoo management and carefully monitored. The items with asterisks should be closely watched, I do not know if any problems ever arose with these things. **Many people use paper products however caution should be exercised, there have been problems when the paper becomes wet and “glues” itself to an animals mouth.** (C. Lent per. com.) **The same holds true for cardboard.**



Hard boiled eggs and rib bones are favorite enrichment treats.

“How Can a Zoo Enclosure be Enriched?”

From: *Compendium of Enrichment Ideas*, Proceedings of 1st Conference on Environmental Enrichment 1993, Oregon Zoo, 4001 S. W. Canyon Rd., Portland, Oregon 97221.

Physical Environment

- Size & Shape
- Complexity
 - Visual Barriers
 - Climbing/Travel Structures
 - Substrates
 - Rest/Sleep Areas
- Temporal Complexity
- Manipulable Objects
 - Toys
 - Vegetation

Food

- Type
 - Novelty
 - Variety
 - Treats
- Delivery
 - Frequency

Social Environment

- Conspecific
 - Group size and composition (wild as a model)
- Contraspecific
 - Mixed Species

Occupational Enrichment

- Learning
 - Training
 - Puzzles
- Presentation
 - Hidden
 - Whole Food
 - Dispersed
 - Live Food
 - Processing Time, etc.

The Senses

Auditory

e.g. Taped Vocalizations

Olfactory

Scents

Faeces

Spices

Tactile

Texture

Manipulable Objects

Novelty

Taste

Variety

Novelty

Seasonal Change

Case Study – Brookfield Zoo – Illinois River Exhibit – Off-Exhibit Enrichment

Contact: Joyce Peterson, Sr. Keeper (The Swamp)

1.2 N. A. River Otters are housed in this exhibit. At this time the females are exhibited together; the females and the male are rotated onto the exhibit for half days. Husbandry procedure training is done while the animals are off exhibit. Some procedures are demonstrated during public educational talks while the animals are on exhibit; the keeper stands in an adjacent area.

“Off-exhibit holding: A row of five holding cages connected by shift doors; two are ‘dry cages’ with nest boxes, bedding and rugs; three are ‘wet cages’, two with small pools in the floor (21”x 4’x3’d), the third with a removable stock tank (4’ diameter, 2 1/2’ deep). Cement floors; 1”square wire mesh on front and doors, painted cement/plaster walls. Cages approx. 6’ x 6’ x 6 1/2’ high. Otters off exhibit for the night.”

There is an extensive enrichment program in place for the otters in the Swamp building. Their repertoire of items includes most of what is listed in the Enrichment Items Table. In addition they make good use of the following things in holding:

- ◆Hard, plastic childrens’ climbing toys including slides, pails, floating pickle, boat, plane (hung from eye bolts in the ceiling), balls, house (about 2’ x 2’ suitable for the animals to climb and sleep on), “crib toys” – hung on side of holding den so the animals can push the knobs (these are watched to ensure that nothing is broken off).

- ◆Lids from pots and pans.

- ◆Large Boomer Ball with 10 – 12” hole cut out and bedding of some sort put inside (animals can climb inside).

- ◆Duck decoys.

- ◆Cargo nets.

- ◆Plastic bread trays hung from the wall so they fold down with carpet in it.

- ◆Assorted pieces and sizes of carpet, towels and natural fiber mats.

- ◆Mirrors

- ◆Food bowls

- ◆Medium Boomer Ball –several holes cut out and a PVC piece stuck through it; hung from the ceiling.

The staff of the Swamp Building are continuously reinventing their enrichment program. For more information contact the Swamp Keepers or Joyce Peterson or Dori Rog – Swamp Enrichment Coordinators. 708-485-0263 ext. 673.

Enrichment Ideas

This list is not exhaustive and not all of these ideas have been tried with otters. Before using any of the fabricated toys, i.e. puzzle feeders, etc., make sure no animals can accidentally become caught inside while under water.

Brush Pile Feeder (Law et. al 1990) – Place meat or other food items under a brush pile. Can also use a rock pile or logs.

Dog Chews – Try different things with them, i.e. hang them, soak them in water, fish juice, blood, etc.

Artificial Tree Food Dispenser (Carlstead et. al. 1991) – Mechanism in tree dispenses food items to one of 6 locations around the tree’s base at random intervals.

Fish Catapult (Washington Park Zoo; Markowitz 1982; Hawke, L., P. Lauer, D. Bartholomeusz & Z. Steen. 2000) – Catapult fed by conveyor belt ejects fish into the enclosure at varying intervals.

Hard Plastic Balls (Shepherdson 1993) – Variations, e.g. “Boomer Balls” can be covered with a variety of scents or holes drilled in them and filled with food, stones, etc.

Meat Trail (Glasgow Zoo, Law et. al. 1990) – Drag meat around the exhibit leaving a trail. The meat may, or may not, be at the end. (Fish juices also could be used.)

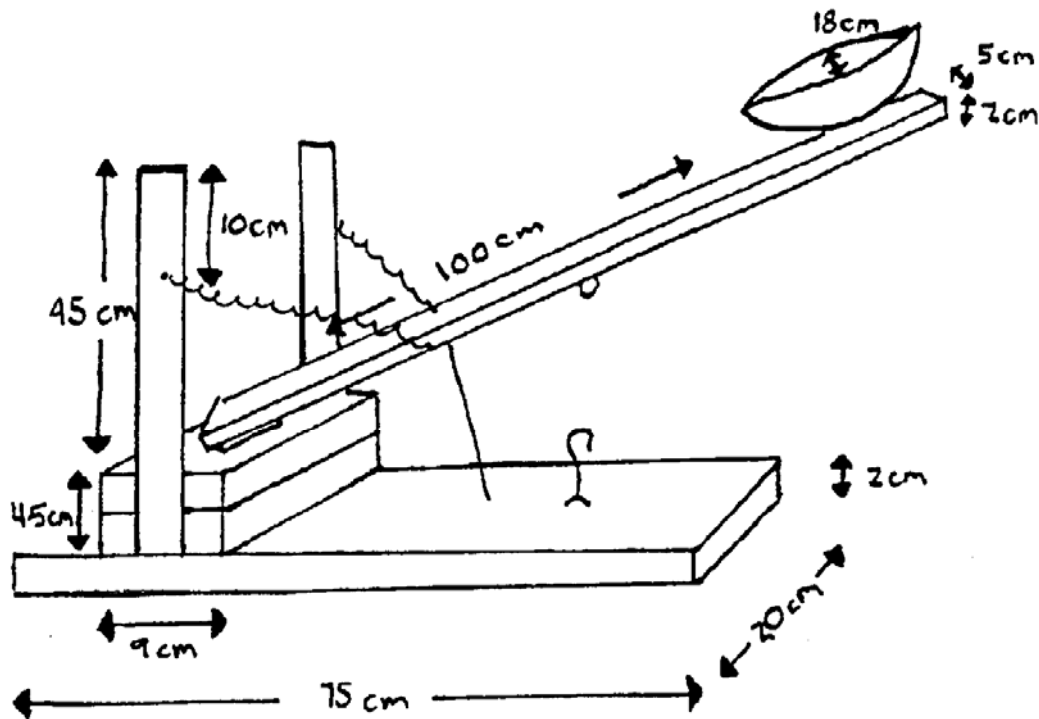
Visual Barriers (Mckenzie et. al. 1986; Adams & Babladelis 1987) – Vegetation, rocks, waterfalls, etc. increase the environmental complexity and increase the animals’ psychological space.

Rubbing Post (C.E.E. 1993) – “Begin with a concrete parking bumper or other appropriate substance. Bolt a natural bristle broom head (bristles up) onto the concrete and put into pool. The animals can utilize the bristles for tactile stimulation. Different texture bristles could be used...” (H. Hellmuth)

Milk Crate Feeder Puzzle (C. E. E. 1993) – “Take a metal milk crate, weight it down and place it upside down on the bottom of the pool with fish underneath. If you cannot enter the pool to place fish under, or for a different type of enrichment, put frozen fish blocks under the crate.

“Take two plastic milk crates and secure them together (or one crate with a makeshift cover). Put fish inside the crates and place them in the pools.” (H. Hellmuth)

Fish Catapult (Hawke et. al. 2000) – This design was used in a study focusing on the reduction of stereotyped behaviors. Treated pine was used for the frame and plastic bowls held the food.



PVC Feeder (C. E. E. 1993) – Idea submitted by the Oregon Coast Aquarium for sea otter.

“4” cellular PVC tube with four holes drilled along its length, ...with slide-able rings covering them. In addition to the floating cellular PVC, a small float is installed under the fixed cap to avoid sinking.

“The four slide-able rings (with retaining tracks) cover the four access holes drilled along the length of the tube. The ring has a hole that matches those on the tube. Once the ring slides to match both holes, items can be reached.”

This idea may be better suited to Asian small clawed otters but could be used for N. A. if something like fish pieces were put in (because otters will tend to take the toy out of the water) and the rings made moveable and easily pushed with noses.

Boomer Ball Feeder (C. E. E. 1993) – Adapted from an idea for sea otters submitted by Oregon Coast Aquarium. Drill holes in any size Boomer Ball. Hole size should be large enough to allow the insertion of ice cubes (these help hold the fish in) and fish pieces.

Ice Cube Mountain (C. E. E. 1993) – Oregon Coast Aquarium. *“Large buckets of ice cubes are dumped in piles at various locations on the deck of the exhibit. Frozen butter clams are hidden under the piles of ice.”* This idea was used for sea otter but could easily be adapted to river otter.

Animal Shower (C. E. E. 1993) – Brookfield Zoo *“Animal can walk or swim to an area in the pool or enclosure and self activate the operation of a shower head located in the area.”* (E. Krajniak) He suggests using a motion sensor like the ones used to turn lights on . Mount a shower head to a water source using a hose. *“Go back to the water valve you are going to hook the hose up to for water. At this point install an electric solenoid valve (you want a solenoid valve that is normally closed when the power is off and opens when you turn the power on.) Next run an electric power line to the motion sensor. Run two wires from the electric wire that would normally turn on lights, when the sensor senses motion, it will turn on the water instead of the lights.”* (E. Krajniak)

Mirrors – Place outside the exhibit, preferably on under water viewing window.

Floating Bag (G. Ziegler) – *“... food items inside a loosely tied mealworm bag (small muslin cloth bag) and tossed in the pool. Our otter played with it longer than anything I've observed. She had a hard time opening the bag, but finally got it.”*

There are an unlimited number of variations and combinations for the enrichment ideas and items listed here. As stated earlier, any one idea may work for some animals and not others; it may take awhile for an animal to respond to any given item so try it more than once; be watchful for adverse reactions, even with previously used items; be creative, and, share. If you find a novel approach send it in to Otterkeeper@otternet.com (join by contacting jrsotter@iserv.net) , the enrichment Listserve at: ENRICH@lists.aza.org (join by contacting jackbell@humboldt1.com), the Shape of Enrichment (1650 Minden Dr., San Diego, CA 92111-7124), or AAZK Animal Keeper's Forum.

Case Study – Clearwater Marine Aquarium
(Angela Gabbert – Marine Mammal Trainer)

The Clearwater Marine Aquarium has an extensive inventory of enrichment items. All food items are placed on a preset schedule to insure they are not relied on too heavily. Each animal has a record kept of what their response was to a particular item. When animals are sent out a list of enrichment items used with that animal is sent with them. Items in their inventory include:

Black and green Astro turf	“Power” chew by Hertz	Carpet pieces
Dive rings	Green gators, hard plastic toy	Hard balls, various sizes
Toy store bowling ball & pins	Hard plastic boats	Holy ball (blue w/holes)
Hard plastic horse shoes	Kong toys	Lrg. red bucket
Mega blocks (lrg. Lego like toy)	Hard plastic purple shovel	Colored dive sticks
PVC pieces, elbow sized	PVC tunnels (12 ¾ in. diameter – various lengths)	
Hard plastic rakes & shovels	“Yapples” – cubes	Shark shovels (toys)
Blue “Jolly” ball	Large traffic cone	Big yellow boat
Bubble maker	Bubble wand	Cat condo-supervised
Cat house	Cat scratching post-supervised	Fire hydrant sprinkler
Funky sprinkler	Garth’s rope toy	Gray sprinkler
Green Lego piece	Green Mega blocks	Mega block dumpster
Mini PVC tunnel	Nylabone	Pink/blue egg ball
Purple bucket	PVC swing	Dental kong
Red dog chew toy	Dumbbell	Quattro toy
Shoe cat bed	Small blue boat	Waffle bat
Hard plastic whales	Hard plastic slides	Hard plastic toys
Hard plastic igloos	Towels	Spanish moss
Apples	Crickets	Hard Boiled eggs
Grapes	Kiwi fruit	Night crawlers
Bananas	Raspberries	Strawberries

All toys are carefully checked to insure there are no breakable pieces. All new items are given only when the animals are supervised, some are only offered while the animals are supervised.

Remember!

When developing your otter enrichment program do not forget the importance of your exhibit design. A complex, well thought out exhibit will provide a multitude of enrichment options. Exhibit furniture can be moved (both onshore and “offshore”) and should be changed periodically to introduce novelty to the animals’ environment. It is preferable to offer a variety of substrates. This affords the animals a choice of where to do their grooming and allows for a range of exploratory behaviors which can be encouraged by planting toys, food items, etc. Pools, streams, waterfalls, etc. need to be varied in depth; if possible, water bodies in the same exhibit should also offer different features such as degree of turbulence, shore composition, and submerged fixtures like logs, rocks, etc. Stones, rocks, pebbles, and sand placed along the shoreline, or as part of shallow water bodies, offer a rich medium for manipulation by the otters and hiding of treats and toys. Temporal enrichment can be a valuable option for those exhibits designed with adequate off-exhibit holding facilities. Animals can be rotated on and off exhibit providing them with the opportunity to explore different spaces, get away from the public or other animals for awhile, pursue a more natural behavior cycle like following the scent of an estrous female, and finally, periodic rotation of animals stimulates activity in the exhibit and creates an opportunity for keepers to introduce other enrichment items to the exhibit. Indoor exhibits should offer temperature gradients to allow animals the choice of where they want to be and outdoor exhibits should provide varying degrees of shade. Sleeping/hiding place choices should be available in any exhibit type.

And finally, when looking for new enrichment items keep these criteria in mind: *“First, the object must be large enough so that it cannot be ingested. Second, it must be strong enough to stand up to their teeth. Third, it cannot have any sharp edges that could cut the otters. Fourth, it cannot have any small parts that could break off...”* (Gabbert 1999)

Colorado Ocean Journey – Case Study

Enrichment is divided into four categories: Training, Natural, Food creation, Plastic/synthetic.

Training: This facility spends a great deal of time working with their animals, there can be as many as three training sessions per day conducted off-exhibit. The animals are trained to go off exhibit, participate in a variety of husbandry procedures, and go back on exhibit.

Natural: Aspen branches, mixed leaves, hay, bamboo, cedar mulch, live crayfish, live shiners.

Food Creation: Ice bucket, ice cubes, krill cubes, clam juice cubes, watermelon juice cubes, fish juice cubes, s/o mix juice ice, krill cubes, ice balls, snow, rosemary, oregano, thyme, milk, peanut butter, red apple, green apple, peach, pear, carrot, HB egg, strawberry, blueberry, cranberry, honeydew melon, watermelon, cantelope, red grape, green grape, pumpkin, clam, chicken, feline diet, smelt, broccoli, dog biscuit, feeder tube, coconut, pecans, bananas, milk bones, corn, mint, basil, sweet potato, portabella mushrooms, shitake mushrooms, plum, pomegranate, mussels, oysters, cilantro, snap peas, peanuts, walnuts, dill, coffee grounds (Ethiopian), lemon juice.

Plastic/synthetics: Ferret logs, boomer balls with and without holes, Frisbees, “Boomer” spindles, Nyla ball, gray rock, abalone.

ENRICHMENT RESOURCES

The Shape of Enrichment – <http://enrichment.org/publication.html>

Enrichment Listserve – join by email jackbell@humboldt1.com

AAZK Enrichment Committee – <http://www.enrich.org/aazk>

CAZA Enrichment Listserve Archives – <http://www.caza.org/enrich/>

Environmental Enrichment Scrapbook – <http://www.well.com/user/abs/dbs/eesb/>

Environmental Enrichment (EE) for Captive Animals – <http://www.iwec.org/enrichment.htm>

Animal Enrichment – <http://www.geocities.com/RainForest/Vines/8435/ak/enrich/index.htm>

Environmental Enrichment – <http://www.wwwebspaces.co.uk/~abwak/enrich.htm>

AAZK Forum Magazine – Monthly publication. 3601 W. 29th St., Ste 133, Topeka, KS 66614, www.AAZK.org

Shape of Enrichment – Quarterly publication. 1650 Minden Dr., San Diego, CA 92111-7124

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CHAPTER 12

TRAINING or BEHAVIORAL MODIFICATION

BEHAVIORAL TRAINING OF NORTH AMERICAN RIVER OTTERS AT THE VIRGINIA MARINE SCIENCE MUSEUM

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While the title of this section and its contents describe some of the Virginia Marine Science Museum's training strategies and methods for *Lontra canadensis*, much of what you will read can be applied to most other types of otters and/or animal species. The physiological makeup and mannerisms in other taxa vary and thus require different approaches, however the concepts and strategies are basically the same.

Before moving forward, it is important to have a basic understanding of behavioral training and how it can serve animal management programs. This information is condensed and intended to provide a general overview of behavioral management. There are several books and journals available which can assist interested persons or facilities in furthering their understanding on this subject.

To begin, "What is Training"?

There are different definitions for training. Some of these descriptions can be found in books and journals which can be complex and confusing. To keep this simple we should define training in its most basic form. *Training is teaching.* (Ramirez - *Animal Training* p.8) For our purposes training is not for teaching tricks but instead to enable animal care staff to teach animals such as otters to live successfully within their zoological environment. Animals under our care look to us to serve many of their physiological, environmental, and behavioral needs. An effective behavioral training program can help to accomplish all of these things and at the same time enhance the lives of the animals under our care.

Why Have A Training Program?

In order to have a successful training program, one should have a clear understanding of why they wish to train. In other words, what do you hope to accomplish by training your animals? Do you desire to have this type of program to enhance the lives of the animals under your care, improve medical husbandry, better facilitate maintenance routines, or all of the above. You should first have clear objectives. The specific training goals will evolve as your program develops.

Training Objectives

Typically, training programs serve a few basic yet critical objectives. These objectives can be broken down into Primary and Secondary reasons to train.

Perhaps the most important purpose or Primary reason to have a behavioral training program is to teach animals to cooperate in husbandry or veterinary procedures. In the case of our five male N. A. river otters at the Virginia Marine Science Museum, we have taught them a variety of behaviors to assist both the animals and staff who care for them. These behaviors range from very simple shifting on and off exhibit to expedite maintenance, to more complicated behaviors. An example of one of our most complex trained

behaviors is allowing our veterinarians and /or myself the ability to sedate each of our otters under protected contact, without physical restraint. We typically conduct this procedure once a year during annual physical examinations. Ultimately, this behavior has allowed us to conduct complete physical examinations with all five otters in about one hour. This process has essentially eliminated any stress associated with restraint. It also eliminates any risk to the otters or keepers if a net and/or a squeeze cage where to be typically used.

Other *Primary* reasons to train include mental stimulation (behavioral enrichment) and physical exercise, both of which help to promote the overall well being of an animal collection. Primary behaviors can be considered behaviors which directly benefit and serve the animal first.

Secondary reasons to train could include public educational programs and presentations, or research projects within a zoological or aquarium facility. Additional *Secondary* reasons with domestic animals could involve police work, rescue work, and assisting the disabled. These behaviors, although beneficial to the animals, more directly benefit and serve the public first.

Now that you have a better understanding of why training is beneficial, the next subject to discuss is where to begin?

How to get started?

If one wishes to begin a behavioral training program with a specific animal group, it is imperative to know as much about the natural history of this animal as possible. In other words, where does the animal normally live? What are its food requirements and typical food preferences? What is its social structure? In a nut shell, how does this animal live and interact within its natural environment. Basic understandings such as these help to lay the groundwork to start this type of program. One also should have a clear understanding of the exhibit and holding area's potential as a source of training for the animals. In other words, how can I train the animals within areas I have to work with, and what limitations are there? Finally, a familiarity of behavioral training should be acquired. You may already have a behavioral coordinator within your facility, or someone with experience on site that can be of assistance. Other sources of help can be found in a few selected books and organizations.

"Don't Shoot the Dog" by Karen Pryor and published by Bantam books is an excellent introduction to behavioral modification and in fact is required reading at several facilities involved with this type of work. *"Animal Training - Successful Animal Management Through Positive reinforcement"* by Ken Ramirez is another very good source of information. Currently, this book can only be purchased by ordering it from the John G. Shedd Aquarium. Additional sources of information are organizations such as IMATA (International Marine Animal Trainers Association), AZA (American Zoo and Aquarium Association). Of course the Internet can open up many resources in a very short period of time.

The Virginia Marine Science Museum River Otter Training Program

The Virginia Marine Science Museum river otter collection consists of 5 males acquired in two separate groups. The first group consisted of two rehabilitated otters which were born in April or May of 1993. When these two otters were first acquired in 1995, they were placed in an off site holding location 7 months prior to the opening of their new exhibit. This temporary kennel system was a 20' x 10' chain link enclosure with a small 3' x 5' shifting kennel attached to one end of the structure. The second group of three otters, born in April of 1994, arrived at the museum approximately 2 months prior to the new exhibit's opening. By the time this second group had arrived, the first two otters had been relocated to their permanent holding location attached to the new exhibit. The second group of otters were placed in the original 20' x 10' enclosure that had been relocated to the museum site from its off-site location. This was done to allow for the completion of their quarantine process and to begin their training program.

Prior to the arrival of the second group of otters, and while still working at the off-site location, I began teaching our first two otters basic behaviors. This was even more challenging because our new staff had no training experience and had to learn training fundamentals as well. Our objectives were at the time fairly simple. We understood that we were going to have 5 male otters arriving in two groups at different times

and they were going to have to be introduced at some point prior to going onto exhibit and living permanently together. The process of training began with our first group of animals.

Establishing A Wholesome And Effective Diet

We began this process by determining what we felt would be not only a nutritional diet for our collection, but also one that we could feed to each otter by hand in individual pieces through their chain link enclosures. The bulk of our otters diet (75%) consists of whole smelt cut into 1' to 2' pieces. Each otter also gets two uncooked, skin-on chicken breasts cut up into bite size cubes. This chicken is evenly distributed into the two or three feeding/training sessions that occur each day. Additionally, each otter gets one or two whole mice (frozen then thawed). A vitamin supplement is given to each otter on a daily basis. We use Mazuri Vita-Zu Mammal tablets. These tablets must be cut to the appropriate size for the animals based on their average daily food intake. The vitamin pieces are hidden in the food. In most cases the otters eat the vitamins without hesitation. There is on occasion the need to replace vitamins if an otter spits a piece out. During the rest of the day, at random times, our otters are given various items for both behavioral enrichment and for food diversity. These items include, but are not limited to, live fiddler crabs from our salt marsh, an occasional blue crab, minnows (Shiners), fruits and/or vegetables frozen in ice, dog bones, eggs, and whatever else we might think up. *Note: We have been asked on occasion if we have any concerns in regards to giving our otters uncooked chicken breasts. Salmonella is of little concern to our veterinary staff in regards to feeding this food item. Otters will normally eat a variety of food items that might carry salmonella out in the wild such as small amphibians and reptiles. The items we feed are of restaurant quality and are slow thawed in a cooler overnight just prior to their use. We have never encountered any problems with our animals when feeding this diet.*

It is very important to note that we feed each of our otters by hand. Each animal receives a specific diet based on its individual food requirements. This method of feeding eliminates competition for food which can occur if a facility where to feed animals in a shared food dish. Hand feeding also enables us to visually check on each individual very closely several times a day. It also enables us to medicate the otters in pill form with relative ease. By feeding in this manner we can help to ensure that our otters are eating and acting normally.

The purpose for cutting the otters' diet up into bite size pieces is so that we may use the food as a reinforcement item during training. Bite size items allow staff the ability to control the quantity of food given for each reinforcement. In other words, a successful behavior might earn a "jack pot" of several pieces of food. Accomplished lesser behaviors might earn one or two pieces of food.

How We Started the Training Process

After determining the appropriate diet we began the training process. In our case we work with our otters under protected contact as they have shown unpredictable tendencies. With this in mind, we first started by simply getting the otters to eat from our hands through the chain link enclosure. At the same time we introduced a common but critical training tool called a "**Bridge**". A Bridge is an audible or visual signal that tells an animal "Good" or "Job Well Done". In other words, this signal "bridges" the gap between the desired response and the reinforcement the animal receives for accomplishing this task. Before an animal can understand that a Bridge means Good, it must be taught this. In our case we chose to use Acme Dog Training whistles as the bridging mechanisms. Our whistles are attached to lanyards that hang from the trainers necks. This type of bridging device leaves our hands free. To teach the otters that the sound of the whistle means good, we began pairing this sound with the process of feeding. At the beginning of each session, we blow the whistle twice as a form of notification that the feeding is about to begin, in other words, "come and get it". After this, the trainer would Bridge (blow the whistle) as a food item was placed in the otters mouth. After a relatively brief period of time, the otters began to associate the whistle with something that was good, food! This repetitious process is called conditioning.

Stationing

Our first objective during this initial phase of training was to get the otters to sit still next to each other at their feeding locations or "stations". The idea is for the animal to eat quietly next to the other otter without being concerned with what he was eating or doing.

To clarify, a station, or the act of stationing is when an animal learns to sit at a consistent location during a feeding or training session. This location can be determined in a number of ways, but often is initially determined during the beginning stages of training by the animal itself. It will often sit to the right or left of another animal based on what is most natural and comfortable for it. You could compare this seating arrangement to that of an elementary student who sits at the same desk each day of school. It is a place of familiarity which provides some elements of comfort. Stationing can eventually evolve to the animal sitting not only at a particular location, but sitting where ever the keeper or trainer moves. The trainer at this point essentially becomes the station location. Where the trainer goes, the animal goes.

During this initial process we simply fed and bridged the otters as the food was given. We also began to use the bridge if the otters sat very still at their station and focused on the trainer. For example, if an otter typically fidgeted during a feed or would leave its feeding station to see what another otter was doing we would obviously not bridge and then reinforce, otherwise you would be reinforcing the otter for leaving. Remember the Bridge means “Good”. To help correct a problem like this, we wait for approximately 3 seconds after the otter returns to its station and focuses himself on the session before we resume the session. This process is called **LRS** or **Least Reinforcing Stimulus**. LRS is an effective way to extinguish an undesired behavior by simply not reacting. For example, if an animal like an otter leaves, and then returns to eat at its leisure, the keeper should give no response at all for 3 to 5 seconds. This means that the keeper should not talk, move or do anything, no response. The reason for this is that we do not always understand what is and is not reinforcing, thus LRS is probably the least possible reinforcing action of a trainer. A simple analogy to help understand this could be, if a comedian were to tell an audience several bad jokes, and they did not laugh or respond in any way, chances are, this person would either stop telling jokes, or find new material to use. In the case of our otters, when they remain at station and show focus, we bridge at the peak of this quiet and stable positioning, and then deliver the food as quickly as possible. If by chance the otter is exceptionally good, we offer a jackpot of several pieces of food. By bridging at the peak of a desired behavior such as sitting quietly, this alerts the otters to the fact that what they have done is very good and that positive reinforcement was on the way. This phase of bridging indicated to us that the otters had graduated to a basic understanding of positive reinforcement. They had learned that the whistle meant Good.

Target Training

Target training is an important behavior which can allow a trainer to teach an animal to accomplish many tasks. A target can be described as an extension of a trainer's hand. It can also be described as “A prop which pinpoints a critical location for an animal in training”. (*Ramirez - Animal Training p. 552*) In our case, we taught each of our otters to “target” by touching their nose to a small blue and white pool buoy attached to the end of a 3' foot PVC pole. We accomplished this process by first showing the otters the “buoy target” through the chain link. Our otters were curious and immediately approached the buoy to get a closer look. As soon as they placed their nose on the target to smell it, we bridged (blew the whistle) and immediately reinforced. After the bridge, the buoy target was removed and the food reinforcement was given. This process was repeated throughout several sessions until the otters got the hang of it. It did not take long! “Touch the buoy with my nose, and get a few pieces of chicken or fish, not a bad deal.”

The next step was to get the otters to not only touch the target, but to maintain contact with it for as long as the trainer desired. This behavior is called extended targeting which can last up to 10 or 15 seconds, and even longer before the bridge and reinforcement. This is accomplished by not bridging right away when the otter touches the target, but instead holding the target in position. When working on this behavior, the otters had a tendency to anticipate the bridge occurring quickly and thus would sometimes touch the target, then immediately break contact from it looking for the reinforcement. When they reacted in this way and did not hear the bridge, and the target was still in place they would typically place their nose back on it. The task was then to get them to stay locked on to the target for increased increments of time. The trainers would literally count in their heads, one thousand and one...Bridge, reinforce. Present the target again and count, one thousand and one, one thousand and two.....Bridge, reinforce. And so on. After a few days of training the otters got the idea and learned to stay on target for increasing periods of time.

The next behavior to train was to get the otters to follow the target. Remember, our training occurs through chain link. We began by calling the animals to their stations, then bridge and reinforce once they are calmly in place. We then present the target to their right or left sides at random intervals during the sessions. By having them move directionally to each side and make contact with the target, they began to learn to go to, or follow the target. Of course during the same session we would ask them to occasionally extend their targeting at random schedules to ensure that they would lock onto to it for more than just a second. We also would present the target in front of them and then slowly move the target to the left or right sides in a smooth motion. This enables the otters to follow the target directionally. Over a brief period of time (2 or 3 days), one or two feet of side to side targeting increased to greater distances. Eventually, the trainer could walk with the target while the otter followed it. When the trainer stopped, the otter would have to stop and lock on to the target with its nose through the fence. At this stage we could lead the otters around to different points within the holding area. These accomplishments opened up new opportunities for both the otters and animal care staff.

The Introduction Of Our Otters

Some of the important benefits achieved by teaching our otters these first basic behaviors were evident during the introduction process. Having five male otters living harmoniously together was the objective, and predictions from other facilities working with otters ranged from “Good luck”, to “No way”, to “Wow, that will be a dynamic situation”. This was a period of time when careful planning, consistent training, and a little luck would play an important role in the success of this living situation.

The introduction began by first establishing an “Introduction Process Plan” while at the same time physically preparing the permanent holding area prior to the arrival of the three newest otters. To fully grasp the plan, it is important to understand the design of our holding area and what we did to make this situation work.

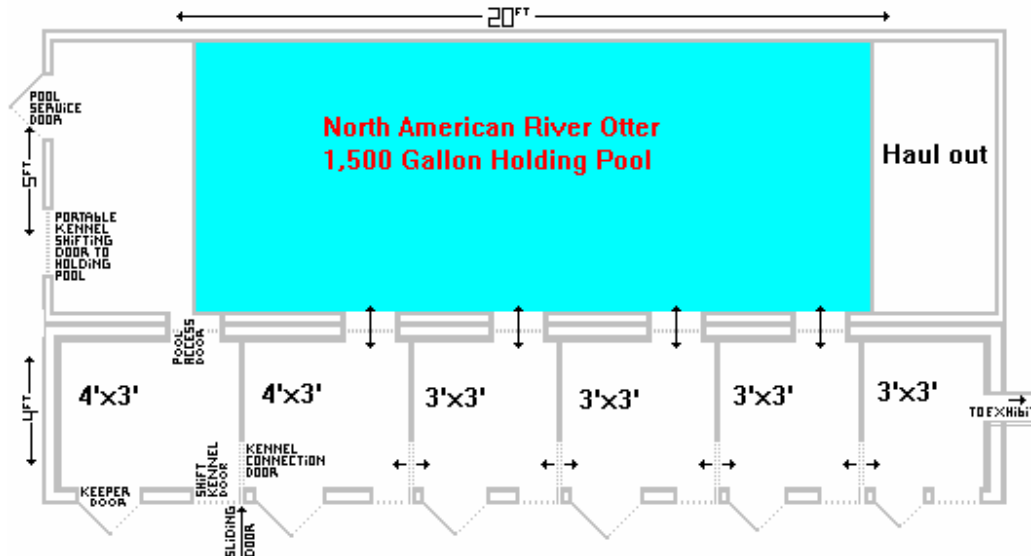
The permanent river otter holding area is made up of two 4'x3' and four 3'x3' kennels constructed of chain link. Each of these kennels can be interconnected, or isolated, from each other and a 1500 gallon pool with clear, lexan guillotine doors. Initially, we used plexiglass as doors, but quickly learned that the otters could shatter those doors with little effort. When completed, this design gave us what we felt to be the most options in moving animals around and providing separate enclosures as necessary. The design in fact played a major role in the success of the introduction. It allowed both groups of otters to live, eat, and share both the kennel enclosures and the pool on a rotational basis with out ever having physical contact with each other up until the day the two groups where mixed.

The first two otters “Tango” and “Cash” had already been living within the permanent holding area for several weeks. They had essentially gotten used to this new surrounding and continued with training sessions during each of their feeds, approximately 3 x daily. While this was taking place, the three newest otters where completing their quarantine process, learning to eat the same diet as the two other otters, and getting a crash course in basic stationing and target training several times a day.

As the animals progressed in their preparation, the animal care staff began lining their interior chain link enclosures with plexiglass. This glass would allow visual access to each other as well as hearing and smelling each other, but it would reduce the possibility of an animal being bitten through the chain link. The overall design enabled the otters to eat together without the fear of competition for food.

The idea was fairly basic in that one group would typically have access to ½ the kennels and the pool, while the other group had access to the other half of the kennels. We had no means of dividing the pool in ½ so that both groups could use it simultaneously, thus they went through frequent rotations within this area on a daily basis. Frequently, one group was closed in the pool area, while the other group was given access to the entire kennel system so as to have direct contact with the other groups kennels. This was often comical to observe as the group exploring this area would make a point of marking the entire kennel system with feces and urine. During a rotation when one group had no pool access, they were given water to drink and a spray hose to play with to keep them cool as needed. Rotating the animals allowed for the sharing of this entire area without contact. It also allowed one group to investigate the area recently

occupied by the other group. This enabled them to get used to the different smells and kennel areas. Of course, the otters always had visual access to each other.



As explained earlier, we feed our otters by hand while they sit side by side. The otters are expected to sit quietly next to each other so that feeding and training can take place with few distractions. During the introductory period, the clear separation doors played a crucial role in the two groups getting comfortable with each other during feeds. Although there was initial aggressiveness during feeds such as growls and screaming, once the otters realized that they could not get to each other and there was no competition for food, they quickly settled down and learned to eat quietly. At each of these feeds, we conditioned the otters to eat at the same spot each time so that they would become used to this location. It would be considered “their feeding station”. This location became a comfortable place for them to eat with little concern about the intrusion of the others.

As their comfort level and training progressed over the next couple of weeks, we began to approximate the otters to the actual mixing process. They had become fairly used to living with each other in the same enclosure yet they had not had physical contact. We began to devise our introduction plan with the hope of minimizing stress and potential injury. For this reason, we decided to introduce one otter from each group to each other. This process would allow us to intervene if necessary, but with only two otters and not all five.

We set a date for the mixing to begin. We did this based on a number of factors, one which included the fact that our exhibits opening date was drawing very near. We also began seeing both otter groups sleeping next to each other with only chain link separating them. Typically, they would sleep on opposite ends of the kennels. The otters were also seen on numerous occasions standing face to face through the chain link sniffing each other without signs of stress or aggression. Finally, we noticed that the otters had begun to rip off the plexiglass barriers attached to the interior of the chain link kennels that served to protect them from biting each other through the chain link. In seeing this, we felt the time had come. We chose the least dominant animals from each group as the two to begin with. The plan was to call all of the animals into their kennel areas and close off access to the pool during a feeding session. After the feed, we would then open the guillotine door to the two selected animals’ kennels allowing them access to the pool and their kennel enclosure. This would provide them with the most room to run around as needed.

Although the plan was well thought out, our newest otters apparently lost patience with us and our slow methodical process of planning. One morning prior to the mix we came in and discovered that Willoughby, an otter from the second group of animals was fast asleep in the kennels with Tango and Cash. We discovered that a pool access door in the newest groups area had been partially pushed out of its tracks. Although this essentially gave the entire group access to each other Willoughby was the only one we new for sure that had mixed. We thus decided to continue with what Willoughby had started by opening the doors to the other kennels one at a time. We chose Rudee as the next animal to introduce due to his calm nature and less dominant presence. This went fairly well with almost no aggression present. Because of this, we finally opened Pungo's door. He was the last of the newest group to be introduced. After doing this we opened all doors and removed all separation barriers to allow the otters the maximum amount of room to run.

What happened next was interesting in that all of the otters began to chase and play with each other, or at least that is what it initially looked like. They began running around and diving in and out of the water with a fairly high level of energy and enthusiasm. This carried on for approximately 30 to 45 minutes. The interaction after this period of time began to elevate to include some aggression and dominance role playing. The otters began screaming at each other and would also mock bite each other. This carried on at random intervals for several hours. During this time we never left them unattended and kept detailed records of the mix. At about mid day, the otters where seemingly so worn out that the two groups went to opposite ends of the kennel system and slept. That afternoon, we fed them in their kennel enclosures with the separation doors closed so that they could eat their entire diets without the concern of the intrusion of the other group. During the next few days, we began mixing them at random intervals for longer and longer periods of time until they where spending most of their days as one group. We also began feeding them with the separation doors partially opened for brief periods of time. As this work continued, aggression decreased and a more cohesive group of otters began to develop. A large hurdle had been overcome. The two groups where now one. The next and perhaps most important step was to have all five otters shift out onto exhibit.

Shifting

Several years ago I observed keepers at a large and well known zoo attempting to shift two otters off of exhibit in to their holding area so that the final days cleaning of the exhibit could take place. What should have only taken a few seconds to accomplish, was never successfully completed on this particular day. In fact, the keepers finally gave up frustrated that they could not complete the days routines. I found it both interesting, and somewhat amusing to see the otters run around chaotically while the keepers attempted to bribe, chase, threaten, and even use a hose to get them to shift. I suspect the keepers' exploits on this and probably other occasions where somewhat reinforcing to the otters. At least, I feel that staying out on exhibit was in this instance more reinforcing than shifting into their holding, otherwise they would have done so.

Shifting zoological collections on and off exhibit as needed, and in a controlled and expedient manner has historically been problematic for keepers with little or no behavioral experience. An inability to accomplish this basic behavior can delay or even eliminate some daily husbandry responsibilities. However, if trained properly, this behavior can allow for flexibility with husbandry routines and even the mixing or rotation of different animals.

I believe this behavior can, and should, become as routine as diet preparation and cleaning. We accomplished this aspect of training at the museum soon after we relocated our otters from their temporary holding location to their permanent holding area for the opening of their new exhibit in 1996.

Nothing seems to encourage a staff to expedite a process like shifting more effectively than to have a scheduled exhibit opening, and a facility Director watching over your shoulder. We were no exception to this situation. We accomplished this behavior with our otters by applying a couple of strategies. First, as the countdown to the exhibit's opening drew near, we began leaving the connection doors from the holding area to the exhibit open. We felt that the natural curiosity of the otters would get the best of them and they would venture out to explore. This process was of course not as easy as it might seem. Our holding area is connected to the exhibit by an 8" diameter clear acrylic pipe that is approximately 10' long. At each end of the pipe is a guillotine door. When shifting animals on and off exhibit, both doors must be manually opened to allow the otters to pass through these locations. In the initial design, the idea was that when the otters moved on and off exhibit through the pipe, the public could watch. At first, the otters were very hesitant to even stick their heads into the pipe. Every so often, one of them might go ½ way through the pipe, then back up until he was back in holding. This was particularly amusing when one or two other otters followed this individual into the pipe and then had to go into reverse as well. Finally, after a few hours, our first otter ventured out on to exhibit. Of course he sat at the entrance to the exhibit for quite awhile before becoming brave enough to explore. By the end of this first day the two otters from the original group were out on exhibit exploring and swimming in their 35,000 gallon pool.

The new group of otters proved to be more of a challenge in getting out on to exhibit. They acted as if they would be more than happy to simply stay in the holding area. Periodically, Tango and Cash from the first group would run into the holding building, instigate play behavior with the others, then run out to exhibit. It was as if they were trying to get the others to come out. This type of behavior did create curiosity with the otters from the new group, but they continued to resist venturing on to the exhibit. At feeding times, we would begin each of our sessions on exhibit in an effort to coax out the remaining three otters. The keeper area where we feed the otters on exhibit has two access doors on each side of it that allow for exhibit maintenance without the public clearly seeing the doors. These doors have ½ inch plexiglass panels instead of chain link. The panels help to further hide the door locations from the public. In order to feed the otters at these door locations we had to cut several 2" circular holes at each door in order to slip food items through the holes. When we first began calling the otters to station on exhibit, Tango and Cash quickly learned to go to the door nearest the holding connection access door. This enabled us to establish their feeding / training station immediately. While working with them on exhibit, at the same time we continued to try to coax the others out on to exhibit.

After one week with the second group of otters still refusing to go onto exhibit I decided to cut a series of 2" holes along the top of the acrylic connection pipe to enable the otters to follow a target out to the exhibit. The holes were spaced approximately 1' apart so that successive approximation "baby steps" could take place. The goal was to slowly get the otters to move further through the pipe by going to the target presented at the drilled hole locations. If they moved successfully to a hole and touched the target they would get reinforced with food. After a few days, each of the otters were going as far as the last hole that was approximately 6" before the entrance to the exhibit. At this point, they could see the other two otters playing and thus they quickly went in to the exhibit. It took a total of two weeks to get the second group of otters to enter the exhibit. They missed the public opening of the exhibit by one week. Fortunately the first two otters were on exhibit at this time and were actively exploring their new surroundings. Once the second group went in, they quickly learned that the keeper access door opposite the door closest to the connection pipe was to be their station for feeding and training on exhibit. The first two otters had already established their feeding / training station, thus the second group had only one other option which made this transition easy.

In order to get the otters to shift on and off exhibit as needed we simply started randomly calling the otters to station in holding, then calling them back out to exhibit to their station using food as the primary reinforcer. We also began varying the amount of time the otters would be closed into the holding and/or exhibit area. When they would successfully shift from one area to the next, we not only reinforced with food, but we also had behavioral enrichment ideas in place that made the shifting a fun process. A variety of otter toys, PVC pipes to crawl through, live fish in the holding pool all offered interesting opportunities to the otters. Offering this type of variety is an important factor in maintaining behavioral consistency. To this day, our otters will generally come off of exhibit at a moments notice. I say generally because, on

occasion some behavioral factor such as breeding season can effect their attention span. They shift with a 95% consistency on a year round basis.

The above information only scratches the surface of potential for training animals such as river otters. By understanding and then applying some of the information within this chapter the doors open up to a more successful animal care program for both your animal collection and keepers. Additional behaviors that can be taught include: kennel separation, crate training, standing on a scale to be weighed, tactile through chain link, application of topical ointments, oral examinations, retrieval of objects, and yes controlled sedation without restraint.

Unfortunately, one could write an entire book on the processes involved to teach the behaviors mentioned, and I only have one chapter and limited time. My final thought on the subject of training and/behavioral management is as follows. Training serves both the animals under our care as well as the keepers that are responsible for them. Perceptions of training in the past do not hold true by today's standards. The trend of behavioral management of animal collections continues to progress with great strides. We are learning that so much can be overcome and improved with some basic training applications. Finally, behavioral management is very rewarding in that you can actually see results. The trick...no pun intended, to maintaining a successful program is to continue to seek out sources of information and apply new ideas in a consistent fashion. Once a behavior is taught, it must be maintained. The end results will speak for themselves.

JOHN G. SHEDD AQUARIUM NORTH AMERICAN RIVER OTTER HUSBANDRY AND TRAINING PRACTICES

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The Shedd Aquarium currently houses 1.1 sibling North American river otters (*Lutra canadensis*). They were captive born on 9 March 1992 at Little Rock Zoo in Arkansas and subsequently purchased by Shedd Aquarium on 29 September 1992. On 4 November 1994, *Ozark*, a male, was donated to the Brookfield Zoo. *Rio*, the female, remained at the aquarium with two other otters (1.1 born 01 Apr 1981; died 09 June 1992 and born 06 Feb 1983 and died 11 April 2000 respectively). On 19 June 1996 Brookfield Zoo donated *Ozark* back to Shedd Aquarium.

Their exhibit was completed in April 1985. It was designed to represent a natural and historically important habitat of Illinois' endangered populations of river otters. The idea behind the exhibit design was based on the following criteria: A varied topography, water level and depth to allow animals to utilize their exploratory behavior and natural inquisitiveness. Secondly, to provide a large enough area for animals to live without restricting the service area behind the exhibit. Finally, to provide for a complex exhibit that is easy to maintain. A combination of cast artificial sandstone bluffs, live plants, waterfall, hollow log and a mural of associated oak riverine forests creates the feel of a natural habitat found on the lower Fox River in Illinois. The exhibit is split-level to stimulate otter behavior on land and water, which can be observed by visitors. The substrate of the exhibit is concrete. Exhibit dimensions are in Table 1. Thirteen-foot high perimeter walls provide safety for the exhibit and a vertical surface to attach artificial rockwork and other decorative components of habitat. Space above the exhibit has been utilized for air handling equipment and skylights that allow for natural lighting. Horizontal surfaces are slightly sloped to allow for optimal public viewing and an easily drainable surface. As a precaution any potential escape route was blocked with Plexiglas barriers. A chain link door with a bolt lock separates the exhibit from the reserve area. This reserve area is accessible to the animals but off public display. A main door with a peep hole and ventilation panel covered with stainless steel screening were designed to view the holding area and detect animals that may have escaped into the holding area. The reserve area can be divided into three cages, two with immediate access to exhibit. The cage separation is accomplished with sliding doors and pin locks. This allows the aquarist and/or animal care specialist optimal control of the otters. The cage also has an attached kennel that holds one and a half feet of water. The water temperature is 65 degrees Fahrenheit. The ambient temperature of the exhibit and reserve area is maintained at a mid 70 degree Fahrenheit range. The water system circulating through the exhibit is cold freshwater.

From 1981 to 1996, the river otters' husbandry and maintenance was provided by Fishes Department staff. The Fishes and Marine Mammal Departments began a cooperative, formal training program in 1996. Currently, in addition to husbandry behaviors, the goals of the training program are to move, separate, and gate the otters. The otters have been housed together in the past, but have a history of aggression toward each other, so are now kept separate at all times. Present contact with each other only occurs through one inch holes drilled in the bottom half of the steel gates which separate them. The animals alternate living in the exhibit and the reserve areas. Both animals are gated into the reserve area a minimum of twice daily for exhibit cleaning and maintenance. All training with the otters is done through wire mesh fencing. Complete physicals and oral exams are conducted yearly, and require general anesthesia. The otters have been trained to go into the kennel that may be removed for veterinary procedures.

The otters' entire diet (Table 2) is split between two training sessions per day, each session lasting approximately 10 minutes. The herring is restaurant quality. The horsemeat recipe is prepared by Brookfield Zoo commissary under contract. Training session times are 8:00-9:00 a.m. and 2:30-3:00 p.m. All exhibit maintenance is conducted during the morning session. Several "mini-sessions" can occur within

each session. The otters are called to station with a double blow on a whistle and/or their names called. Each animal has learned to station at an individual shape (red circle for the female, blue square for the male.) A verbal "good" is used as the bridging stimulus. Food reinforcers are hand fed through the fencing. Otters are individually or simultaneously worked by a single trainer. Shedd Aquarium also offers enrichment items for the otters. The schedule of our enrichment varies. Some type of enrichment is offered daily at the trainer's discretion. Usually, edible items are given a few times a week, whereas other items or grooming aids are given daily. Table 3 represents enrichment items.

A detailed record keeping system is an integral part of our river otter program. Daily records are kept on training, behavioral observations, medical concerns, enrichment, and diet intake. This allows us to track any trends that may develop. The list below represents husbandry and other behaviors the trainers have developed with the otters.

Husbandry Behaviors:

- Gating and Shifting – allows us to move animals
- Targeting – including extended targets and follow targets
 Target is a hard red buoy on a PVC pole.
 The animals touch the buoy with their nose or other body part.
- Kennel – animals enter a kennel on cue and allow us to close them inside.
- Weights – animals are trained to climb into a plastic bin that sits on top of a scale. Weights are taken twice a month and diets are adjusted accordingly.
- Mouth open - for visual inspections
- Paw present – front or rear paw lifted to fencing for inspection
- Tactile – front and rear paws, and tail. Otters allow tactile by trainer or second person. Props and medical ointments can be applied.
- Rump present – for voluntary pole injections
- Ventral up – animal lies on back

Other Behaviors:

- Hold – animal stays still at station, allowing trainer to move or adjust gates
- Spin
- A to B's – animal moves from A trainer to B trainer
- Up – animal stands upright on hind paws
- Window work – animal works with trainer through exhibit window
- Shape Discrimination
- Name recognition

Table 1: Shedd Aquarium Exhibit Dimensions	
Floor space of entire exhibit	495 sq. feet
Land surface area available to animal	211 sq. feet
Surface area of den (two entrances, water and land)	10 sq. feet
Water surface available for animals	194 sq. feet
Water surface area of deep tank	55 sq. feet
Water surface area of shallow tank	100 sq. feet
Planters	42 sq. feet
Holding area	39 sq. feet
Cage area	21 sq. feet

Table 2: Shedd Aquarium Otter Diet		
	Ozark	Rio
A.M. Feed	.25 kg horsemeat	.20 kg horsemeat
	.10 kg herring	.10 kg herring
P.M. Feed	.20 kg horsemeat	.15 horsemeat
	.10 kg herring	.10 kg herring

Table 3: Shedd Aquarium River Otter Enrichment			
Edible	Grooming Aids	Other	Items otters have destroyed (now considered potential health risks)
Live fish	Carwash strips	Nyla-bones of various shapes	Cardboard boxes
Gelatin molds	Astro-turf	Logs	Paper bags
Smelt cubes—Ice with smelt frozen inside	Spray hose	Frisbees	Grass mats
Ice cubes and large ice blocks	Mirror ☺	Hard plastic bowls	Whiffle ball
Fresh Snow		Boomer balls of various sizes	Softball
Crickets: Sometimes hidden inside objects		PVC pipe pieces	Plastic two-liter bottles
Vegetables whole and cut (not a big hit!)		Large Rubbermaid bin	
Frozen smelt: <ul style="list-style-type: none"> • Hidden around habitat, or inside feeder balls and PVC feeder tubes • Non-scheduled session free-feed of smelt 		Plastic basket (for french fries originally)	

BEHAVIOR TRAINING RESOURCES

ADon't Shoot the Dog by Karen Pryor, published by Bantam books, is an excellent introduction to behavioral modification and in fact is required reading at many facilities involved with this type of work.

Animal Training - Successful Animal Management Through Positive reinforcement by Ken Ramirez is another very good source of information. Shedd Aquarium Press. (1-888-Sea Stuff), John G. Shedd Aquarium, Chicago, IL.

Learning and behavior – P. Chance. 1998. Brooks/Cole Publishing

IMATA (International Marine Animal Trainers Association)

AAZK (American Assoc. of Zoo Keepers) Animal Behavior Management Committee – www.AAZK.org;

AAZK Forum - ABC's Column by Diana Guerrero, Ark Animals of California, P.O. Box 1154, Escondido, CA. arkabc@arkanimals.com

Training List Serve To join contact mthompson@lifegate.net

Animal Behavior Management Alliance

c/o Gary Wilson
Moorpark College
7075 Campus Road
Moorpark, CA 93021
805-378-1441

Behavior Bridge Trainers' Association – Quarterly journal.
2005 Sunny Lane, Knoxville, TN 37912. BhvrBridge@aol.com

Clicker Training – www.clickertraining.com

A Beginner's Guide to Operant Conditioning –
www.clickersolutions.com/clickersolutions/articles/ocguide.htm

An Animal Trainer's Introduction to Operant and Classical Conditioning
www.geocities.com/Athens/Academy/8636/Clicker.html

CHAPTER 13

NORTH AMERICAN RIVER OTTERS IN EUROPEAN ZOOLOGICAL INSTITUTIONS

Several European facilities have had tremendous success with the North American river otter, in recent years this is particularly true for the Bristol Zoological Garden. There are several issues that should be dealt with on a cross-continental basis, most notably, diet, the genetic make-up of the captive population, and a pooling of experiences to solve the sporadic breeding record of this species in captivity. I would like to extend my appreciation to John Partridge and Sheila Sykes-Gatz for conducting a European survey.

HUSBANDRY SURVEY RESULTS FOR NORTH AMERICAN RIVER OTTERS (*LONTRA CANADENSIS*) IN EUROPEAN ZOOS

Conducted and Compiled by John Partridge* and Sheila Sykes-Gatz**

Introduction

A “Husbandry Survey for North American River Otters (*Lontra canadensis*)” held in European zoos was conducted by John Partridge of Bristol Zoo Gardens (UK) in 2000. Sheila Sykes-Gatz compiled the survey results. This 5-page questionnaire covered historical and current census data, enclosure design and furnishings, environmental and behavioral enrichment, diets, breeding and management, hand-rearing, new mate introductions, and post-mortem data. The results of this survey are as reported below. Nine of the thirteen institutions surveyed responded. The responding institutions are as listed: Baby-Zoo (Wingst-Dobrock, Germany), Banham Zoo (Banham, Norfolk, England), Basel Zoo (Basel, Switzerland), Bristol Zoo (Bristol, England), Drusillas Zoo Park (Alfriston, East Sussex, England), Eekholt Wildlife Park (Eekholt, Germany), Novosibirsk Zoopark (Novosibirsk, Russia), Paradise Park (Hayle, Cornwall, Great Britain), and Zoo de la Fleche (La Fleche, France). The invaluable information that was provided by the survey respondents (see Acknowledgements) helped make this paper possible. Within the following sections, each institution surveyed (name in bold print) is credited for specific information contributed. This report is not intended to set standards for the care of North American river otters, rather it is meant to provide an overview of the current husbandry, management, census, and reproductive history of this species in European zoos. It is hoped that it will stimulate communication and information sharing among all institutions holding North American river otters.

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North American River Otter Census in European *			
Name of Institution	No. of Otters Held in September 2000	No. of Litters Born / No. of Litters Survived** 1983 - 2000	No. of Cubs Born / No. of Cubs Survived** 1983 – 2000
Baby-Zoo (DE)	1.1	0/0	0/0
Banham Zoo (GB)	1.1	0/0	0/0
Basel Zoo (CH)	1.3	7/7	5.13/5.13
Bristol Zoo (GB)	1.3	3/3	2.4/2.4
Drusillas Zoo Park (GB)	1.1	0/0	0/0
Wildlife Park Eekholt (DE)	4.4	1/1	1.2/0.2
Novosibirsk Zoopark (RUS)	1.3	1/1	0.3/0.3
Paradise Park (GB)	1.2	0/0	0/0
Zoo de la Fleche (FR)	1.1	0/0	0/0
Total No. of Institutions = 9	12.19	12/12	8.22/7.22

* Nine of the thirteen European institutions surveyed responded. **Survived beyond weaning.

Enclosure Design, Furnishings, and Environmental / Behavioral Enrichment

The zoos surveyed provided information on the following: enclosure size, land to water ratio, exhibit land and pool design, containment barriers, indoor housing and dens, and otter access times to the exhibit. Also included are land and pool furnishings (i.e. substrates, vegetation, furniture), environmental and behavioral enrichment, indoor housing design, den furnishings, shelters, sleeping box/nest box design, (see Breeding and Management for breeding boxes/nest boxes and temporary transport cage), and grooming/bedding materials.

Baby-Zoo

The outdoor exhibit measures 13m x 13m including the pool which is approximately 6m x 13m. The exhibit containment barrier is 1.45m high and is composed of a 0.8m high wall and a 0.65m high fence extending above the wall. An electric wire is positioned on the containment barrier wall (0.8m high) and extends 0.1m outward from the side of the wall. An “otter house with two separations” adjoins to the side of the exhibit. The otters are only locked inside when the keeper is cleaning the exhibit.

The enclosure land area has soil, sand, and abundant natural vegetation including bushes and trees. A shelter, separate den, and small waterfall are included within the exhibit. Hay is provided in the nest boxes. A play ball is also given.

Banham Zoo

The outdoor exhibit measures approximately 17.7m x 14m and has a 65% land to 35% water ratio. Three smaller pools surround the front of the main pool and a waterfall adjoins the main pool at its backside. The exhibit containment barriers include 1.48m high back and side walls and a front and side moat measuring 1.9m x 0.55m. There is no overhang on the containment barriers or electric fencing. The “main house” adjacent to the enclosure measures 1.14m x 1.14m x 1.72m.

The exhibit contains a large mature oak tree with a hollow burrowed into the roots and a dead oak tree with a burrow between its roots. The enclosure is grassed over and contains some rocks. A wooden house/box measuring 0.75m x 0.5m is placed within the exhibit. The pair sleeps in the wooden house. Shavings are provided in the house (for a toilet area) and straw is provided in the nest box (shredded paper has been used in the past). Occasionally sprats are scattered into the pool and frozen fish blocks (with and without fish) are given.

Basel Zoo

The outdoor exhibit (formerly a brown bear enclosure) contains 2/3 land area to 1/3 water area and the inside housing area measures 4m x 2m. Staff emphasizes that a large land area is important. The containment barrier walls are 3-4m high. Otters have access to the outdoor exhibit all of the time.

The outdoor enclosure contains wooden bark chips, sand, concrete, a wooden platform, many dead fir trees on land (which are renewed/exchanged), trees, hollow roots, rocks, and cut dead trees in the pool. Three breeding boxes lined with straw and equipped with heat lamps are provided in the enclosure (see breeding box description in Breeding and Management). Straw is provided in the litter boxes of the concrete indoor housing area.

Bristol Zoo

The 12m x 18m outdoor exhibit connects to an additional off-exhibit indoor housing area/hut measuring 4.25m x 1.8m. A small corner of a large lake and an artificial pool that is 1.5m at its deepest point are contained within the exhibit. The land to water ratio of the exhibit is 65% land to 35% water. A gentle slope continuing all the way around the artificial pool's edge creates shallow water areas (designed to aid cubs learning swimming). The much deeper lake area has steep sides, so large tree trunks were placed in the lake spanning to the lake's edge. Cubs that fall or are taken into the lake will be provided with a safe and easy exit from the lake via the logs. The artificial pool is filtered using a biological system, the water returning to the pool via a waterfall. The 2m high containment barrier is constructed of glass panel sections (each measuring 2m²) along the enclosure's front and part of one side, a solid wall at the exhibit's back and along part of one side, and a 1.1m high wall on the other side. Perspex sheeting is fitted to the top of the 1.1m high wall and it overlaps the top of the inside of the wall to complete the total height of 2m. The glass viewing windows and shrubs planted behind the perspex give the overall feeling of a well-planted open enclosure. The otter entranceways to the inside/outdoor enclosure have sliding shift doors which are operated from the keepers' part of the hut, so that the whole area can be worked without going in with the animals. (Otters are locked in the hut every morning before the keepers clean the exhibit).

A 2m high large soil mound with growing grass is at the enclosure's center. Placed through the mound are large diameter (30cm) drainage pipes, one set at ground level and the other about half-way up. The otters use these pipes quite a lot. The pipes increase the opportunity for overall enclosure use and are ideal for hiding food inside and general play activity. They also provide an additional sleeping/resting area. The height of the mound enables the otters to get up to a higher level, and it is occasionally used as a lookout across the lake. In wet weather, especially, it is used as a slide. A small shelter/box (in which an otter can be locked into) is placed at the far end of the enclosure, well away from the (breeding) hut. This is done to provide the male with a sleeping/resting area that is as remote as possible from the female, as she is aggressive towards the male when she is raising cubs (see Breeding and Management). Four different types of substrates are deliberately used: grass (including the soil mound), which was initially covered with wire mesh to discourage digging (with limited success!), bark chippings; sand and small stones/pebbles to form a beach-like setting alongside the lake. All four substrates are used regularly by the otters and are occasionally replaced when necessary. The enclosure also includes natural foliage, rocks, and large gravel. Daily scatter feeds and whole rabbits (etc. see Diets) are provided for additional behavioral enrichment.

The indoor housing is a 4.25m x 1.8m hut situated behind the containment wall at the back of the exhibit. Two entrance holes in the exhibit wall lead to the hut. The hut contains 2 sets of sleeping/breeding boxes as well as a small wire run connected to the larger box, and a keeper area. A hay/straw mixture is offered as a nesting material. (See the sleeping/breeding box design in Breeding and Management.) Keepers enter the hut from a service area behind the enclosure and there is a safety porch entrance system (the keepers' area of the hut also contains another door that accesses the exhibit).

Drusillas Zoo Park

The outdoor enclosure is approximately 25m x 10m and the land area covers 2/3 of the exhibit and the pool area covers 1/3. The 6 foot containment barrier fence has a 1 foot overhang, electric wire (220-240 volts, 50HZ, 3W), and 4 window viewing areas. A rocky covered entrance within the exhibit leads to a 5 ft. x 4 ft. holt positioned adjacent to the exhibit. Two keeper doors (one with a window) access the holt. A high window and a mirror placed at an angle allow the public to see the otters resting. Two keeper entrance doors with secondary containment "safe areas" are placed at two exhibit ends (securing access to the holt as well). The otters have access to the exhibit 24 hours per day.

The enclosure contains trees, grassy land, an area of wood-bark chips, a waterfall, a hill, stones, and rocks. Straw and wood shavings are used for bedding in the holt and the otters also bring in grass themselves. For additional enrichment food is hung in the trees, balls are filled with food, food is thrown into the water, boxes are filled with food and straw, and insects are scattered about the exhibit for foraging food.

Wildlife Park Eekholt

The wildlife park's three separate outdoor enclosures measure 528m², 240m², and 264m². The fence containment barriers have overhangs and electric fencing. Each enclosure's pool has a continual fresh flow of water. Each enclosure contains 2 or 3 wooden nestboxes and a separate shelter (with a lid). Otters have access to the entire exhibit all the time.

The enclosures are a natural habitat and contain soil, grass, trees, bushes, dead wood, stones, and large pool rocks. A large tree trunk forms a bridge over one pool (where the pool narrows). Straw is provided for bedding material in the shelters and nestboxes.

Novosibirsk Zoopark

The outdoor exhibit is an enclosed system composed of three adjoining enclosures connected with passages to the adjacent enclosures. The average area of each enclosure is 70m². Their 1.3 otters move freely about the area and have access to the entire exhibit all the time. The exhibit land to water ratio is 3:1 and the pool is 1.5m deep. The enclosure containment barriers are made of metal wire fencing with 2cm x 2cm mesh. Electric fencing is not used.

The enclosures have a sand floor with patches of green grass (in the summer) and turf. Trees and bushes also grow within the exhibit. The enclosures are furnished with a variety of logs, stumps, branches, snags, and stones and the pools have small logs and floating rafts. The otters enjoy swimming around and playing on/with the small logs and rafts floating in the water. They also like to play with the branches and snags on land. The enclosures have dens and nestboxes. In the winter sawdust is used in the den for insulation against heat loss. Hay is spread around near the dens for use when grooming and is provided all year round. Nestboxes are furnished with hay all year round. The nestboxes are made of one or two celled portable dens. See their breeding box design in Breeding and Management.

Paradise Park

The outdoor enclosure is approximately 75 sq. m. and has a 90% land to 10% water area. The containment barriers are composed of 2.1m high block walls (with no overhangs or electric fence) and 3 glass viewing windows at the exhibit's front. Otters have access to the enclosure all year around.

The enclosure is covered with grass and has planted conifer trees and bamboo. Hay, straw, and reeds are provided for bedding materials. There are many logs in the ponds. The otters are fed by hand (i.e. food is thrown to them) twice a day for a public show.

Zoo de la Fleche

The outdoor exhibit dry land area measures approximately 7.5m x 4m and additionally the outdoor exhibit pool is 6m in diameter and 2m in depth. The containment barriers are made of concrete walls with at least 6 large glass viewing windows. The nest box in the indoor housing is tiled and contains 3 partitions. Each partition of the nest box measures 60cm in width x 90cm in length x 110cm in height.

Natural substrate covers the exhibit and bamboo stands are planted in at least 4 areas of the enclosure. The terrain of the land has different levels of heights (the highest spot is just in front of the pool). There are many large logs on land and small logs floating in the pool. Straw is provided in the nestboxes.

Diets

All institutions offered fish, otherwise the diets varied widely. The nine institutions responded as follows:

Baby-Zoo

Mornings: ½ kg river fish each

Afternoon: + - ½ kg chicken each

Daily two pullets [young chickens] each with two fish eaters tablets

Twice a week carrots and/or apples

Banham Zoo (Holds 1.1 otters.)

Morning: Two day old chicks each

Main Feed: Mid-afternoon: 500g spratts and 1 chicken/turkey poult leg (250g approx.)

Carnivore supplement given daily

Basel Zoo

Fed three times a day, especially mice and fish

~ 25 mice or 15 fish per day per animal

Bristol Zoo

Fed three times per day at 8:30, 12:00 and 16:00 hours. Feeding increased to 4 times daily at 8:15, 11:00, 14:00 and 16:30 hours – when the female was nursing babies.

Mornings: usually chicks and sprats (hidden around enclosure for behavior enrichment).

Mid-day: Fish (herring and mackerel, and very occasionally trout) (scattered around enclosure for behavior enrichment).

Afternoon: Meat and sometimes chicks or mice (scattered around enclosure for behavior enrichment).

Occasionally: Once every four or five weeks whole rabbits (1 per otter).

Sometimes offered: rats, pigeons, raw eggs, dog biscuits, and Zoo Diet A. Otters have caught and eaten ducks and sea gulls that strayed into enclosure.

Drusillas Zoo Park

Following food for 2 otters:

	A.M.	P.M.
Monday:	Two adult rats	Two large trout
Tuesday:	Not fed	Two large Mackerel
Wednesday:	Two pigeons	1 ½ lbs. horse meat & 6 small sprat
Thursday:	½ rabbit each	Two trout
Friday:	Two adult rats	Two trout
Saturday:	Two rats	1 ½ lbs horse meat & 6 small sprat
Sunday:	Two trout	Two Mackerel

Wildlife Park Eekholt

Fed 2-3 times a day.

Fed 750-1000g per animal per day.

Offered different types of fish, chicks, minced meat enriched with vegetable, mineral powder, vitamins, and liver oil.

Novosibirsk Zoopark

Fed two times each day and three times each day if temperature is below 10°C.

Noon feed: Fish types offered: Walleye pollack, greenling, herring, river fish, & sometimes Teuthida. Each adult otter fed 200-300g fish per day.

Evening feed/s: Meat products (beef, liver, heart, and lungs with bones, fat, etc. removed) are cut into 100-150g pieces. Each animal is offered 700-800g of these meat products in summer and 1000g in winter and an egg. If temperature is below 10°C the meat products are divided into two feeds at 5 p.m. and 11 p.m. When temperature is below 15°C the portion is increased by 20-30%.

Vitamin supplements are given daily.

Paradise Park

Daily diet as follows: (Holds 1.2 otters.)

	Morning	Evening
Chicks	15	18
Whiting	28 oz.	8oz.
Heart		8oz.
Liver		6oz.
Rabbit		¾ of rabbit

Offered trout one day a week. Given 1 medium size fish each.

Zoo de la Fleche

Fed 3 times per day. Fish are especially fed in the morning and end of morning and the most substantial part of the diet is offered in the evening.

Diet offered: 80% fish (native fresh water fish), 18% meat/chicken, and 2% carrots, apples, other fruits. The otters are given live fish (roaches and carps) regularly.

Breeding and Management

Four of the nine institutions surveyed reported births. Births occurred at Basel Zoo, Bristol Zoo, Wildlife Park Eekholt, and Novosibirsk Zoopark. Five of the nine institutions surveyed reported no breeding, although two of these five institutions have observed mating. Specific breeding information and management for breeding used at each institution applicable are discussed below. Discussed are breeding census data (i.e. birth dates, sexes, survivorship [survived beyond weaning]), mating seasons, litter size, and body weights of cubs. Also discussed are parental and cub-rearing behavior, removal and reintroduction of the sire, cub development, keeper care, breeding/cub management, removal of cubs from parents, and enclosure furnishing/design used to facilitate successful breeding/cub rearing (i.e. breeding box designs, shelter placement, gently sloping pool sides, shallow pool areas). Bristol Zoo presents extensive details on many of these issues (Partridge 1997).

Baby-Zoo

Reports no breeding as of yet and the male is not removed from the enclosure. No other breeding management information is reported.

Banham Zoo

Comments that their very old pair is still mating but they have had no offspring. Their mated pair's birth dates are unknown, although the male arrived at Banham in 1983 and the female arrived in 1984. No other breeding management information is reported.

Basel Zoo

18 animals from five litters have been born.

February 18, 1983	1.1 born / 1.1 survived
February 19, 1987	1.1 born / 1.1 survived
April 3, 1992	0.2 born / 0.2 survived
March 23, 1994	1.2 born / 1.2 survived
March 21, 1997	0.2 born / 0.2 survived
March 22, 1997	1.3 born / 1.3 survived
March 19, 1999	0.2 born / 0.2 survived

Reports variability in breeding. Breeding has occurred yearly, every second year, and occasionally at larger intervals. Their otters started to breed at 2-3 years of age. All cubs were born in February, March, or April. Their average litter size is 2-3 and the litter size ranged from 1-7. The cubs have been parent-reared and hand-reared (see Hand-Rearing).

Previously, in a former enclosure, the male was removed from the female, although now the male is left with the female in the bigger enclosure. The male was closed in his individual den when the female was still very aggressive to provide relief/protection for the male. When the female was not aggressive, all dens, including the male's, remained open to provide complete access for all individuals. The young are dispersed at 10 months of age or older.

The breeding box is made of three joined wooden box compartments and each compartment has one glass pane and wire mesh door. There are 4 round entrance holes (2 of which are at the box ends) to access each box compartment. The enclosure contains three breeding boxes, each of which is filled with straw and equipped with heating lamps.

Bristol Zoo

Three litters were born.

April 5, 1996	- 1.2 born/1.2 survived
April 3, 1998	- 1.0 born/1.0 survived
April 5, 2000	- 0.2 born/0.2 survived

Reports their otter's breed every second year. Cubs were always born in April and the litter size ranged from 1-3. The litter size for each of 3 litters was 3,1, and 2 cubs (one additional cub of the last litter was stillborn). The male is not removed from the enclosure and the young are parent-reared. (See below for female aggression towards the male during cub-rearing). The young are removed from the parents at 7-8 months.

The inside housing area/hut contains 2 sets of sleeping/breeding boxes. The breeding boxes have sliding doors fitted to the first entrance holes – each hole measuring 28cms high by 25cms wide - so that the boxes can be isolated. One breeding box is divided into 2 compartments and the other into 3 compartments. (*Bristol is planning to refurbish the breeding areas and renew the boxes. Experience has shown that it would be better if each compartment could be isolated using a closing a door*). Each box compartment is 0.6m wide x 0.6m long. Each box compartment is serviced from the top via a hinged lid, and set within the lid is another much smaller (25cm x 20cm) hatch with a wire cover fixed immediately below it. This system enables the otter to be shut into the box where, by opening the small hatch, it can be visually examined or, if necessary darted through the mesh panel. Also, these boxes can be removed from the hut, complete with otter, if required, and therefore double as a catching/transportation facility. (*The present design allows for the whole box to be removed. A new design will allow for just one section to be taken away*). A hay/straw mixture is offered for nesting material.

A small shelter/box (into which an otter can be locked) is placed at the far end of the enclosure, well away from the (breeding) hut. This is done to provide the male with a sleeping/resting area that is as remote as possible from the female, as she is aggressive towards the male when she is raising cubs. She would not

allow the male in the hut, even with the additional sleeping box within the hut. The male slept in the pipes within the soil mound (see Enclosure Design...) and in the shelter for at least the first 84 days after the cubs were born.

The excerpt below, from "North American River Otters At Bristol Zoo" (Partridge 1997), discusses further detail on mating seasons, parental and cub-rearing behavior, cub development, keeper care, breeding/cub management, and enclosure furnishing/design used to facilitate successful breeding at the Bristol Zoo:

"Breeding

Our pair have always got on well together and mating was observed frequently from about May onwards....Mating was a regular event throughout the summer and autumn and, although less frequent, continued in December and throughout the following January and February.

Towards the end of March 1996, when we were just beginning to think that nothing was going to happen that year, the female started to spend more time than usual in the larger of the two nest boxes. Additional nesting material was offered and some of it was taken inside.

On 5th April, when the animals were checked at 8 a.m., the male was outside while the female refused to come out of the sleeping box. This in itself was unusual, as both animals are normally quite active first thing in the morning. Tiny squeaking noises were heard coming from the box, so the area was immediately vacated by the keeper and no one entered the area until the end of the day, when food and fresh drinking water was offered to the female. She briefly emerged from the box to feed. Meanwhile the male had been fed outside during the day, and when he decided to venture inside, he was aggressively chased out by the female. This became the pattern over the ensuing weeks, and the male lived outside all through the summer, using for shelter the pipes in the soil mound and a small box at the far end of the enclosure, well away from the breeding den.

For almost a week no cleaning was attempted at all; when keepers entered the hut, it was only briefly to feed and water the mother, and no lights were put on during the process. There is no natural daylight in this area, and the only light used for the first week was that coming through the door when it was opened. On Day 6 it was possible to shut the mother into the breeding box for a short time so that the inside area could be cleaned and fresh bedding put down. It was possible to clean the outside area on Day 14 when the male was shut in the smaller nest box, but two days later the female was seen aggressively chasing him outside, and from then on he refused to use the smaller nest box; we were unable to get him inside again until Day 46, some three-and-a-half months after the babies were born. From about Day 14 the female was seen occasionally to use the outside enclosure, enabling a quick inspection of the nest box to take place on Day 16, when two babies were seen (it later transpired that three were present). Three days later, the female was seen swimming with the male, but soon after that she was again observed chasing him aggressively, and after that he always steered clear of her whenever she came outside.

Keeping to the same routine, all went well, and by Day 53 the youngsters were moving around a lot in their box. One was seen in the indoor run for the first time on Day 56, and all three began to emerge two days later. Day 61 saw one baby showing mild interest in a fish head, and all three were seen in the outside enclosure with their mother at 8 a.m. on Day 63 (6th June). Although the female took them back inside almost immediately, they were seen outside for short periods throughout the day. Whenever the male showed some interest in his babies (never aggressively), the female chased him off.

One of the concerns I had had before the babies emerged from the hut was that they might fall into the steep-sided lake pool and be unable to get out. Only one part of that area had a gentle slope to it. To improve the situation, large tree trunks were placed in the lake from the bank so that any babies falling in could get out again via the trunks. I was hoping that the smaller, artificial pool with its gently sloping sides would be used at first by the youngsters. As it happened, mother otter arranged things admirably by taking her offspring by the scruff of the neck one at a time and dunking them in the lake. They didn't like it very much, but soon got the idea of how to swim. (I had seen our male Asian short-clawed otter do the same with his babies in the past.)

By Day 67 (10th June) the adults slowly began to spend more time together and the male began to relax. Eight days later, all five animals were seen swimming together and it was possible to shut all of them outside to enable the inside area, including sleeping boxes, to be given a thorough clean. It was interesting to note that the bedding was hardly soiled at all, just stale. Later that same day, the youngsters were seen chewing on a dead mouse, and two days after that they joined their parents in chasing after food thrown for them around the enclosure at feeding time.

On Day 84 (28th June) the male emerged from the indoor area with the female, although it was not clear whether he had been sleeping in the boxes with her and the cubs. From that time onwards all five continued to spend a lot of time together and, on Day 94, it was possible to shut all five inside so that the outside area could be cleaned. Thereafter, the normal daily cleaning routine was re-commenced. The youngsters were caught up (anaesthetised)-for sexing (one male and two females), inoculating and identifying (transponders were fitted) on Day 145 (25th August), and all three youngsters will be removed from the exhibit and sent to another U.K. institution in early November, to give the adults some respite before the appearance (we hope) of more cubs next year.

Conclusions

We are very pleased to have been able to breed from our animals so soon after their arrival, particularly since a number of well-established U.K. pairs have failed to breed. Of course, we have learnt from our experiences and have built a small shelter for our male at the far end of the otter enclosure, well away from the breeding hut. Our intention that the male would use the smaller of the two nest boxes failed to materialise because, I think, it was too close to the female's breeding area. Following the female's aggressive behaviour towards him, it is hardly surprising that he refused to enter the smaller box to enable cleaning to take place. A shelter at the other end of the enclosure into which he can be shut sometimes will be much better for all concerned and avoid the possible need to remove him from the exhibit in the future. (We don't have a suitable alternative area for him). This apart, we have been pleased with the way events transpired." End of excerpt from Partridge (1997).

Drusillas Zoo Park

Reported no breeding and breeding has not been encouraged because their pair are siblings. The male is not removed from the enclosure. No other breeding management information is reported.

Wildlife Park Eekholt

Reported one litter born.

April 5, 2000 - 1.2 born/0.2 survived (1.0 died June 12, 2000- drowning?)

The male was removed from the enclosure, otherwise at all other times the pair is housed together. The young are parent [mother]-reared. One breeding box is described as a 1m wooden box that is furnished with straw bedding.

Novosibirsk Zoopark

Reported their pair had one litter in 1990.

March 18, 1990 - 0.3 born/0.3 survived

The pups weighed 450g, 450g, and 470g at 10 days of age. The male was removed immediately after delivery because the female "grew restless". The male was not reintroduced to the mother with young. All of the cubs were mother-reared. The young were removed at 5 months of age to an enclosure distant from that of their mother's.

"Parallel piped-shaped boxes" made of wood are offered as breeding boxes. A wooden passage is adjoined to the box's entry hole to protect the female from draught and intrusive attention.

Paradise Park

Reports no breeding. The male is not removed from the enclosure. No other breeding management information is reported.

Zoo de la Fleche

Reports no breeding, although their pair was seen mating many times at the end of April 2000. The male is not removed from the enclosure. No other breeding management information is reported.

Breeding/Genetic Overview in Europe

This overview seems to support reasoning that further research (e.g. regional studbook) is needed in order to facilitate the responsible genetic management of the European captive population.

Baby-Zoo. Animals received from same location (Canada 1989) and at the same date as adults. Unknown if they are related and no breeding – animals are old.

Banham Zoo. Most likely are unrelated but no breeding. Both animals are old.

Basel Zoo. Good breeding results from unrelated animals.

Bristol Zoo. Good breeding results from unrelated animals.

Drusilla's Zoo. Siblings and no breeding seen. Both are at least 13 years old.

Wildlife Park, Eekholt. Relationship of the otters held here is not clear. Recent breeding in 2000.

Novosibirsk Zoo. Have had successful breeding in 1990. Parent relationship unclear. (Both arrived from Canada on the same date in 1989). New male arrived in 1991 to replace old sire that died but no breeding has occurred.

Paradise Park. 1.2 siblings (born Bristol 1996). Male to be exchanged for unrelated animal.

Zoo de la Fleche. 1.1 not related. Mating seen in April 2000.

Hand-rearing Cubs

One of the nine zoos surveyed hand-reared cubs. Their report follows.

Basel Zoo

Three cubs were hand-reared because their mother died shortly after giving birth.

Milk Formula:

210g herrings

4 ½ spoons of milk powder (al 110)

1 ½ tablets "Benerva" (thiamine)

½ spoon vitamin supplement (Combi Feline)

210 ml water & double quantity of Esbilac milk (lactose free).

Milk formula is pressed through a sieve and gauze (because of bones).

If babies develop diarrhea, porridge or wet rice is added to their diet.

Cubs were fed every 2-4 hours in the beginning until 18 days old when feeding intervals were gradually increased.

Introduction of New Mates

Three of the nine zoos surveyed introduced new pairs. Their reports follow.

Basel Zoo

Both individuals can explore the outdoor exhibit separately. As well, they are provided adjacent boxes inside so that they can see, smell, and hear each other before they are let together for full-contact.

Wildlife Park Eekholt

Reports that introducing new pairs is very difficult. The otters are first kept separately for several weeks but they have visual contact at this time. "An approach of both otters is attempted when all are fed properly and under control." They report these attempts often fail.

Paradise Park

They have holding pens adjoining the main enclosure. Wire mesh doors measuring 30cms x 30cms enable animals to see each other in the adjoining enclosures. The doors are opened when an introduction is to take place.

Post-mortem Data

Four zoos have reported deaths and their causes. They are as follows:

Basel Zoo

Reported 6 deaths due to the following:

1. Chronic myocarditis and glomerulonephritis. *Female. Age at death: 11yrs 2months*
2. Angiostrongylus vasorum [infection] [French heartworm]. *Female. Age at death: 1yr 2months +/- 2months.*
3. Abscess in a molar tooth and exhaustion. *Female. Age at death: 9yrs 2months.*
4. Glomerulonephritis and Lymphosarcoma? *Male. Age at death: 8yrs 8months +/- 6 months.*
5. Arteriosclerosis (IMCA) and myocardial infarction. *Female. Age at death: 14yrs 8months +/- 6months.*
6. Killed by a grey heron.

Wildlife Park Eekholt

Reported 2 deaths due to the following:

One 2-month-old male otter cub probably died from drowning.

One otter died of a white tailed sea-eagle attack.

Novosibirsk Zoopark

Reported 2 deaths due to the following:

One adult male died from inflammation of the bowels.

One 9-year-old female died from poisoning.

Zoo de la Fleche

One 2-year-old female died of parvovirus infection.

Acknowledgements

The information provided by respondents of the “Husbandry Survey for North American River Otters (*Lontra canadensis*)” (2000) helped make this paper possible. Their invaluable contributions and time are greatly appreciated. The survey respondents are listed below by institution:

Baby-Zoo (Germany): Mr. Fritz Bechinger. Banham Zoo (Great Britain): Mike Woolham. Basel Zoo (Switzerland): B. Steck and F. Salz. Bristol Zoo (Great Britain): John Partridge. Drusillas Zoo Park (Great Britain): Sue Woodgate (Curator). Wildlife Park Eekholt (Germany): Dr. E. Schettler. Novosibirsk Zoopark (Russia): Rostislav A. Shilo (Director). Paradise Park (Great Britain): Dale Jackson. Zoo de la Fleche (France): Cyril Hoe (Animal Dept. Manager).

References

Partridge, John 1997. North American River Otters At Bristol Zoo. *International Zoo News* Vol. 44, No. 8 (1997), pp. 466-472.

CHAPTER 14

REHABILITATORS and OTTER RESOURCES

Cochrane Ecological Institute
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OTTER MANAGEMENT AT THE COCHRANE ECOLOGICAL INSTITUTE Clio Smeeton, President, CEI



Description of Facility:

The Cochrane Ecological Institute (CEI), established in 1971, is a registered charity, a non-profit, non-government organization established as a center for the captive-breeding for re-introduction of extirpated or endangered indigenous species into their historic range, and the rescue, rehabilitation and release of injured and orphaned wildlife. In addition, the CEI provides Field Station facilities for individuals interested in undertaking behavioural research on the species maintained and managed at the Institute.

Although the CEI operates under a zoo permit (2986GP, Alberta Environment) all species held there are intended for re-introduction and release, not for exhibit, trade or sale. As none of the animals held at the CEI are on exhibit, some of the management constraints that influence the way animals are kept within the zoo community are not applicable at the Institute. For example, enclosure size varies from a minimum of 60 meters by 90 meters, 2 1/2 acres, 20 acres, up to a maximum of 130 acres, and no enclosure is designed to facilitate public observation of the animals housed within it.

The CEI is set at 4,700 ft above sea level in the foothills of the Rocky Mountains, and consists of 160 acres of natural prairie/montane habitat, enclosed by an 8ft game fence with 4ft. ground-wire mesh along its base and surmounted by a 4ft. wire-mesh overhang. Within the enclosed 160 acres are three spring-fed bodies of water, a large bog, aspen bluffs and spruce groves.

Situated at the center of the CEI is a fenced off 30 acre enclosure containing the three CEI buildings (main building containing office facilities, staff housing, and library, Animal Health center, Interpretive center), the swift fox, *Vulpes velox-V.v.hebes*, captive-breeding facility, Mews and raptor flight pens, as well as enclosures designed to house other orphaned species destined for rehabilitation and release.

The CEI has been working with the North American river otter, *Lutra (Lontra) canadensis*, since 1983 and over that period has both successfully raised orphaned otter cubs for release into the wild, and undertaken the capture, translocation, and release into suitable habitat of adult and juvenile “nuisance” individuals.



Captive otter management at the CEI.

CEI facility designed to house orphaned otters:

The otters housed at the CEI have all been orphaned animals and, in general, arrive at the Institute severely dehydrated and often close to death. It is vital that otter cubs, of any age, should be kept in a quiet, dim area that is warm, dry, free of draughts and where the animals are easily, non-intrusively, observable over 24 hours.

The area set aside, at the CEI, for newly arrived otter cubs is 10 ft by 12 ft in size, within the CEI main building and referred to as the “otter room”. The otter room is heavily insulated to reduce any noise disturbance, and to keep it at a warm, even temperature. The floor is linoleum, while the walls have stainless steel sheeting up to a height of 18 in., above which they are painted wood. A thermostatically controlled infra-red lamp, set 5 ft above the floor, ensures that the animals are never chilled. Both hot and cold water is provided within the otter room. Two sets of 3 ft. deep wood shelves are set on two sides of the room up to a height of five feet. If the room is occupied, these shelves are covered with toweling. Set along one wall there is an 8 in. deep, 8 ft. by 4 ft. fiberglass bath, with a steel grid covered drain. Adjacent to that is a 2 ft. by 4 ft. by 8 inches deep “drying” area containing sawdust or fine sand. The bathing and drying area is divided from the main body of the room by a four foot high wall and door. It is essential that the bathing area can be closed to very young cubs, and also, when the area is made available to the animals, that there is a large space where the otters can dry off.

Within the otter room, a 6 inch deep, 4 ft. by 6 ft. box of dry powdered peat covered by a layer of hay is set against one wall, under the shelving. We have found well-cured fine hay to be more suitable than the coarser oat or wheat straw more commonly used as bedding, as hay is equally absorbent and holds together better than straw when the cubs burrow into it. The peat and hay “nest” gives the otter cubs shelter and privacy while still making it possible for the keeper to keep them under observation. Also, while the room is in use by otter cubs, the linoleum floor is thickly covered with newspaper. The otter room is entered, from the CEI library, through a horizontally divided “stable” or “Dutch” door.

The whole area can be observed, through plexi-glass windows, from the CEI main library and also from outside through double paned insulated glass windows. The CEI library has an alternative access giving directly onto the CEI’s, fenced, 130 acres. When the animals become old enough to leave the otter room and go outside they then have free access to 130 acres of land through a specially constructed, insulated, “otter exit” in the CEI library wall built next to the library’s outside door.

The “otter exit” consists of a 2 ft by 2 ft by 8 ft insulated, lidded wooden box containing 3 baffles set at 2 ft intervals along the inside of the box. The baffles are designed to reduce the amount of winter draught and cold that would otherwise whistle into the library. Entry, exit, and passage past the 3 interior baffles is through holes that are 7 inches in diameter.

Immediately outside the CEI library are three specially constructed ponds linked by a shallow creek. Initially, the young otters will make use of these ponds only when in the company of their keeper and spend the rest of their time, voluntarily, in the “otter room”. When the animals are 6 months of age, the keeper will spend a great deal of time taking them for walks all over the CEI’s 130 acres and introducing them to the CEI’s three large water bodies. These ponds contain, as well as amphibians native to the area, introduced rainbow trout (*Oncorhynchus mykiss*). The natural prairie habitat of the CEI’s 130 acres also houses wildlife indigenous to the area, large mammals such as moose, elk, white-tail and mule deer, small predators such as coyotes, red foxes, and bobcats as well as a wide range of prey species.

The largest, seven-acre, pond has an artificially built otter holt, a six foot by three foot insulated box with direct access to the pond. This “holt” is set within a section of the machine room at the base of a windmill. The pump operated by the windmill keeps the water open and ice-free all winter, enabling the adolescent animals to use the water throughout that period. By midwinter of their first year, most young otters will be

living in the windmill holt, and will spend little time in the otter room. By the time of release, September, they will spend no time at all in the otter room

Handling and hand-rearing North American otter cubs:

Otters are an active, lively, vocal, and intensely social species. Work undertaken at the CEI has demonstrated that it is essential both for the well-being of the orphaned animals and for success in re-introduction and release, that the orphaned animals have significant interaction with their keepers, that they be taken, from the age of five months on walks with the keeper and introduced to natural water bodies. This exercise cannot, and must not, be hurried. As the animals get older, it is important that they are introduced to fishing and to the other indigenous species that occupy their native habitat. Although otter cubs are as dependent upon their Keeper for reassurance as any dog is to its master, at the age of 18 months, most hand raised otter cubs will exhibit a large measure of independence and will cease to be reliant upon their Keeper.

On Arrival: otter cubs have been brought to the CEI from within 24 hours of their birth to four months of age, one thing is in common for all new arrivals; they are dehydrated and severely stressed. The skin of the new arrival should be pinched between forefinger and thumb to check for “tenting”. Ideally, the pinched skin should slide smoothly back into position and not stay peaked. The animal’s gums should be examined for colour (rose pink, not white), while doing this, the body temperature can be estimated by sticking your little finger into the animal’s mouth (it should not feel cold to the touch). If possible, little other veterinary action should be taken until the animals are accustomed to their new accommodation and feeding well.

The newly arrived otter cubs should be kept isolated from other animals for 2 weeks, or until it is certain that they are disease-free.

All handling of otter cubs should be done without gloves*, and should be undertaken quickly, firmly, but gently. North American otter cubs do not open their eyes until the 34th to 36th day after birth (Liers E.E., 1958, Early breeding in the river otter. *J.Mammal.* 39:438-439, Liers, E.E.,1960, Notes on the breeding of the Canadian otter. *Int. Zoo Yb.* 2: 84-85, C. J. Harris (1968) Otters, A study of the recent Lutrinae, Weidenfeld & Nicholson, 5 Winsley St, London, W1.UK) and handling them without gloves at that age is of no risk to the keeper. Older otter cubs also offer no threat if properly and confidently handled.

The handler, no matter how idiotic it seems, should speak continuously and reassuringly to the animal. Otters are a vocal species and respond well to vocalization, even of a human sort.

The first essential, after it’s arrival, is to re-hydrate the animal. Using electrolytes, we have found that injection, rather than the use of an I.V. drip, is more efficient and less stressful to the cubs.

If the animal is caked and filthy with dried faeces, (this is more likely if it is single, because a group of cubs will suckle each other clean) it is essential to clean the animal up, using a moist, blood heat, cloth and a slow rhythmic motion to remove detritus. This gentle rhythmic cleaning action is generally reassuring to the young animal being treated.

Formula and Diet:

At the CEI we give otter cubs, that come in toothless and with their eyes still shut, a formula consisting of Esbilac (PetAg, Hampshire, Il. USA, www.petag.com) mixed as recommended by the company, plus 4ml of cod liver or halibut oil per 240ml of formula. This formula is fed, at blood heat, every hour during the day, every 2 hours during the night. At approx 2 ½ weeks after arrival, or when the milk teeth erupt, one tablespoon of infant’s Rice or Oatmeal Cereal is added (Heinz, H. J. Heinz Company of Canada Ltd.5700 Yonge St, North York, Toronto Ontario M2M 4K6, Canada), included is 40ml of liquidized raw meat (beef or chicken heart) per 240 ml of formula, plus one raw egg per day. Any un-used formula should be disposed of and not kept, even under refrigeration.

We use very soft nipples (Gerber; 0 to 3 months), with the nipple hole enlarged, for feeding young cubs. As the animals increase their formula intake, the number of feedings can be reduced, but there must never be a gap of more than 3 hours between feedings until the animals are eating solid food. Usually, by six weeks of

age young otters will be eating solid food, and taking milk formula on demand. At the CEI we wean otter cubs at five months old, unless an animal has been ill or is noticeably undersized, in which case we will continue to provide formula in order to enhance weight gain.

When the animals are eating solid food, they should be provided with an ample supply of food at regular intervals, in individual bowls, at a minimum of four times a day in the summer months. We have found that an adult North American river otter will easily eat an average of 3 to 5lbs of meat per day, although rarely more than 1lb per meal.

Because the animals maintained at the CEI are intended for release, once on solid food, they are fed raw trout, herring, smelt, anchovies, chicken necks, whole chicken hearts, chopped beef heart or liver, day-old chicks, and mice. The daily composition of the feed must vary, as otters get easily bored. The otters also are given access to limited amounts of fresh berries and fruit. As five-month old otters kept at the CEI also have free access to 130 acres, they are supplementing their feed (with varying levels of success) by hunting.

Any animal that is looking slightly “off-colour” is given mice. In Europe, where eels are readily available, they are fed eels as a pick-me-up in preference to mice (C.J.Harris. Otters, A Study of the Recent Lutrinae, Weidenfeld & Nicholson, 1968).

Prior to release, captive-raised rainbow trout (*Oncorhynchus mykiss*) are released into the CEI ponds, so that the juvenile otters can hunt them. The young otters also take the indigenous species naturally occurring on CEI land: amphibians, Richardson’s ground squirrels *Spermophilus richardsonii*, pocket gophers *Thomomys talpoides* and other small mammals.

Estimating age:

It is the experience of the CEI personnel that it is practically impossible to estimate the age of orphaned North American otter cubs, once their eyes are open. Size varies in direct ratio to the amount of feed available to the lactating female and the number of cubs in a litter. If the animal has been abandoned for some time, it will be smaller than a normal cub of similar age.

We have noted the size and weight of four blind and toothless cubs at 24 hours old (the otter bitch was observed whelping) to be 4 in. to 6 in. in length, and weighing between 5 and 6 oz. At 16 days of age their size and weight had increased substantially to between 7 and 9 inches in length and 12 to 16 oz in weight. Their eyes opened at 35 to 36 days, by which time they each weighed in at 2 ½ to 3 ½ lbs. In contrast, we have had otter cubs brought in whose eyes have been open and whose milk teeth are all in place, (meaning that they must have been older than 39 days) , that have weighed less than 20 oz and measured 12in. in total length.

Scat:

After each feeding, the otter cub’s stomach, abdomen and anus should be massaged with a damp finger (the finger will inevitably become damper) to ensure a bowel movement. This action takes the place of the licking a mother would naturally give her cub and contributes significantly to the animal’s well-being. The procedure should be following each feed until the cub’s eyes are open and they are able to leave their “nest” by themselves. Otters, even little cubs, are naturally clean, and, as soon as their eyes are open will leave their “bed” to defecate on the paper provided. Once they have decided upon a suitable site within the inner enclosure, it will become a “latrine” and will be used by all the otter cubs contained in the enclosure. If the otter’s bed gets damp or dirty from faeces it is a warning sign of potential ill health.

A milk-fed otter’s scat should look like a row of small amber beads in a translucent jelly. As they begin to eat solid food the colour and size of the “beads” will change to reflect the changes in the animal’s feed, for example, chicken hearts can result in dark red “beads”, and some insect chiton will pass unchanged right through the otter.

Otters are very formal in the use of latrines, and once they are using a larger enclosure, or in the case of the CEI, 130 acres, they will continue to use the same areas as latrines. These are generally distinctive sites; prominent rocks or fallen logs, a site where two trails cross, the end of a rocky promontory in a lake, or

sometimes a site, which to the human eye, has nothing distinctive to recommend it. The regular use of latrine sites by otters is a useful trait, and makes it easier to monitor the animals over a large area.

Singles versus Groups:

North American river otter cubs are seldom alone in the wild and they are intensely dependent upon their family group. If the cubs brought in are in a group, the level of stress is greatly lessened. Single cubs are sometimes reduced to a coma-like behaviour by prolonged anxiety. This coma-like condition will be alleviated by the keeper putting the cub inside his/her shirt until the animal has warmed-up and revived. Once the single cub has revived and is feeding well, it is possible to put it in the hay bed in the otter room, if the keeper takes off his/her worn T-shirt, wraps it around a ticking clock and provides a stuffed animal for company. If the intention is to produce a healthy well- balanced individual, it is essential to spend at least an hour with the single cub at each feeding, handling it, massaging it, and talking to it.

Introduction to other otters:

At the CEI we have had success introducing otter cubs, of any age up to and including 8 month old animals, to each other. If their milk teeth have not yet erupted, cubs can easily be put together, and will accept each other, without any obvious stress or aggression. In the case of older animals (6 to 8 months of age), as otter cubs will follow their keepers anywhere, our policy has always been to take the litter-mates for long (4 km) walks and to introduce newcomers during these walks. We have experienced no aggression between newly introduced animals.

We have, once, introduced a single cub to an adult female (as our aim is to introduce singles to groups as soon as possible,) because at that time we did not have a group of cubs of a similar age to introduce it to. Initially the female rejected the cub, but after one month she accepted the animal. We have not introduced adult animals to each other as we have not had the occasion to do so.

Introduction to other species:

Juvenile otters, hand-reared at the CEI come in contact with most of the species native to the eastern slopes of the Rocky Mountains. Moose *Alces alces*, elk *Cervus elaphus*, mule deer *Odocoileus hemionus*, and white-tailed deer *Odocoileus virginianus*, occur on the 130 acres in use by the otters, as do coyotes *Canis latrans*, red fox *Vulpes vulpes*, swift fox *Vulpes velox*, bobcat *Felis rufus*, skunk *Mephitis mephitis*, porcupine *Erethizon dorsatum* , and black bear *Ursus americanus*. Although the otters have been observed near to these animals there has been no observed adverse reaction between the species.

Health:

North American river otters are capable of survival on an insufficient diet in improper housing, but they will not do well. If maintained as a zoological exhibit they will prove unsatisfactory and unappealing to the public. They will be in poor condition, solitary, lethargic, depressed, a wasteful exhibit in a Zoo, and unlikely to survive if released. Their coats will be patchy when wet and dull when dry.. A healthy otter is active, curious, and extremely lively. It's coat is slick when wet, and, as soon as it comes out of the water and shakes will form into paintbrush tips, before drying to a shiny evenness.

Otters are susceptible to both canine and feline distemper, parvo virus and its mutations, feline panleukopenia, human jaundice and hepatitis. Pneumonia, abscesses, and perforated ulcers can be caused by improper management and housing. Death from over-heating and stress can occur very rapidly if the animal is improperly confined, or transported in an unsuitable travel crate. At the CEI we have lost one animal to intestinal torsion, "twisted gut". We have had five adult otters (four of them dead) brought in to us with mercury poisoning, and one cub.

Release methodology:

The CEI works with the Canadian Provincial government, the Environmental Agencies of British Columbia and Alberta, in order to identify potential release sites for otters. It is also necessary to obtain import, export, and transport permits from the relevant government jurisdictions prior to the animals' release into the wild. After review of the information provided by provincial government agencies, CEI personnel will examine potential release sites for prey availability, existence of other otters, and possibility of adverse

human/otter interface. The policy is to release animals into areas on coastal rivers where there is no human occupancy of the land.

CEI hand-reared otters are prepared for release in their second year and are released onto suitable, previously identified, coastal rivers when the salmon (*Oncorhynchus nerka*, *Oncorhynchus keta*, *Oncorhynchus tshawytscha*, *Oncorhynchus kisutch*), are running in September. We have noted groups of two-year old otters wintering together along the seacoast of British Columbia, and also, if there is sufficient feed available, there is a marked increase of otter use in estuarine habitat. The choice of the Fall of the year for the release of juvenile otters at the time of their natural dispersal, and when there is an ample supply of readily obtainable fish, appears to enhance survival.

Transport:

Crates are best constructed of heavy gauge, fine mesh, welded wire with a solid metal or wood roof and floor. The crate should be large enough to comfortably contain the animal when divided in half, one half being dark and draught-proof, and the other half open to the air on three sides, with an 8 inch diameter entrance hole giving the animal access to both halves. A heavy metal water-bowl should be bolted to the floor. The crate and all its fastenings should be made extremely stoutly, and the enormous strength of adult otters constantly considered while the crate is under construction. Crated animals should never be exposed to heat, direct sun, wind and rain. Otters have little heat tolerance and will die rapidly from being overheated (Best, A. 1962, The Canadian otter, *Lutra canadensis*, in captivity. *Int. Zoo. Yb.* 4: 42- 44)

Capture of adults for translocation:

The CEI has most frequently been requested to remove adult animals from the crawl-space under the main building of sea-side cottages in early Fall or over the Winter. In general, these animals are either single, or very small groups of juveniles. After checking that the otter is in occupation and discovering which entrance to the cottage's crawl-space is most used by the animals, an un-baited drop-trap (Pied Piper, Model 301, 15" x 15" x 46"), covered with plywood, is set in the otter's entryway. All other entrances to the crawl-space are stopped up (again, the enormous strength and power of the otter must be taken into consideration). Like many mustelids, otters seem to be attracted to tunnels, and, if the drop trap is properly covered by a fitted wooden box, will willingly explore it. The trap should be unobtrusively checked, using binoculars, every hour. Once the animal has been removed, the entryway should be firmly and permanently blocked. Any adult animals intended for translocation are not maintained at the CEI facility but translocated to a suitable site, not less than 15 miles away, as soon as possible after being trapped.

Design of permanent otter facility.

For the successful management of otters in captivity it is essential to provide them with sufficient food, clean running water, and a ratio of 2/3rd dry land to 1/3rd water. Water is essential for otters, both for their health and also to provide the public with the entrancing and educational sight of healthy happy otters behaving in a natural fashion. If the pool is an artificial one, the drain outlet should be designed in such a way that the otters cannot stop it up. Sufficient land, not a cement pit, is equally essential for the animal's well-being. Provided with the enrichment of sufficient land, running water, and ample food otters will repay their care, by providing a fascinating exhibit.

*I appreciate that handling without gloves is a difficult requirement within an accredited Zoo, but there are no gloves that can withstand the bite of a determined otter, but the contact or bond formed between keeper and animal, between bare hand and fur, is beyond price.

References

- Best, A. (1962), The Canadian otter, *Lutra canadensis*, in captivity. *Int. Zoo. Yb.* 4: 42- 44
Harris, C.J. (1968) otters, a study of the recent Lutrinae, Weidenfeld & Nicholson, 5 Winsley St, London, W1.UK
Liers E.E., 1958, Early breeding in the river otter. *J.Mammal.* 39:438-439, Liers, E.E.,1960, Notes on the breeding of the Canadian otter. *Int. Zoo Yb.* 2: 84-85.

REHABILITATORS with otter experience

(I am familiar with only a few of the rehabilitators listed in this section. If you have an orphaned otter you are encouraged to: 1) Place the animal with another animal already in rehab if at all possible. 2) Place the animal with someone who has had experience working with otters. 3) Notify the appropriate state wildlife authorities. 4) Keep in mind otters are difficult to raise in captivity and release, successfully, into the wild. If there is any hope of success they should not be raised with dogs and made comfortable with people.)

AnimalHelp.Com

jwitte@animalhelp.com

(678)428-3098

Jodi Witte – Jodi has a web site dedicated to identifying rehabilitators and their areas of expertise, because an endeavor of this nature is so dynamic please check her site for new listings.

Canada

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Cochrane Ecological Institute (CEI)

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Otter Listserve

To join this Listserve contact jrsotter@iserv.net

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SAMPLE EDUCATION PROGRAMS

“For zoos and aquariums looking to change people’s attitudes and behaviors about the environment, the challenge and the opportunity is to offer learning experiences through exhibits, visitor programs, classes and field programs that are engaging and fun for all ages.” (1)

In North America many people view otters as charismatic mammals. The phrase, “I love otters”, is frequently heard from zoo visitors. At the same time, the two species of otter found in North America, sea otter (*Enhydra lutris*) and river otter (*Lontra canadensis*), are frequently confused and misunderstood by a segment of the North American population. Additionally, although sea otters numbers were increasing for several years, there have been recent set-backs in this trend and while river otter populations are stable to increasing in much of their range, they are considered vulnerable to extirpated in other portions of their historic distribution. For these reasons, educational efforts to clarify the otter’s identity and role in their respective habitats is vital to the continued survival of these species in the next century.

“The potential for education...through zoos is quite staggering: conservative estimates suggest that the world zoo community...is visited by ten percent of the world’s population annually. Zoos also have egalitarian appeal, attracting a wide cross-selection of society, and therefore their potential educational influence is immense. However, this potential has yet to be realized; zoos are to a large extent the “sleeping giants of the wildlife education and conservation field.” (Anonymous)

Successful education programs all seem to follow a similar process: 1) Identification of the subject and goal of the educational effort, 2) Identification of the audience, or target group, for the educational message, 3) Identification of possible partners for funding and/or creation of the education program, 4) Creation of the education materials, 5) Use of the educational materials, and, 6) Evaluation of the program’s success.

A preliminary survey of AZA member institutions has revealed some “otter education” programs, a few of these are summarized below.

Brookfield Zoo

The Brookfield Zoo outside of Chicago, Illinois offers a wonderful education program called *Connections* geared toward students in the 4th through 6th grades. The *Wonders of our Wetlands* unit focuses on these objectives, 1) Learn to define wetlands, 2) Learn to recognize the biodiversity of wetlands, 3) Learn to identify the benefits of healthy wetlands, 4) Understand why the river otter is a good indicator of a healthy wetland.

The program is extensive, incorporating pre- and post-visit activities to prepare for, and supplement, the on-site experience. Some of the items included in the material sent out to teachers are guides for adults that will be accompanying the children, a variety of activity masters for pre- and post-visit use (e.g. otter obstacle course game), masters for Field Notebooks so each student can make notes while visiting the zoo, wetland habitat posters to be colored, and a slide show for pre-visit viewing. This program is available at a cost of about \$30.00 through the Brookfield Zoo Education office.

Lanis Petrik, School Program Manager, 3300 S. Golf Rd., Brookfield, Illinois 60513-1099 U.S.A. phone: 01-708-485-0263, fax: 01-708-485-3532, lpetrik@BrookfieldZoo.ORG.

Cincinnati Zoo

Otter Creek Exhibit – this is an area of the zoo that features several species found in similar habitats with the otter as the focal animal. In order to maximize their educational message without using a sledgehammer, the zoo has tried something a little different. Before visiting the zoo a family, or teacher, can log onto the zoo’s web site and download a “family guide” which gives them information, fun activities and further resources for otter knowledge.

WWW.CINCYZOO.ORG; Diane Silver, Distance Learning Coordinator, 3400 Vine St., Cincinnati, Ohio 45220 U.S.A. phone: 01-513-475-6130, fax: 01-513-559-7776, diane.silver@cincyzoo.org. Their family guide to the river otter exhibit is available at <http://www.cincyzoo.org/mainhtm/2ocefge.htm>. This guide has a great deal of useful information on otters and a number of fun, education activities that can be used anywhere, by anyone.

Tennessee Aquarium

“*Otessa Otter*”, an auditorium program for children up to eight or nine years old features a furry, larger-than-life river otter. Otessa is actually a staff member dressed in an otter costume whose purpose is to educate and entertain young and old visitors alike. The Otessa program shows students how otters have adapted to their semi-aquatic life and what they can do to help keep Otessa’s habitat clean by keeping trash and other pollutants out of the water.

Sandy Skorput, Director of Education, P.O. Box 11048, Chattanooga, Tennessee 37401-2048 U.S.A. phone: 01-800-262-0695 or 01-423-785-4032, fax: 01-423-267-3561, sjs@tennis.org.

Woodland Park Zoo

River Otter Ramblings classes at Woodland Park Zoo run about two hours and are for children ages four to five or six to eight. The program varies depending on the age group but generally follows this format. 1) Introduction and an otter coloring activity. 2) Circle time activity. This involves the true teaching component. The children are introduced to the two species of otters found in North America through the use of artifacts such as skulls, pelts, and rubber toys representing prey items. Concepts such as aquatic adaptations, lifestyle, threats to survival and conservation are also discussed. The key to making learning fun is making it participatory so the kids are encouraged to try different things. These activities include twisting around in their shirts to illustrate grooming and loose skin, curling forward and backwards on the rug to show flexibility, and darting between sounds to show what it is like to dodge cars or escape from frightening things. 3) Tour Northern Trails exhibit area where the children can see the otters, another Mustelid the Fisher, and wolves, bears and eagles all potential predators of otters. 4) Return to the classroom for a snack, otter craft project, otter stories and final questions.

Lincoln Park Zoo – “*Otter Waterways*” A week long youth camp program focusing on Chicago’s waterways.

REFERENCES – REHABILITATORS & RESOURCES

AZA (American Association of Zoos and Aquariums). 1999, *2020 Trend Report*, published by: AZA, 8403 Colesville Rd., Suite 710, Silver Spring, MD 20910-331, pp 27

CHAPTER 15

WEBSITES, ON-LINE EDUCATION, USEFUL ADDRESSES

OTTER EDUCATION SOURCES

River Otter Alliance (ROA). U.S. based organization dedicated to conserving all otter species and otter habitat, supporting otter research, and furthering public education on the status and behavior of otters. Educational boxes are available for loans to schools. <http://www.otternet.com/ROA/index.htm>

International Otter Survival Fund (IOSF). This organization is dedicated to the conservation of all 13 species of otter. They can be reached at iosf@otter.org and located at: <http://www.otter.org/>

Otternet.com. This web site is full of otter facts, news, links to other otter web sites, and a bulletin board for posting messages and questions by the general public. It can be found at: <http://www.otternet.com/>

Florida Otter Spotter site. This site offers some general otter information and a way to contribute information on otters sightings in Florida. <http://www.riverotter.org>

New York River Otter Project. Organization involved in the relocation and restocking of otters in New York state. <http://www.nyotter.org>

The Otter Habitat. <http://www.riverotters.org>

The Kildeer Countryside Virtual Wetlands Preserve, Illinois Wetlands. This web site offers good general information on otters and some excellent games for all ages. This site was developed in conjunction with the Brookfield Zoo. www.twingroves.district96.k12.il.us/Wetlands/RiverOtter/RiverOtter.html.

Cincinnati Zoo – Otter Creek Family Guide. The Cincinnati Zoo Education Department has done a fine job with this site. It provides an excellent introduction to their otter exhibit and other exhibits found in the same area as well as intriguing activities for families to do before, during and after a visit to the zoo. www.cincyzoos.org/mainhtml/2ocemain.htm.

Missouri department of Conservation Otter Pages. This web site is full of information on otters in Missouri and also has some excellent educational materials and games that can be downloaded. <http://www.conservations.state.mo.us/nathis/mammals/otter/info.htm>

Enchanted Learning.com. This site has an animal print out page for the river otter. <http://www.enchantedlearning.com>.

There are many more on-line resources, unfortunately, too many to mention all of them here.

PROFESSIONAL RESOURCES

Studbook Keeper: David Hamilton, Knoxville Zoological Gardens, PHONE: (423) 637-5331, ext. 362, FAX: (423) 637-1943, EMAIL: hamilton@knoxville-zoo.org

IUCN/SSC Otter Specialist Group E-mail Listserve. This service is divided into the following lists: General, Africa, Asia, Europe, North America, South/Central America for river otters, Otter Keeper (for captivity issues), and a separate list for those interested in sea otters. Contact jrsotter@iserv.net to join one of these lists, or to post an information request to a list.

American Association of Zoos and Aquariums (AZA). <http://www.aza.org/>

American Association of Zoo Keepers (AAZK). <http://www.aazk.org/>

International Species Information System (ISIS). A network of 500 zoos and aquariums from 54 countries that share information on more than one million specimens (living and dead). Web site can be found at: <http://www.worldzoo.org/> 12101 Johnny Cake Ridge Road, Bldg. A, Rm. 6, Apple Valley, MN 55124-8151. 952-997-9500. Fax: 952-432-2757. isis@isis.org

GENERAL CONSERVATION RESOURCES

IUCN or the World Conservation Union. <http://www.iucn.org/>

Biodiversity Conservation Information System (BCIS). “BCIS is a global partnership of a dozen conservation organizations that use Internet technology to leverage their data, information and expertise; providing ready access to the most current knowledge about biodiversity - location, distribution, trends and protective measures.” The Web site can be located at: <http://www.biodiversity.org>

TRAFFIC. Wildlife trade monitoring program run jointly by WWF, World Wildlife Fund for Nature and IUCN, The World Conservation Union. Web site can be found at: <http://www.traffic.org/>

Ramsar Convention on Wetlands. <http://www.iucn.org/themes/ramsar/>

Wetlands International - Created in 1995 by the integration of Wetlands for the Americas(WA), the International Waterfowl and Wetlands Research Bureau(IWRB), and the Asian Wetland Bureau creating a global network for the conservation of wetlands and wetland species. Web sites are as follows: **Americas** – <http://www.wetlands.ca/wi-a/wadex.html>.

CHAPTER 16

OTTER TALES and LEGENDS

Here are a sampling of otter tales and a poem. Unless otherwise noted, these tales were assembled by John Mulvihill, of the River Otter Alliance, from a variety of sources. The Otter can be found in numerous other tales from all around the world.

Assiniboine Tale

Why Crane's Feathers are Brown and the Otter Doesn't Feel the Cold

Once, a crane chick was born too late to fly south in the fall. The mother crane asked Otter to take care of her young one until spring. Otter took the little crane to her lodge. She kept a fire burning and fed the little bird from her stored food. She did not hunt because in those days her fur was not warm enough. Finally, at the end of winter she went to look for food. While she was gone, Cold stole the young crane and forced it to work for him, fanning coals with its wingtips until they were singed brown. Otter asked Thunder and Lightning to help her get the crane back. Thunder rumbled at Cold, while Lightning struck him down in front of his lodge. Then the spring rains came, and the mother crane returned for her child. The young crane said to Otter, "You saved me twice. In return, I give you this gift. In my wingtips I hold cold's magic. Your coat will be sleeker and warmer than any animal's. You will hunt and swim when the cold is great and the snow is deep." And so it was.

Nimipoo Tale

The End of the World

One autumn in the time of the animal kingdom, Itsayaya, the coyote, set out on a journey just as the aspens turned to gold. He wanted to get a supply of ripe choke cherries to dry for the winter. Wonderful fruit. Always grew just toward the little stream that emptied into the Roaring Snake River. Along the river bank, not far from where Roaring Creek empties into the Snake, lived the Kilosks, the otter and his wife. Now in those long ago days, the otters lived on dry land, not in the water as they do today. They built their homes in the banks of the rivers and creeks and only went into the water if they had to catch a fish.

As Itsayaya came to the camp of the otters, he saw a huge rack of crayfish drying in the sun. Itsayaya loved crayfish. He licked his lips as the delicious odor drifted toward him. He called to the otters, "*Hey there, otter! You have a fine lot of crayfish.*" "*Yes.*" said otter, "*we have worked hard for many moons to get enough for the winter.*"

Itsayaya looked longingly at the drying fish, "*I'm going up for choke cherries up by Lapwai Creek where the best fruit in these mountains is ripe right now,*" he said. "*I'll pick enough for you and your wife and trade them to you for some of your crayfish.*"

Kilosk, the otter, flipped his tail and laughed. "*Ho, ho! What a joke! We otters never eat chokecherries. Once my great-grandfather tried some and got a most painful stomach ache.*"

Itsayaya sat down near the drying rack. The crayfish smell was nearly driving him mad with hunger. "*Please, Kilosk,*" he pleaded, "*maybe the choke cherries wouldn't hurt you.*"

"*No, no, no! I will not eat chokecherries. My wife will not eat them. Otters never eat choke cherries.*" shouted Kiosk, the otter.

Itsayaya turned away and trotted up the river, but he could not forget those crayfish. As he hurried along he thought of another scheme. He turned around and ran back to the otter's camp. "Kilosk," called Itsayaya, "I have a big, cozy lodge in Siminikum. Why don't you both come and live with me?"

"And why should we do that?" asked the otter.

"We would have happy times there," said Itsayaya.

"Oh, yes, especially if we brought our winter food stores," said Kilosk's wife. "Go on, Itsayaya. My husband and I will stay here with our crayfish."

So once again Itsayaya, the coyote, left the otter's camp.

As he traveled up the Roaring River, the coyote could think of nothing but those delicious crayfish drying in the sun. Finally, when he could stand it no longer, he thought of another scheme. He turned around and ran back downstream.

"Run for you lives!" he shouted. "Hurry! The end of the world is coming. Run! Hide!"

The otters were terrified when they heard Itsayaya's cries. "Quick, let's dive into the water," cried Kiosk. "Maybe we'll be safe there."

So the otters dived into the deep river, where they live to this day, waiting for the end of the world that has never come.

Itsayaya, the coyote, rushed to the drying rack stuffed his knapsack with crayfish, and trotted off down the river to his lodge. And all otters still have trouble with the wily coyote who still tries hard to share in the fish that they catch.

Cherokee Tale

How Rabbit Tricked Otter And Other Cherokee Trickster Stories.
Gayle Ross 1994, Harper Collins, Publishers

How Rabbit Tricked Otter

Long ago, the animals did many of the same things that people do. They especially loved to dance. One time, the animals decided to hold a dance to honor the animal with the most beautiful fur coat. They called a great council, and they talked for a long time about whom to honor at the honor dance. Some animals had short fur, while others were covered with long, silky hair. Some animals had spots; some had stripes. Raccoon boasted of the stripes on his tail, and Skunk was especially proud of his brilliant black-and-white fur. But finally, it was decided that the animal with the most beautiful fur coat was Otter. Now, Rabbit was the messenger. This meant it was his job to travel up the river, tell Otter about the dance, and bring him back down to the council house. Rabbit knew that his own fur coat was nothing very special, although he was quite proud of the long curly tail Creator had given him. Nevertheless, it made him jealous that Otter was going to have an honor dance. As Rabbit traveled up the river to Otter's house, more and more he thought what a funny joke it would be if he could trick Otter into staying away from the dance and fool everyone into thinking that he was Otter. There was only one way to do that, and that was to steal Otter's fur coat. Rabbit reached Otter's house and told him about the dance. Otter is a very shy and humble fellow, and it made his heart feel good to know that the animals wanted to honor him in this way. He agreed to travel back down the river with Rabbit to the council house. They hadn't gone very far when Rabbit decided to camp for the night. "This is a sacred place," Rabbit said. "It will be good for you to sleep and dream in such a place the night before you dance. Something happens here that doesn't happen anytimes, at night, fire falls out of the sky. That's what they call this place -- the 'Fire Falling from the Sky Spot.'" Otter had never heard of the 'Fire Falling from the Sky Spot,' but then he had not traveled very much. He thought maybe Rabbit knew more about these kinds of things. And so he listened when Rabbit told him what to do. "Take off your fur coat," said Rabbit, "and hang it in a tree away from the river. You wouldn't want the falling fire to burn a hole in it. And when you go to sleep, lie

down right next to the water. *If the fire falls from the sky, jump in the river, and you will be safe.*" Otter took off his fur coat and hung it in a tree. And when he went to sleep, he stretched out right beside the river. Rabbit waited, and when Otter was sound asleep, Rabbit took a curved piece of bark and scraped all the coals from the campfire into it. Then, standing over Otter, he threw the coals into the air as high as he could. *"Fire, falling from the sky!"* cried Rabbit. Otter saw the coals raining down, and he jumped into the river. Rabbit snatched Otter's fur coat and ran. The next day, Rabbit was back at the council house, and there was no sign of Otter. When the sun went down, the fire in the council house was built into a great roaring blaze. The drums began to play, and the singers called for everyone to dance. Meanwhile, Rabbit disguised himself as Otter. First, he pulled down his long ears and tied them into a knot underneath his chin. Then he eased into Otter's coat. Rabbit thought he looked pretty good. He was just coming out to lead the honor dance into the council house when he remembered something. He stopped and thought about his nose, with that split running right down the middle. If the animals saw Rabbit's nose, they would know he wasn't Otter. So Rabbit put one paw over his nose, and that's how he danced all night long. When anyone asked him what he was doing, Rabbit just said, *"This is the latest dance."* And since everyone had gathered to honor Otter, they respected his strange dance, and pretty soon all the animals were dancing with one paw over their noses. Except for Bear. Bear was a good friend of Otter's, and all evening the idea grew in Bear's mind that this was not his friend. So when Bear saw his chance, he danced over to Rabbit and knocked that paw away. Everyone saw Rabbit's split nose, and with one voice, they screamed, *"Rabbit!"* Rabbit threw Otter's coat down and ran. But Bear was so angry that Rabbit would play such a mean trick on Otter that when Rabbit dashed by, Bear reached out with his great paw and snatched Rabbit's long, curly tail right off. The other animals took Otter's coat and began traveling up the river to look for him. They found Otter coming toward the council house, and he was glad to get his coat back. But he wasn't very sorry about missing his dance. Something new had come into Otter's life. Until Rabbit had tricked him into jumping into the river, Otter had never been swimming, and he discovered that he liked it better than anything else. So if you are looking for Otter's grandchildren, look in the rivers and the lakes and the streams. Because all the otters are living there still. And even now, you will see that Rabbit's grandchildren do not have the beautiful tail that Creator gave them. All that is left is a little white puff of fur.

Shawnee Tale

(As told by: Neeake "He-talks-as-he-flies" a.k.a. Fred Shaw)

Laughter is Born

The grandfathers say that long ago there was a person called Otter. His hair was long and dark. He was sleek, handsome, and slender. But for all that, he had never laughed, never smiled, for laughter had not been born into the world yet.

But there was one thing Otter could do. He could eat fish. He would eat fish when the sun was high in the sky. He would eat fish when the sun went down. Otter would eat fish if he woke up in the night. He loved fish.

But more than eating fish; Otter loved to go fishing. One day he picked up his fish spear and went to a high bank above a deep, cool pool in the stream. And there, hiding under a rainbow, was grandfather trout. Otter said, *"Ummm,"* and smacked his lips as he looked at Grandfather Trout. Otter raised his spear and...Grandfather Trout moved off to the side! *"Humph!!"* said Otter and raised his spear again and leaned farther from the bank. But Grandfather Trout just moved off to the side. *"Humph!"* Otter said again and raised his spear as he leaned further from the bank.

And...Whoops! Otter's feet went out from under him, and he fell headfirst into the mud, pushing up mud with his nose, hitting the water with a splash, and coming up from the water spitting a waterfall from his mouth.

He looked around very surprised, and there, on the end of his spear, was Grandfather Trout. Now Otter had never laughed, never smiled, for laughter had not been born into the world as yet. But when he thought of pushing up mud with his nose, hitting the water with a sploosh, spitting a waterfall from his mouth, and

finding Grandfather Trout on the end of his spear, something happened to Otter's body. His belly began to shake. And it shook, and it shook! And a sound came out of his mouth, "Cha!" He felt good. So he thought about it again, about pushing up mud with his nose, hitting the water with a sploosh, spitting a waterfall from his mouth, and finding Grandfather Trout on the end of his spear. Once again his belly began to shake. And it shook and shook until the sound came out, "Cha!" He felt very good.

So he decided to do it again. He laid Grandfather Trout down on the bank. He felt good, but he was not foolish. Then he ran toward the stream bank and dove headfirst into the mud, pushing up mud with his nose, hitting the water with a sploosh, and spitting a waterfall from his mouth. Again, the new sound came out, "Cha!" He felt very good, so he did it again and again and again.

Then he got hungry. He picked up Grandfather Trout and went back to his wigwam. Otter's wife was sitting outside. She was very beautiful. Her hair was long and dark like Otter's. The stars always shone in her eyes. But for all that, she never had laughed, never had smiled, for laughter had not been born into the world as yet.

But when she saw her husband coming toward her all covered with mud, dripping water, and making a sound with each step like, "squish, squish, squish," something happened to her body. Her eyes got big. She pointed, and her belly began to shake. A sound came out of her mouth, but not like Otter's. Hers was high and sweet, like the first sounds of the birds in the morning. "Ha, ha-ha-ha-ha-ha, hee-hee-hee-hee."

Otter, who had liked the new sound until now, wasn't sure he liked it anymore. But his wife said to him, "Oh, my wonderful husband, you are so tall, hee, so handsome, ha-ha-ha, so muddy, hee-hee-hee, so wet, hee-hee-ha-eee." She fell on the ground and rolled back and forth holding her sides until water came from her eyes. Before he quite knew what was happening, the same thing happened to Otter. They felt very good.

When they finally could get breath back into their bodies, Otter said to his wife, "My dearest, if you think you feel good now...You should push up mud with your nose!"

They both went to the stream, and they jumped down the bank pushing up mud with their noses, hitting the water with a sploosh!, and spitting waterfalls from their mouths. The new sound echoed up and down the valley. Everyone who heard it felt good.

Kiji Manito, the Great Creator, had been watching this. He said, "That's a good sound. We'll keep it." Then he said to Otter and his wife, "Because you have given this good gift to the world, I will give you a gift. Your hair, is all covered with mud; I will make fur with the color of the flesh of your mother, the earth. It will keep you warm in the coldest water. You can even play in the snow."

"And I will give you a power," Kiji Manito continued, "so you can swim as fast and with more twists than Grandfather Trout. You will always have plenty to eat and much time to play."

"This will be your gift to the world. Anyone who sees you, anyone who hears you, will learn to laugh."

Thus, laughter was born into the world, and Otter became as he is to this day. He still eats fish, and he plays in the mud. But most of all, he laughs!

Yukon otter legend

(from: Yukon Department of Renewable Resources web site, www.renres.gov.yk.ca/hunting.fur.html)

"Yukon First Nationals considered the spirit of the otter to be one of the most powerful characters in the animal world. Before the arrival of commercial trapping, people did not kill otters as it was considered bad luck to do so. The Tlingit believed that people who drowned turned into otter men. Because of its power, the otter was a favorite spirit helper of shamans."

The river otter in Navajo tribal culture

(from: Na'azheel, "The One's Who Hunt:." *The Role of Carnivores in Navajo Tribal Culture*. Steve Pavlik, Spavlik@aol.com; Paper presented at Defender's of Wildlife Carnivore 2000 conference, Denver, Colorado, November 2000. This is the section on otters. Reprinted with permission from S. Pavlik)

*"The River otter, *Lutra canadensis*, was once found in the northern limits of Navajo Country – along the entire length of the Colorado River, including a 1906 sighting at Lee's Ferry on the contemporary border of the Navajo reservation – and the San Juan River, as well as in the rivers and streams of Southwestern Colorado. Otters are now believed to be extinct in all of these areas today except for the Gunnison River where they were reintroduced in 1984.*

"The Navajo name for the otter is tqa'ba'astgin – probably from the words tqaba which means "the shore", and setqi which means "it lies" – in sum, an animal that lies by the shore. Otters are somewhat unique among the carnivores in that they are considered to be one of the "Water Creatures", and thus are more likely to be associated with beavers and frogs than with other meat-eating animals. In addition, since a general taboo existed in traditional times against eating fish, it is quite possible that Navajos did not consider the otter to be a "true" carnivore.

"In the Creation story the otter first appears in the Third World and along with Mountain Lion, Bear, and Big Snake, was one of the Chiefs of the Four Directions.

"Otters are especially associated with the Beautyway ceremony. In the Beautyway story Younger Sister encounters the Otter people at Slim Water Lake, then again at Scattered Springs. Big Snake, the principle protagonist in Beautyway, possesses an otter skin quiver. In one Beautyway sandpainting, a male otter is depicted along with other "Water Creatures". This sandpainting is used when a person has been thrown by lightning, drowned, or harmed in a corn, squash or tobacco field. The "Mountain Gods" in another Beautyway sandpainting, also wears otter skin collars.

"Otters also appear in the stories, and consequently, in the sandpaintings, associated with Mountainway, a ceremony closely related to Beautyway. One Mountainway sandpainting, "People with Long Hair", includes a brown otter. At least two other Mountainway sandpaintings, "The Long Bodies", and "Whirling Rainbow People", also depict figures wearing otter skin collars.

"In an important Navajo story the Hero Twins, Monster Slayer, and Child Born of Water, are tested by their father, the Sun, who attempts to freeze them. The brothers are saved when Beaver Man and Otter Woman give their skins to them. This story explains the importance of beaver and otter skin collars in traditional Navajo religion and ceremonialism. Navajo singers use such collars – with a cane reed whistle attached – for the purpose of summoning the Holy People during ceremonies. Beaver and otter skin collars are said to be one of the most powerful pieces of equipment for Shootingway singers. In addition, a Shootingway singer must always possess at least a small strip of otter skin in his Jish. In a Shootingway ceremony a screen is erected to which a male beaver collar is hung at the south end, and a female otter skin is hung at the north end. In a number of Shootingway sandpaintings, such as one entitled "Buffalo never Dies, the Holy People are also shown wearing otter skin collars.

"In another Navajo story Self Teacher is stuck in a log at a falls on the San Juan River. Offerings are made to the Water People, including Otter, for his release. In the same story Frog tells Self Teacher how to invoke himself with prayer sticks if any of the Water People, such as Otter, should ever give disease. Otter prayer sticks are brown in color.

"Both Calling God and Fringe Mouth wear otter tails as part of their dress.

"In addition to its fur, other body parts of the otter are used in various ceremonies. Otter fat, for example, is used by singers to clean their Jish. Otter fat mixed with charcoal, is also used to produce body paint for the "darkening rite" portion of some Navajo healing ceremonies.

“Otter also plays a major role in one of the popular “Coyote Stories” of the Navajos. In this story Coyote comes across a group of otters at play. The otters were betting their skins against one another on the results of the game. When one otter lost his skin, he would jump into the water and miraculously emerge with a new skin. After considerable pleading Coyote was finally allowed to participate in the game – and soon lost his skin. Jumping time and time again into the water, Coyote’s skin would not return. Finally taking pity on him, the otters place him into a badger’s hole which they then covered with earth. When he emerges, Coyote is again covered with fur, but it was coarse and rough, not the glossy fur he once had. Coyote has worn his new skin ever since.

“Otters were once considered to be “rare game” for the Navajos, that is an infrequent food source that allows itself to be caught and eaten in time of need.

“In the Navajo way the otter represents playfulness and happiness. In her kinaalda – the Navajo girl’s puberty ceremony, a girl who exhibits such traits, a girl who is well liked and for whom things in life come easily, a hair tie made of otter skin will be used. Otter and Mountain lion skins are also considered to be signs of wealth and are highly sought as possessions. In earlier times otter pelts were valued trade items and were usually acquired from the Pueblos of the northern Rio Grande River valley.”

Indian Fable

(from: Fables of India by Joseph Gaer 1955; An example of an otter tale from another country.)

The Otters and the Fox

Two otters were fishing one day and had the good fortune to catch a huge trout, three feet long and almost as heavy as they were. The trout put up a great fight and both otters were completely exhausted by the time they landed their fish.

When the trout was safely grounded, the two friends began to quarrel about how to divide their catch. They could not agree on who should get the head and who should get the tail, and to whom belonged the greater share.

Along came a fox and stopped to listen to their dispute. The two otters turned to him.

“We caught this great trout together”, they explained. “But we cannot agree on how to divide him between us. Will you help us make a fair decision?”

The fox said gravely: *“I have judged many cases like this, and I am known far and wide for my skill and fairness in such matters.”* The fox cut the trout in three parts, and asked: *“Who saw the trout first?”*

“I did”, said one otter.

“Then to you belongs the head”, said the fox, and gave him the head. He asked again: *“Who helped secure the fish on the ground?”*

“I did”, said the second otter.

“Then to you belongs the tail,” said the fox, and gave him the fish tail.

“But what of the body of the fish?” asked the otters.

“That is my share for acting as judge”, said the fox as he ran off with most of the great trout in his mouth.

When the fox arrived home, his wife exclaimed admiringly: *“My dear husband, how very clever you are! Tell me, how did you, a land animal, catch so great a fish?”*

"I caught him without having to go near the water", replied her husband. "I met two otters who knew how to catch fish together, but they did not know how to agree together when it came to dividing him. And their quarrel made me a better fisher than either of them."

Burmese Tale

(From: Burmese Folk Tales by, Helen G. Tracer, 1968; the animal identified as a coyote is probably a mistranslation.)

Partnership

An otter and a coyote lived near a river, and after awhile decided to form a partnership. They agreed that they would pool all the food each was able to gather, and that they would share it equally at the end of the day.

On the first day of their partnership, the otter caught some crayfish, and the coyote caught a carp. The food was shared equally, and the partners were satisfied.

On the second day, the coyote caught a fish stranded on the sand bar, but the otter had an off-day and could find nothing. Faithful to the agreement, the coyote shared the carp with the otter.

On the third day, the coyote had no luck at all, but the otter went fishing and succeeded in catching a huge trout. Now, as the otter was greedy, he announced, *"I will cut the fish into four parts. I will take the head and the belly, and you can take the rest."*

"Be fair" replied the coyote, *"I shared my catch equally with you yesterday"*.

"And I am sharing the fish equally with you, also", argued the otter. *"You will get two pieces and I will get two pieces"*.

"But you intend to take the tastier parts", protested the coyote.

"Remember, it is I who caught the trout". boasted the otter and they argued for a long time, getting nowhere, until they agreed to ask the mountain lion to help them settle their disagreement.

The wise mountain lion listened patiently to the evidence presented by each one. Then, taking a sharp stone, he cut the fish right down the center from head to tail into two equal parts. *"Now both of you shall have a piece of the fat belly"*, he explained *"and both of you shall have a piece of the tasteless tail"*.

So the otter and the coyote went away quite satisfied, and they lived in happy partnership for many days.

NATIVE AMERICAN MEDICINE WHEEL

REST AND CLEANSING MOON

(Otter)

20 January – 18 February



“Those born during the second moon of the year, the Rest and Cleansing Moon, have the otter as their totem in the animal kingdom, the quaking aspen tree as their plant totem, and silver as their mineral totem. Their color is silver, and they are of the Butterfly elemental clan. According to the Medicine Wheel, the dates of birth of these people are January 20 to February 18.” (Sun Bear & Wabun, 1980; *The Medicine Wheel Earth Astrology*; A Fireside Book, published by Simon & Schuster, New York, New York)

Otter people are generally well-liked and make good friends and very interesting companions. They also are considered to usually be, highly intuitive, emotional, malleable by nature, playful, bold, clever, helpful and gentle.

A Life of Joy

With the flow of bubbling water
Came the bobbing of his head
And he passed me by unnoticed
In the flow of the river bed
And then at once he seemed to wake
He stood on the sandy shore
Back up the bank he rolled and ran
Then floated by once more.

If there ever was an animal
Who spent his entire day
Making work so well achieved
Seem just like it was play
Then it must be this comedian
Who frolics in the wild
Who at first glance will prompt a laugh
Like a clown does to a child.

He barks and chirps and chases fish
And often picks a stone
To roll and toss and hide and find
He plays so well alone.
His coat is sleek and whiskers brisk
That face just can't be beat
And if you truly want to be amused
Then take a quiet seat.

He will glide beneath the water
The bubbles silver blue
And when he rises black and wet
He turns to look at you
He seems to be so well equipped
To live on land or water
I know few other joys in life
As great as watching otters.

Ken Jenkins

CHAPTER 17

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