NORTH AMERICAN RIVER OTTER

Husbandry Notebook, 4th Edition; Chapters 1 - 6

(Photo: Dave Mellenbruch)

NORTH AMERICAN (Nearctic)
RIVER OTTER *(Lontra canadensis)*
Husbandry Notebook, Section 1 Chapters 1 - 6©

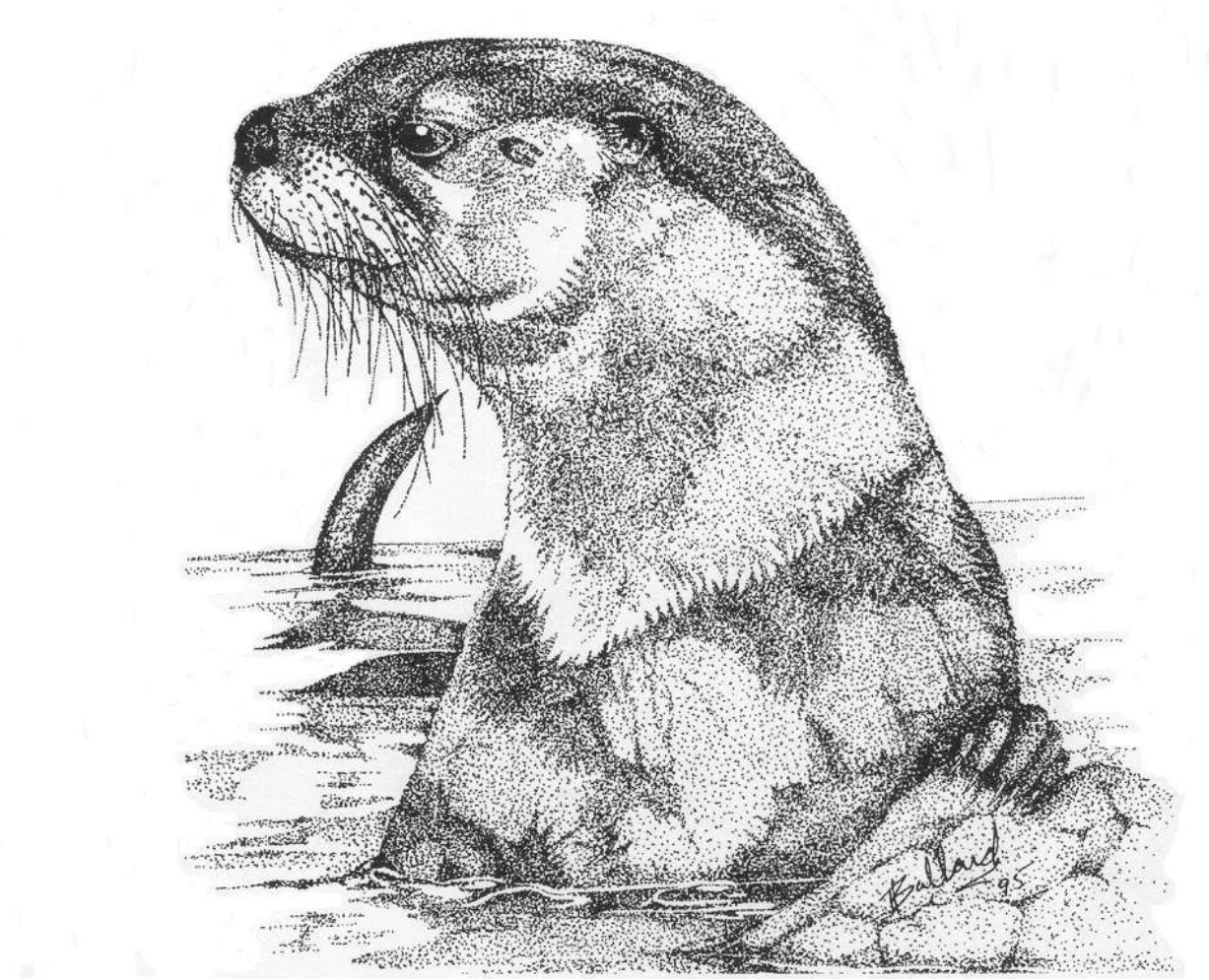
Edited & Written by:

Janice Reed-Smith
2012

Originally funded by:
John Ball Zoological Garden and Core Gorsuch Foundation

With the support of:

The AZA Small Carnivore Taxon Advisory Group



"Alacris ad ludos est."

"It is quick to play"

(Albertus Magnus, 13th Century teacher and naturalist)

North American River Otter Husbandry Notebook
4th Edition; Section 1, Chapters 1 - 6
Published 2012
Edition 1 published 1994
John Ball Zoo, Grand Rapids, Michigan

Jan Reed-Smith, Editor
jrsotter@iserv.net
Original Contributing Authors: Jan Reed-Smith, MA; Kris Petrini, D.V.M.; Lucy Spelman, D.V.M.; Gwen Meyers, D.V.M., Sue Crissey, Ph.D; Chip Harshaw; Angela Carter; Mac McFeely; Maris Muzzy; Clio Smeeton; John Partridge; Sheila Sykes-Gatz; **Significant Contributors to 2012 Edition:** Gwen Myers, D.V.M; Barbara Henry; Mike Maslanka; David Hamilton; Melanie Haire; Tanya Thibodeaux; Clio Smeeton; Christine Montgomery; Jessica Erhgott; Paige Morabito; Kevin McKay; Jan Reed-Smith.

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 shone 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
The River Otter Journal Vol. VIII, No. 2, Autumn 1999

Contributors

4th Edition

Thank you to all who contributed to the 1st and 2nd editions as well as the 1997 Husbandry Survey. Some of this information is still part of this edition. However, the 2nd edition is available on the IUCN Otter Specialist Group website and the original Otter Lore and other deleted sections can be found there.

Contributors to this new edition include: Helen Bateman, Gwen Myers, DVM, Melanie Haire, Tanya Thibodeaux, David Hamilton, Brian Helton, Lynn Hougle, Jennifer Mattive, Kristina Smith, Mike Maslanka, M.S., Barbara Henry, M.S., Monica Anderson, Nicole Barker, Rachael Chappell, Julie Christie, Kristin Clark, Erin Dauenhauer-Dacota, Erin Erbren, Bethany Gates, Katie Jeffrey, Maggie Jensen, Brett Kipley, Marcy Krause, Tara Lieberg, Hilary Maag, Christine Montgomery, Melissa Newkoop, Melanie Pococke, Josh Prince, Nancy Ramsey, Tami Richard, Karen Rifenbury, Jan Sansone, Ashley Snow, Alicia Striggow, Maicie Sykes, Janée Thill, Marla Tullio, Jen Wilson, Andrea Dougall, Victor Alm, Courtney Lewis, Bill Hughes, Jennifer Galbraith, and the Otter Keeper Workshop Attendees (2004, 2006, 2008, 2010. 2012). Thank you to the zoo and aquarium people who contributed photos and to the professionals who gave permission for use of their photographs: Dave Mellenbruch, Haley Anderson, Graham Jones, Gary Woodburn, Debbie Stika, and Herb Reed.

USER GUIDE

INTRODUCTION

***Lontra canadensis* is most commonly known as the North American river otter but also will be referred to here as the N.A. river otter, NARO, and Nearctic otter.**

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. Each edition should be used as a beginning point when looking for an answer to a particular otter problem or question. Our approach to captive husbandry should be as dynamic as the animals in our care. **This 4th edition includes updated information. Since publication of the last 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 enclosure, training and enrichment information have been included in this digital update of the NARO husbandry notebook. All deleted information and sections (e.g. North American River Otters in European Institutions) are still available in the 2nd edition. The 2nd and 4th editions are available at otterspecialistgroup.org, Otters in Zoos, etc. link (OZ Task Force – Otters in Zoos, Aquariums, Rehabilitation, and Wildlife Sanctuaries).**

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 however, it is recommended. 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. This new notebook has been split into three sections allowing the inclusion of more photos while trying to keep the file sizes manageable. They are as follows:

SECTION 1

SECTION 2

SECTION 3

Table of Contents

Table of Contents

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 (Koepfli 1998a, Koepfli and Wayne 2003).

Current Otter Taxonomy and Common Names

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

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

In 1776 Schreber created an engraving of an animal he called the "American otter". This name became the North American river otter and more recently the species has been referred to as the Nearctic otter; other English names include; otter, common otter, water dog, river otter, land otter and Fisher (this usage most likely started as a deliberate falsification). Common names in other languages include: Fischotter (German), loutre (French-Canadian), nutria norteamericana (Spanish), and lontra canadese (Italian). Native American names include: Neeg-keek (Chippewa), Ku-tet-tahx (Potawatomi), Cuilinguq (Yupik Eskimo), Kolta (Klamath), Nannocks (Wasco), Neekeek (Cree, Ojibway, Sauteax), Nit-sook (Naskapi), Nop'-e-ay (Chipewyan), Oshan (Choctaw), Pah-hua-pe'na (Keresan), Pahtsugo (Piute), Pat-cukee (Comanche), Pe-tang (Yantkton Sioux), Ptan (Ogallala Sioux), Saquenu'ckot (Algonquian), See-hah (Zuni), Un'-chuch (Montagnais), and Xyinixka (Biloxi) (Native American names taken from Melquist et al. 2003 citing original sources).

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 braziliensis, 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 pacifica*	*L.c. sonora*	*L.c. vancouverensis*
L.c. nexa	*L.c. degener*	*L.c. interior*	*L.c. mira*
L.c. brevipilosus	*L.c. periclyzomae*	*L.c. texensis*	*L.c. yukonensis*
L.c. optiva	*L.c. evexa*	*L.c. kodiacensis*	
L.c. chimo	*L.c. preblei*	*L.c. vaga*	
	L.c. extera	*L.c. lataxina*	

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
Lutra canadensis canadensis	*Lutra canadensis canadensis* Schreber 1776
L. c. degener	
L. c. kodiacensis	*L. c. kodiacensis* Goldman 1935
L. c. interior	*L. c. lataxina* Cuvier 1823
L. c. lataxina	
L. c. texensis	
L. c. vaga	
L. c. mira	*L. c. mira* Goldman 1935
L. c. vancouverensis	
L. c. brevipilosus	*L. c. pacifica* Rhoads 1898
L. c. evexa	
L. c. extera	
L. c. nexa	
L. c. optiva	
L. c. pacifica	
L. c. preblei	
L. c. yukonensis	
L. c. periclyzomae	*L. c. periclyzomae* Elliot 1905
L. c. sonora	*L. c. sonora* 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* Grinell 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."*

Hydrictini

***"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 where 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 (KOEPFLI & WAYNE 1998)

> *"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."* Additional information on the phylogenetic work carried out by Koepfli and Wayne available in their 1998, 2003, and Koepfli et al. 2008 publications.

References - Taxonomy

Baker, R. H. 1983. *Michigan Mammals*. Michigan State Univ. Press, East Lansing, Michigan

Corbet, G. B. & J. E. Hill, 1986. *A World List Of Mammalian Species*. British Museum and Cornell University Press, Ithaca, New York.

Davis, Joe, 1977. *A Classification Of The Otters, Summary Of A Revision In Progress*. Paper presented at the First Working Meeting of the IUCN/SSC Otter Specialist Group in Paramaribo, Suriname, 27 – 29 march, 1977.

Davis, Joe, 1978. *A Classification Of Otters*; In: *OTTERS*, Duplaix, N. editor, Proceedings IUCN Otter Specialist Group Meeting, Paramaribo, Surinam, 27 – 29 March 1977; IUCN Publication, New Series, Gland, Switzerland.

Hall, E. R. Ph.D., 1981. *The Mammals Of North America*. Vol. II, 2nd Edition. John Wiley & Sons, New York.

Hall, E. R. Ph.D. & K. R. Kelson, 1959. *The Mammals Of North America*. Ronald Press Co., New York.

Harris, C. J. 1968. *Otters, A Study Of Recent Lutrinae*. Weidenfeld & Nicolson, London, England.

Hershkovitz, P. 1972. *The Recent Mammals Of The Neotropical Region: A Zoogeographical And Ecological Review*. 311-421. In: Evolution, Mammals and Southern Continents. A. Keast, F. O. Erk, B. Glass, editors. New York State Univ. Press

International Species Information System (ISIS), 1999. *Mammal Taxonomic Directory*. Apple Valley, Minnesota. 12101 Johnny Cake Ridge Road, Bldg. A, Rm. 6, Apple Valley, MN 55124-8151. 952-997-9500. Fax: 952-432-2757. isis@isis.org

IUCN/Foster-Turley, P, S. Macdonald & C. Mason, eds., 1990. *Otters, An Action Plan For Their Conservation.* Kelvyn Press, Inc. Broadview, Il. Publ. Services – Chicago Zoological Society, Brookfield, Il.

Jenkins, J. H. 1983. *The Status And Management Of River Otter (Lutra canadensis) In North America*. Acta. Zool. Fennica 174:233 – 235.

Kellnhauser, J. T. 1982. *The Acceptance Of Lontra Gray For The New World River Otters*. Can. J. Zool. 61:278-279.

Koepfli, Klaus & Robert K. Wayne. 1998. *Molecular Phylogenetics Of Otters*. Unpublished working paper from Department of Organismic Biology, Ecology and Evolution, Univ. of Calif. at Los Angeles, CA 90095-1606.

Koepfli K-P, Wayne RK: 1998a. *Phylogenetic relationships of otters (Carnivora: Mustelidae) based on mitochondrial cytochrome b sequences*. J Zool (Lond) 1998, 246:401-416.

Koepfli K-P, Wayne RK: 2003. *Type-1 STS markers are more informative than cytochrome b in phylogenetic estimation of the Mustelidae (Mammalia: Carnivora)*. Syst Biol 2003, 52:571-593.

Koepfli, K. P., K. A. Deere, G. J. Slater, C. Begg, K. Begg, L. Grassman, M. Lucherini, G. Veron, and R. K. Wayne. 2008. *Multigene phylogeny of the Mustelidae: Resolving relationships, tempo and biogeographic history of a mammalian adaptive radiation*. BMC Biology 2008, 6:10 doi:10.1186/1741-7007-6-10. This article is available from: http://www.biomedcentral.com/1741-7007/6/10

Lariviere, Serge & L. R. Walton, 1998. *Lontra canadensis*. Mammalian Species No. 587, pp. 1 – 8. American Society of Mammalogists.

Pocock, R. I., 1921. *On The External Characters Of Some Species Of Lutrinae (Otters).* Proc. Zool. Soc. Lond. 1921:535-546.

Pohl, H. 1919, 1920. *Die Unterfamilie Der Lutrinae*. Arch. Naturgesch. 85 Ab. H. Heft 9:1-247.

Serfass, T. L., 1994. *Conservation Genetics And Reintroduction Strategies For River Otter*. An unpublished Ph.D. dissertation, Penn. State Univ., Happy Valley, Pennsylvania.

Sokolov, I. I., 1973. *Evolutionary Trends And The Natural Classification Of Otters (Lutrinae, Mustelidae, Fissipedia).* (In Russian.) Bull. Mosc. Nat. Soc. 78(6):45-52.

van Zyll de Jong, C. G., 1972.. *A Systematic Review Of The Nearctic And Neotropical River Otters (Lutra, Mustelidae, Carnivora).* Royal Ontario Museum, Life Sci. Contrib. 80:1-104.

van Zyll de Jong, C. G., 1987. *A Phylogenetic Study Of The Lutrinae (Carnivora; Mustelidae) Using Morphological Data*. Can. J. Zool. 65:2536-2544.

Wilson, D. E. & D. M. Reeder, 1993. *Mammal Species Of The World A Taxonomic And Geographic Reference*, 2nd Edition. Smithsonian Institution Press, Washington D. C. & London.

Wright, Clarence, 1988 *Otter Questionnaire*. Lincoln Park Zoological Gardens, 2200 N. Cannon Drive, Chicago, IL 60614.

CHAPTER 2 DISTRIBUTION

Introduction

Historically, along with the beaver and timber wolf, the Nearctic river otters occupied one of the largest geographic areas. This was an area that is estimated to have encompassed roughly 20 million km^2. Their range extended from 25° 08' N latitude in southern Florida to 68° 20' N latitude in northern Alaska and from 55° 30' W longitude in eastern Newfoundland to 162° 49' W longitude in western Alaska (Right map).

River Otter Distribution during the time of European settlement
From Pulliam 1955 & Hall 1981

By the late 1800's through the first half of the 1900's, the river otter rapidly disappeared from much of its former range. This disappearance was due to a variety of factors including over-trapping and hunting, general habitat degradation which included: pollution, agricultural development, and the drainage and canalization of water systems. By the late1970's, Nilsson & Vaughn (1978) estimated that the river otter was found in only 33% of its former range [in the U. S.]. By 1977 their distribution was <75% of the historic range. See map to left.

River Otter Distribution circa 1977
From Deems & Pursley 1978

Due to the efforts of conservationists and restrictions on trapping beginning in the 1970's and 1980's the otter has gradually reclaimed much of its former range. Wetland conservation, the Clean Water Act, and trapping restrictions also contributed resulting in a river otter distribution increase to roughly 75% of their historic range by 1988; making the river otter one of the success stories of the North American wildlife conservation movement.

SUBSPECIES

►*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.

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* is found on Kodiak and Afognak islands, Alaska. A smallish subspecies, the subspecific distinction is based on a combination of cranial details (Harris 1968).

►*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.

Total weight ranges from 7.25 kg. 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* is found in the Alexander Archipelago, Alaska (including the Prince of Wales' Island). This is the largest of the subspecies with a massive, broad, and somewhat angular skull (Harris 1968).

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

►*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. This is a large subspecies; weight ranges from about 8.8 kg. to 11.3 kg. (19 lbs. to 25 lbs.), and a total length up to about 1348mm (53 in.). This form has a very long hind foot (Harris 1968).

Lontra canadensis – Subspecies Map

***Lontra canadensis* Subspecies**

1. ***L. c. canadensis***
2. ***L. c. lataxina***
3. ***L. c. pacifica***
4. ***L. c. sonora***
5. ***L. c. mira***
6. ***L. c. periclyzomae***
7. ***L. c. kodiacensis***

References - Distribution

Baker, R. H. 1983. *Michigan Mammals*. Michigan State Univ. Press, East Lansing, Michigan

Corbet, G. B. & J. E. Hill, 1986. *A World List Of Mammalian Species*. British Museum and Cornell University Press, Ithaca, New York.

Davis, Joe, 1977. *A Classification Of The Otters, Summary Of A Revision In Progress*. paper presented at the First Working Meeting of the IUCN/SSC Otter Specialist Group in Paramaribo, Suriname, 27 – 29 march, 1977.

Davis, Joe, 1978. *A Classification Of Otters*; in OTTERS, Duplaix, N. editor, Proceedings IUCN Otter Specialist Group Meeting; IUCN Publication, New Series, Gland, Switzerland.

Foster-Turley, P, S. Macdonald & C. Mason, eds., 1990. *Otters, An Action Plan For Their Conservation.* Kelvyn Press, Inc. Broadview, Il. Publ. Services – Chicago Zoological Society, Brookfield, Il.

Hall, E. R. Ph.D., 1981. *The Mammals Of North America.* Vol. II, 2nd Edition. John Wiley & Sons, New York.

Hall, E. R. Ph.D. & K. R. Kelson, 1959. *The Mammals Of North America*. Ronald Press Co., New York.

Harris, C. J. 1968. *Otters, A Study Of Recent Lutrinae.* Weidenfeld & Nicolson, London, England.

Hershkovitz, P. 1972. *The Recent Mammals Of The Neotropical Region: A Zoogeographical And Ecological Review*. 311-421. In: Evolution, Mammals and Southern Continents. A. Keast, F. O. Erk, B. Glass, editors. New York State Univ. Press

International Species Information System (ISIS), 1999. *Mammal Taxonomic Directory*. Apple Valley, Minnesota.

Jenkins, J. H. 1983. *The Status And Management Of River Otter (Lutra canadensis) In North America.* Acta. Zool. Fennica 174:233 – 235.

Lariviere, Serge & L. R. Walton, 1998. *Lontra canadensis*. Mammalian Species No. 587, pp. 1 – 8. American Society of Mammalogists.

Nilsson, G. & A. S. Vaughan. 1978. *A turning point for the river otter.* National Parks and Conservation Magazine 52(4):10 – 15.

Serfass, T. L., 1994. *Conservation Genetics And Reintroduction Strategies For River Otter.* An unpublished Ph.D. dissertation, Penn. State Univ., Happy Valley, Pennsylvania.

Wilson, D. E. & D. M. Reeder, 1993. *Mammal Species Of The World A Taxonomic And Geographic Reference*, 2nd Edition. Smithsonian Institution Press, Washington D. C. & London.

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 measures included, 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 U. S. 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 the1990 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. Subsequent to this a questionnaire status survey was conducted by Serfass (2000) and a web search survey by Reed-Smith in 2012 (see N. A. River Otter (Lontra canadensis) – U. S. Wild Population Status – Table).

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.

During and since the 1994 survey results show 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. Pelt prices rose and fell somewhat during the late 1990's, became quite high in the early 2000's and is still (2012) at a fairly high level.

In recent years several states have reinstated an otter trapping season, including several states where reintroductions or stocking programs took place. The otter is considered a fur-bearer species in the United States so management to allow for trapping was most likely part of most state plans. At this time some states are doing a good job of monitoring trapping but, efforts could likely be improved upon in some areas. The price for an otter pelt in 2012 averaged about $70 with tanned skins or full pelts going for $249 or more (http://www.fursource.com/otter-fur-pelts-tanned-skins-p-375.html).

Editor's note: Trapping is very controversial; I personally do not condone it. However, as a wildlife professional I recognize that trapping fees, etc. are important resources to state management of wildlife. Also, trapping is an activity with a long tradition in many states. Some states are open about wanting a trapping season; others justify it by positioning otter populations as in danger of becoming too large and wiping out fish resources. This is not a sound assessment as populations are under many natural controls including habitat availability and environmental dangers such as injury, predation of young, roads, habitat loss, habitat fragmentation, dogs, etc. Some states have carried out diet analyses that indicate otters are taking far more crayfish than anticipated and that their overall impact on the status of game fish populations is minor. However, due to pressure from sport fishermen, based on the perception otters are impacting fish populations, otters have been trapped out of some watersheds. Caution should be exercised when portraying river otters as responsible for extensive fish depredation as a justification for trapping seasons.

N. A. River Otter (Lontra canadensis) – U. S. Wild Population Status - Table

STATE	IUCN OAP 1990	REED-SMITH 1994	SERFASS (2000)	REED-SMITH (2012)
Alabama	HP, SP	HP, SP	HP, IP	HP, US
Alaska	HP, SP	HP, SP	HP, SP	HP,
Arizona *	HNP, SP	HNP, SP, T	HNP, SM-RE, SS	HNP, DP, SS
Arkansas	HP, IP	HP, IP	HP, IP	HP, IP presumed
California	HNP, SP	HNP, SP, SS locally,	HNP, SP	HNP, SS
Colorado *****	HNP, DP	HNP, US, E	HNP, E	HNP, T, US
Connecticut	HP, SP	HP, IP	HP, IP	HP, SP
Delaware	HP, SP	HP, SP	HP, SP	HP, SP
Florida	HP, SP	HP, SP	HP, SP	HP, SP
Georgia	HP, IP	HP, IP	HP, IP	HP, SP
Idaho	HNP, SP	HNP, IP	HNP, SP-IP	HP, SP
Illinois *	HNP, US	HNP, IP, E	HNP, T	HNP. IP
Indiana *	Extirpated, US	HNP, E	HNP, E	HNP, SS, IP
Iowa*	HNP, IP	HNP, SP, SM, T	HNP, IP, T	HP, SP
Kansas *	HNP, IP	HNP, IP, SM	HNP, IP	HP, SP
Kentucky *	HNP, IP	HNP, IP, PM	HNP, IP, PM	HP, SP
Louisiana	HP, SP	HP, SP	HP, SP	HP, SP
Maine	HP, SP	HP, SP to IP	HP, SP	HP, SP
Maryland *	HP, IP	HP, IP	HP, IP	HP, SP
Massachusetts	HP, SP	HP, IP	HP, SP	HP, SP
Michigan	HP, SP	HP, SP	HP, IP	HP, SP
Minnesota*	HP, SP	HP, IP	HP, SP	HP, SP
Mississippi	HP, SP	HP, SP to IP	HP, IP	HP, SP
Missouri *****	HNP, IP	WL	HP, IP	HP, SP
Montana	HP, SP	HP	HP, IP	HP, SP
Nebraska *	HNP, IP	HNP, IP, E	HNP, E	HNP, E, IP
Nevada	HP, SP	HP & HNP (county dependent), SP	HP, SP	HP & HNP (allowed in 5 counties)
New Hampshire	HP, IP	HP, SP, U to C	HP, SP	HP, SP
New Jersey	HP, SP	HP, SP to IP	HP, SP	HP, SP
New Mexico*	HNP, US	extirpated	extirpated	SM, U
New York *****	HP, IP	HP, IP	HP, SP	HP & HNP, SP
North Carolina *	HP, IP	HP, SP to IP	HP, IP	HP, SP
North Dakota	HNP, IP	HNP, regarded as extirpated	HNP, extirpated ?	HNP,SM, SS
Ohio *****	HNP, SP	HNP, IP, E	HNP, IP, E	HNP & HP (by zone), SP
Oklahoma *	HNP, IP	HNP, IP	HNP, IP	HP, SP
Oregon *	HP, SP	HP, IP	HP, SP	HP, SP
Pennsylvania *****	HNP, SP	SS, IP	HNP, SS, IP	HNP, SS, IP
Rhode Island	HNP, IP	HNP, IP, PM	HNP, IP	HNP,
South Carolina	HP, SP	HP, SP	HP, IP	HP, SP
South Dakota*	HNP, US	HNP, US, T	HNP, T	HNP, T
Tennessee *	HNP, IP	HP & HNP, T in part, SP to IP	HP & HNP, IP, T	HP, SP
Texas	HP, IP	HP, SP	HP, IP	HP, SP
Utah *	HNP, US	HNP, US, SM, SS, SM	HNP,SP, SS	HNP, SM, PM
Vermont	HP, IP	HP, SP, C	HP, SP	HP, SP
Virginia*	HP, SP	HP, IP to DP dependent on area,	HP, SP-IP	HP, SP
Washington	HP, SP	HP, IP to SP dependent on area	HP, IP	HP, SP
West Virginia *	HNP, IP	HNP, PM	HNP, PM	HP, SP
Wisconsin	HP, IP	HP, SP to IP, C	HP, IP	HP, SP
Wyoming	HNP, IS	HNP, US to DP, PS, SM	HNP, PM	HNP, U, SS

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**; ***
Reintroduction, Restocking, or translocation projects have taken/are taking place/ or are under consideration.

State Specifics

The most current update was done utilizing the states' websites. Some were user friendly; others made it more difficult to locate trapping information. Most sites do not provide an assessment of current population trends so an assumption was made that at a minimum, were trapping is allowed, the population is stable.

Alabama: Little known about state distribution but considered of Least Conservation Concern. Trapping permitted during season which runs between November 10 and February 28.

Alaska: Harvest is permitted. Studies to better assess sustainable harvest level and population status are on-going. Otter season is broken down by region (known as Unit) as follows: Unit 1 – 4: December 1 – February 15; unit 5: November 10 – February 15, units 6, 9 to 11, 13, 14A & B, 16, 17, 18: November 10 – March 31; units 7, 14C, & 15: November 10 – February 29; unit 8: November 10 – January 31; units 12, 19 – 25,26A, 26B, 26C November 1 – April 15; There is no bag limit in any of these areas. (Taken from 2011- 2012 Alaska Trapping Regulations; http://www.adfg.alaska.gov/index.cfm?adfg=wildliferegulations.main). Fish & Game supported research in the early 2000's into better ways to assess river otter populations and sustainable trapping levels; one conclusion they reached is:

> *"The effects of oil contamination and logging on habitat use, movements, and food habits of river otters indicate these animals are sensitive to disturbance by humans. River otter response to these types of human disturbances and to others, such as harvest, construction of dwellings, and heavy recreational use, are important management considerations that need to be addressed."* (Golden 2004)

Arizona: Several otters from Louisiana were introduced in 1981 to 1983. Historically the L. c. sonora subspecies occurred in the Colorado and Gila rivers and their major tributaries. Listed as a state species of concern.

Arkansas: Hunting and trapping are permitted within season. Hunting and trapping seasons are: November12 – February 29 with a limit of two per day for hunting. No information could be found online regarding the status or assessment methodology.

California: Species listing does not appear to have been updated since 1998. No information available on population status.

Colorado: The state has an online otter observation report form intended to use citizen reports of sightings to assist with their management plan. Between 1976 and 1991 roughly 114 to 122 otters were released into Colorado. An additional 67 otters were released by Utah into the Green River near the Colorado border some of which may have crossed over. Survival of these released otters was approximately 60% for the first 3 months. No reliable methodology has been developed to assess current population status or increase.

Connecticut: Trapping is permitted, with a bag limit of 8, from November 4 – December 31 and January 1 – March 15.

Delaware: Trapping is permitted from December 1 – March 10. No information available on bag limit or methodology used to assess otter status.

Florida: Trapping is permitted from December 1 to March 1 (which means pups may be left in dens) with no bag limit. No information available on the Fish and Wildlife site regarding status of population or methodology used to assess sustainability of harvest.

Georgia: Trapping is permitted from December 1 to February 29 (which means pups may be left in dens) with no bag limit. No information available on the Fish and Wildlife site regarding status of population or methodology used to assess sustainability of harvest.

Idaho: A trapping season was reinstated in 2000. The season runs from November 1 (in some areas it begins October 22) – March 15 with a per person quota of 2. During the 2011 – 2012 trapping season 94 of a harvest quota of 125 were taken.

Illinois: Otters were listed as Threatened in 1977 and reclassified as Endangered in 1989. A restocking program was carried out between 1994 and 1997 when 346 Louisiana otters were released. This led to an upgraded listing to Threatened in 1999 and a delisting in 2004. The state Fish and Wildlife web site appears to be positioning the otter population as approaching saturation. This is likely a prelude to reinstating a trapping season.

Indiana: Between 1995 and spring of 1999, 300 otters were released in the state leading to a delisting as Endangered and their status as a species of special concern. At this time documentation from accidental mortality finds & sightings indicate an increasing population.,

North Dakota: On the state list of 100 Species of Conservation Priority; given a Level II listing which means they are in need of conservation but have support from other programs.

> *"Historically, river otters occurred in aquatic habitats throughout North Dakota. A combination of unregulated trapping, loss of wetlands and riparian habitat and susceptibility to pollutants resulted in the near-extirpation of otters from the state. In recent years, the number of otter sightings has increased, according to the NDGFD. However, it is not known if otters have re-colonized their former range or if a viable population exists in North Dakota."* (Hagen et al. 2005)

Threats facing otters in ND include:

- *"Habitat: The greatest threat to river otters is destruction or modification of riparian habitat for the purposes of economic or housing developments, recreation, or for conversion to cropland.*
- *Other Natural or Manmade Factors: Aquatic habitats where river otters have been sighted and other water bodies throughout North Dakota have documented pollution issues (i.e., dissolved oxygen, sediment, nutrient and heavy metal levels) that could impact survival of otters by reducing prey availability or impairing reproduction. River otters are susceptible to human-caused mortality, including incidental trapping and collisions with vehicles. In 2004, five of six reported otters were human-caused mortalities."* (Hagen et al. 2005)

Iowa: By the early 1900's there were very few otter sightings in most of the state. A small remnant population was known to exist along, and adjacent to the Mississippi River in northeastern and central Iowa. Reintroduction efforts were begun in 1985 and continued through 1990 with a total release of about 222 otters. In 1997 and 1998 otters were released into two additional watersheds. The river otter was delisted from the state threatened list in 2001 but still received some protected status until the first trapping season in 2006 – 2007 (with a statewide limit of 400 and an individual bag limit of 2). Between 2002 and 2004 some otters were live trapped and translocated to under-populated areas within the state. The statewide quota was raised to 500 for the 2008 – 2009 season (7 November – 31 January) with an individual bag limit of 2; this was increased to a statewide quota of 650 and a personal bag limit of 3 for the 2011-2012 season. http://www.iowadnr.gov/Portals/idnr/uploads/Hunting/2010_logbook.pdf shows maps of each county and trapping takes.

Kansas: As has been reported from much of the otter's historic range the river otter had mostly disappeared from Kansas by the early 1900's; the last reported otter was trapped near Manhattan in 1904. Otters (17 animals) were released into the state from 1983 to 1985. Beginning in 2011there is a provisional trapping season from 14 November to 31 March with a statewide limit of 100 otters and a per person limit of 2.

Kentucky: The 2011 – 2012 trapping season ran from 4 November – 29 February (which means females may have cubs in the den). Between 1991 and 1994 335 otters were released in the eastern and central portions of the state. The first experimental trapping season was opened in 2004 and between 2006 and

2008 a study was contracted to assess the otters' status within the state. Currently the bag limit is 6 per individual; hunting with guns and dogs is permitted.

Louisiana: The most recent trapping season ran from 20 November 2011 to 31 March 2012 (which means females may have cubs in the den). No information could be found regarding bag limits on the state's website.

Maine: The most recent trapping season ran from 30 October to 31 December 2011 statewide. During the 2010 season 754 otters were taken; dating back to 2003 the highest number of otter taken in one year was the 2005 season with a harvest of 1,041. There is no state bag limit during the trapping season.

Maryland: Most of the state has an open (no limit) trapping season for otter. There is a proposed, limited (bag limit of 1) for the last two counties where otter populations were the lowest. This proposal is to take into account accidental trapping in beaver sets. In the 1990's otter were trapped within the state and translocated to a three-county area where their numbers had dwindled throughout the 19th century and early 20th century.

Massachusetts: Trapping is permitted from 1 November to 15 December. Otter trapping is permitted statewide with no state quota or individual bag limit.

Michigan: Trapping is permitted from 25 October to 15 April in the Upper Peninsula (Unit A) with a bag limit of three. Unit B season runs from 1 November to 15 April with a limit of 2 and in Unit C (lower third of the state) runs from 10 November to 31 March with a limit of one otter per trapper.

Minnesota: Trapping is permitted 27 October to 5 January in the northern zone, there is no season posted for the southern zone for otter. They estimate that roughly 2,000 otters are trapped each year from a population of about 12,000.

Mississippi: Trapping is permitted, without a bag limit, between 1 November and 28 February (which means females may have cubs in the den).

Missouri: Trapping is permitted between 15 November and 20 February (which could mean cubs left in the den). There is no limit. During the 1980's and 90's over 800 otters were introduced into the state.

Montana: Trapping is permitted statewide between 1 November and 15 April with a bag limit of two otters per person.

Nebraska: In 1986 the river otter was given a state listing of Endangered. Between 1986 and 1991 otters were released into seven sites. The Nebraska Fish and Game website was one of the easier to use and offered some interesting facts about the disappearance of the river otter nationwide:

> "*The take of river otters listed in the records of fur trading companies, including the famous Hudson's Bay and Northwest companies, indicate that otter harvest peaked in about 1800 when some 65,000 otters were taken in North America. Otter take gradually declined to a low of about 4,500 in 1904, about the time otters disappeared from Nebraska. Unregulated trapping was probably the most important factor leading to the complete disappearance of otters from Nebraska. For about the next 75 years, few otters were reported from Nebraska, and none were verified." In 1977, an otter was inadvertently trapped along a tributary of the Republican River in Furnas County. Otters continued to be reported in various parts of the state, mainly in the Republican River drainage. Because otter sightings were infrequent and no concentrations of animals were ever found, it is likely the animals observed since 1977 were transients rather than part of an established population. Although otters are endangered and fully protected* [no longer protected] *in Nebraska and are uncommon in neighboring states, they are relatively abundant in Alaska, most of Canada, the Pacific Northwest, the Great Lakes states and most states along the Atlantic Coast and Gulf of Mexico. Currently, about half the lower 48 states, Alaska and all the Canadian provinces have otter trapping seasons. In some recent years, more than 50,000 otters have been taken in North America. The otter harvest in Louisiana sometimes exceeds 10,000*

animals, usually surpassing that in any other state. Although otters are common in many areas, their population densities, as predators near the top of the food chain, never approach those of animals lower on the food chain."

Nevada: Trapping is allowed in five counties only. The season runs from 1 October to 31 March.

New Hampshire: There is a trapping season the timing of which varies somewhat with the location in the state; either 15 October or 1 November to 10 April. The seasonal bag limit is 10 per trapper.

New York: Trapping is permitted in areas of the northeast and southeast of the state. The northeast season runs from 1 November to 7 April and in the southeast from 10 November to 28 February. There are no bag limits in these areas.

New Mexico: River otters were believed extirpated from New Mexico with only an occasional sighting of what were believed to be transient animals from neighboring states. Lobbying for reintroduction of the otter began in the 1980's with a feasibility study begun in the early 2000's and approved in 2006. The first reintroductions of otters were slated to occur in 2008 but may have been put on temporary hold. At this time they are considered a protected fur bearer species.

North Carolina: Trapping is permitted, dependent on location within the state, between 1 November or 1 December and 28 February. Despite the statement on their website that trapping season is designed to take females when young are independent this is most likely inaccurate as young may be born as early as February and will still be dependent on the female. The website does not list bag limit.

Ohio: Trapping is permitted in two zones between 26 December and 29 February. Trapping is not permitted in Zone A (roughly the western half of the state), a bag limit of one is allowed in the central region (Zone B) and a limit of three is allowed in the eastern portion of the state (Zone C). Beginning in 1986, 127 otters were released over the next 7 years. After reintroducing otters the first trapping season was held in 2005 – 2006.

Oklahoma: Trapping season, open in certain counties, runs from 1 December to 29 February with a season limit of two. There are rule change proposals under consideration for the 2012 – 2013 season that would open otter trapping statewide and raise the limit to 4. Otters were reintroduced to the state in the late 1980's.

Oregon: Trapping is permitted from 15 November to 15 March throughout the entire state except one county and all areas closed to beaver trapping. No information available on bag limit.

Pennsylvania: The otter is listed on the state's list of Species of Greatest Conservation Need as a species of Maintenance Concern because the population is still re-establishing itself after becoming extirpated and then reintroduced beginning in the 1980's.

Rhode Island: Harvest is not permitted; unable to locate species status.

South Carolina: Harvest is permitted from 1 December to 1 March (which means dependent young could be left in the den). No information on quotas could be found.

South Dakota: Listed as a State Threatened Species.

Tennessee: Trapping allowed from the Friday before Thanksgiving until 15 February (which means dependent young could be left in the den). There is no bag limit.

Texas: Trapping is permitted, difficult to find details.

Utah: River otter were never very common in Utah and have been legally protected since 1899 when the reduction of the population from historic levels was first reported. Trapping is not permitted and in 1989

otters were first reintroduced into the state. This re-stocking of otters has taken place periodically throughout the years since.

Vermont: Trapping is permitted between 27 October and 28 February.

Virginia: Trapping is permitted from 1 December to 29 February (which could leave dependent cubs in the den). There is a bag limit of 2 west of the Blue Ridge and no bag limit in counties east of the Blue Ridge.

Washington: Trapping is permitted from 1 November to 31 March with a bag limit of 12.

West Virginia: The river otter was first given protection in 1925. While occasionally observed through the late 1950's it is believed the population was too low to be self-sustaining. West Virginia was one of the first states to successfully reintroduce otters. This introduction effort ran from 1984 to 1997 (245 otters). A trapping season was proposed for the 2011/2012 year which ran from 5 November to 29 February with a possession limit of one.

Wisconsin: Trapping season varies slightly with location; typically ranges from early November to 31 March in the southern and central part of the state and until 30 April in the northern part of the state.

Wyoming: River otter are considered an uncommon non-game species and given a listing of NSS4 (native species of special conservation status, level 4) in the 2009 state atlas and relisted as NSSU in a 2010 listing. The following map shows believed distribution of the species within the state. (http://gf.state.wy.us/web2011/Departments/Wildlife/pdfs/SWAP_NORTHERNRIVEROTTER0000518.pdf

Raesly (2001) published the results of her status survey done in 1998.

Table: N. A. River Otter (Lontra canadensis) – Canadian Wild Population Status
(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 & 2012
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	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.**

Cites Listing and IUCN Red 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). This species is currently listed as Least Concern by the IUCN/SSC.

"*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)*

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, wetlands continue to disappear, and habitat fragmentation accelerates. (See also Native American Tales and Legends)

Ex-Situ Status and Studbook Information

The N. A. River Otter Studbook Keeper, David Hamilton (General Curator, Seneca Park Zoo), has provided the following information (Hamilton 2012). As of 2 July 2012 there were 270 (145.125.0) river otters held in 110 AZA institutions participating in the studbook. Studbook information is continuously updated and refined to provide the most accurate current and historical record of the *ex-situ* Nearctic otter population.

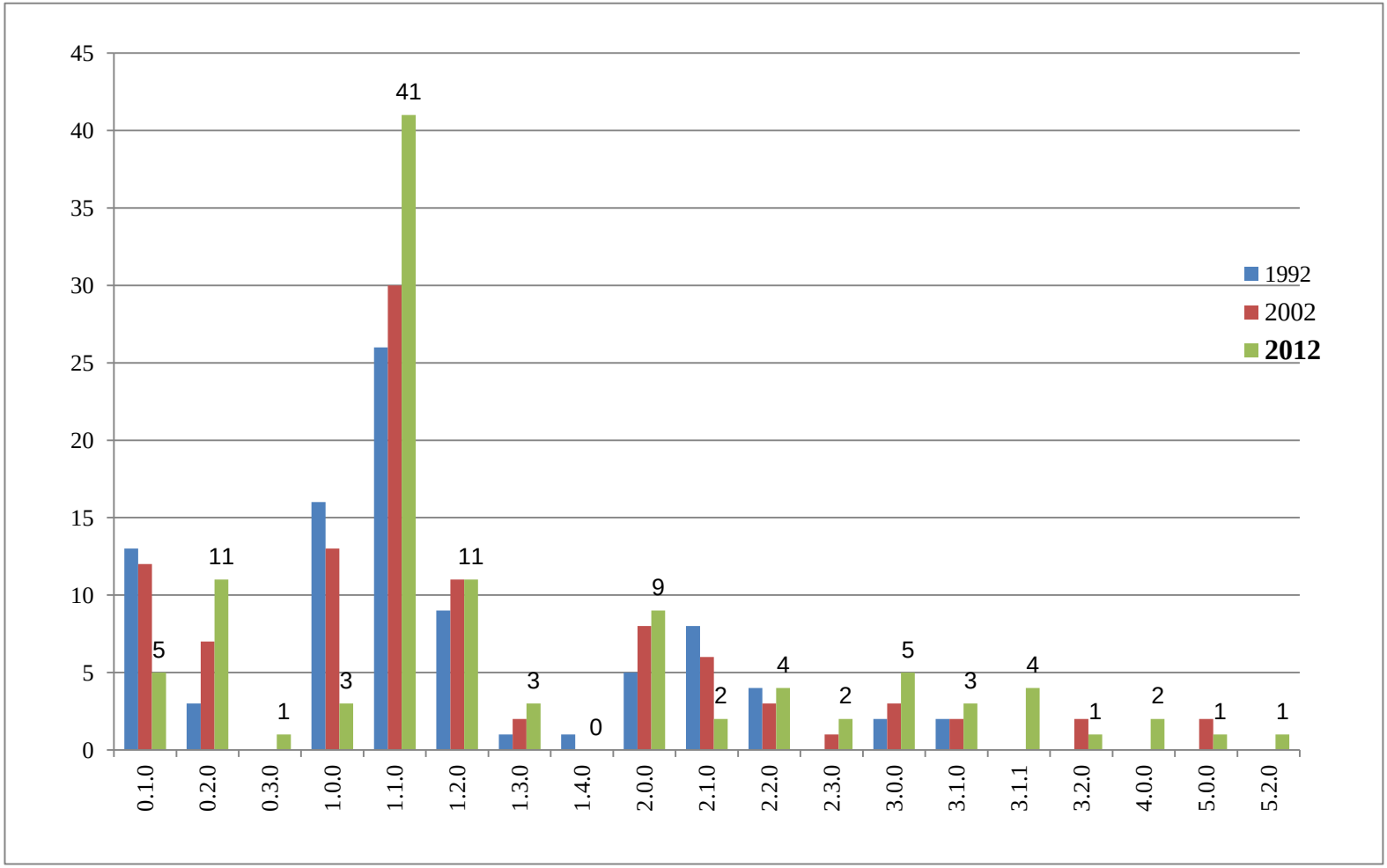
GROUPINGS HELD

Snapshot of otter groups held in AZA institutions on 01 January of each 10 year period. The data is presented in chart and then graph formats.

Otter Group Held (M.F.U)	# Institutions 1/1/1992	# Institutions 1/1/2002	# Institutions 1/1/2012
0.1.0	13	12	5
0.2.0	3	7	11
0.3.0	0	0	1
1.0.0	16	13	3
1.1.0	26	30	41
1.2.0	9	11	11
1.3.0	1	2	3
1.4.0	1	0	0
2.0.0	5	8	9
2.1.0	8	6	2
2.2.0	4	3	4
2.3.0	0	1	2
3.0.0	2	3	5
3.1.0	2	2	3
3.1.1	0	0	4
3.2.0	0	2	1
4.0.0	0	0	2
5.0.0	0	2	1
5.2.0	0	0	1
Total Institutions	90	102	109
Year	1/1/1992	1/1/2002	1/1/2012
Total Otters M.F.U (total)	99.88.0 (187)	123.105.0 (228)	142.127.0 (269)

M.F.U = Males.Females.Sex unknown

Nearctic Otter Group Composition (male.female.unknown) Held by AZA Institutions as of 01 January of each 10 year period.



DAM INFORMATION

71 reported dams, with 175.147.50 (372) offspring (not including 406 offspring of UNK/MULT dams)

Litter Size

Median size: 3 Mean size: 2.657

Litter Size	Frequency	Percentage
1	30	21.43
2	30	21.43
3	45	32.14
4	28	20.00
5	7	5.00
Total	140	100.00

Dam Age at First Reproduction

Median age: 4.983 Mean age: 5.35

10 Youngest Dams Age at First Reproduction:

Studbook ID	Age At Birth	Dam's Birth Date	Estimate	First Offspring's ID
2216	1.988	3/5/2004	None	2250
1321	2.001	1/1/1979	Year	1391
1291	2.721	6/1/1977	Year	1366
2376	2.776	4/1/2007	Day	2391
1171	2.979	4/2/1972	None	1240
1848	3.023	1/22/1995	None	1951
1591	3.034	3/1/1988	Month	1699
2300	3.064	3/2/2007	None	2411
1712	3.091	11/22/1991	None	1827
1408	3.19	1/1/1982	None	1494

10 Oldest Dams Age at First Reproduction:

Studbook ID	Age At Birth	Dam's Birth Date	Estimate	First Offspring's ID
1559	11.874	4/7/1987	None	1985
1606	10.163	1/1/1989	Year	1988
1162	10.111	1/1/1972	Year	1415
1285	10.015	4/1/1977	Month	1559
1831	9.969	12/31/1994	Month	2218
1431	8.246	1/1/1983	None	1703
1579	8.126	1/1/1988	Year	1887
1999	8.044	12/15/1999	None	2333
1986	7.951	2/20/1999	None	2276
2209	7.904	5/1/2003	Month	2439

Dam Age for All Reproduction

Median age: 6.097 Mean age: 6.562

10 Oldest Dams to Have Reproduced

Studbook ID	Age At Birth	Dam's Birth Date	Estimate	Offspring's ID
1377	13.966	4/1/1980	Month	1810
1893	13.057	3/1/1996	None	2366
1393	12.999	1/1/1981	Year	1800
1285	12.983	4/1/1977	Month	1655
1285	11.967	4/1/1977	Month	1618
1377	11.937	4/1/1980	Month	1731
1559	11.874	4/7/1987	None	1985
1893	11.069	3/1/1996	None	2287
1618	11.064	3/20/1989	None	2040
1606	10.163	1/1/1989	Year	1988

10 Dams with Most Offspring

Studbook ID	# of Offspring
1893	25
2216	25
1377	20
1940	19
1712	16
1541	14
1647	11
1618	10
1710	10
1859	9

10 Shortest Inter-birth Intervals

(Intervals are calculated from the last of a litter to the first of the next litter.)

Studbook ID	Interval (Days)	Offspring1	Birth Date	Birth Date Est.	Offspring2	Birth Date	Birth Date Est.
1616	327	2139	4/1/1994	None	1849	2/22/1995	None
1377	339	1597	4/30/1988	None	1620	4/4/1989	None
1616	346	1779	4/20/1993	None	2138	4/1/1994	None
1712	346	1829	12/25/1994	None	1867	12/6/1995	None
1859	346	2074	3/17/2002	None	2147	2/26/2003	None
1291	352	1369	2/20/1980	None	1398	2/6/1981	None
1893	354	2047	3/24/2001	None	2048	3/13/2002	None
2216	354	2303	3/2/2007	None	2371	2/19/2008	None
2216	356	2403	3/9/2010	None	2432	2/28/2011	None
1969	356	2126	3/28/2003	None	2185	3/18/2004	None

Birth Seasonality

First of litter must have a birth date estimate of None, Day, or Month to be counted.

Month	Number of Litters	Percentage
January	14	10.07
February	22	15.83
March	62	44.60
April	24	17.27
May	1	0.72
June	0	0.00
July	0	0.00
August	1	0.72
September	0	0.00
October	0	0.00
November	2	1.44
December	13	9.35
Total	139	100.00

SIRE INFORMATION

57 reported sires, with 143.118.37 (298) offspring (All ages are at dam conception)

Sire Age at First Reproduction

Median age: 5.216 Mean age: 6.279

10 Youngest Sires Age at First Reproduction:

Studbook ID	Age At Estimated Conception	Sire's Birth Date	Estimate	First Offspring's ID
1241	0.934	3/26/1975	None	1280
1741	1.136	11/1/1992	Month	1825
2316	1.93	1/3/2006	Month	2344
1526	1.958	4/5/1986	None	1618
1754	2.04	2/1/1993	Month	1887
2147	2.059	2/26/2003	None	2271
1521	2.097	3/1/1986	Month	1625
2149	3.012	2/26/2003	None	2300
2130	3.014	2/15/2001	Day	2225
2230	3.053	2/28/2005	Day	2345

10 Oldest Sires Age at First Reproduction:

Studbook ID	Age At Estimated Conception	Sire's Birth Date	Estimate	First Offspring's ID
1581	17.136	1/1/1988	Year	2249
1537	14.99	4/1/1987	Month	2126
1313	14.163	1/1/1978	Year	1759
1184	13.216	1/1/1973	Year	1557
1904	12.227	1/1/1997	Year	2411
1766	11.962	3/17/1993	None	2253
1532	11.222	12/1/1986	Month	1985
1175	9.344	7/16/1972	Year	1427
1604	9.164	1/1/1989	Year	1988
1161	9.112	1/1/1972	Year	1415

Sire Age for All Reproduction

Median age: 7.084 Mean age: 7.864

10 Oldest Sires to Have Reproduced

Studbook ID	Age At Estimated Conception	Sire's Birth Date	Estimate	Offspring's ID
1581	17.136	1/1/1988	Year	2249
1720	16.222	1/1/1992	Year	2366
1263	16.214	1/1/1977	Year	1810
1604	16.175	1/1/1989	Year	2254
1537	16.044	4/1/1987	Month	2190
1766	16.005	3/17/1993	None	2413
1537	15.964	4/1/1987	Month	2185
1480	15.214	1/1/1985	Month	2023
1537	14.998	4/1/1987	Month	2127
1537	14.99	4/1/1987	Month	2126

10 Sires with Most Offspring

Studbook ID	# of Offspring
1720	25
2149	22
1604	16
2098	11
1741	11
1263	10
1609	10
1466	10
2130	10
1580	10

References - Status

AZA (American Association of Zoos and Aquariums), 1994. *Manual Of Federal Wildlife Regulations. Vol. Two (B): Laws & Regulations*. pg. Intro-131. Bethesda, Maryland

Baker, R. H. 1983. *Michigan Mammals*. Michigan State Univ. Press, East Lansing, Michigan

Corbet, G. B. & J. E. Hill, 1986. *A World List Of Mammalian Species*. British Museum and Cornell University Press, Ithaca, New York.

Foster-Turley, P, S. Macdonald & C. Mason, eds., 1990. *Otters, An Action Plan For Their Conservation*. Kelvyn Press, Inc. Broadview, Il. Publ. Services – Chicago Zoological Society, Brookfield, Il. IUCN/SSC Otter Specialist Group.

Golden, H.N. 2004. *Furbearer Management Technique Development; Research Final Report 1 July 2001 – 30 June 2004.* Alaska Department of Fish and Game, Division of Wildlife Conservation. http://www.adfg.alaska.gov/static/home/library/pdfs/wildlife/research_pdfs/fur-mgt04.pdf.

Hagen, S., P. Isakson, S. Dyke. 2005. *North Dakota Comprehensive Wildlife Conservation Strategy*. North Dakota Game and Fish Department. http://gf.nd.gov/conservation/cwcs.html.

Hall, E. R. Ph.D., 1981. *The Mammals Of North America*. Vol. II, 2nd Edition. John Wiley & Sons, New York.

Hall, E. R. Ph.D. & K. R. Kelson, 1959. *The Mammals Of North America*. Ronald Press Co., New York.

Hamilton, D. 2011. *REPRODUCTIVE REPORT North American river otter Studbook* (*Lontra canadensis*) North American Regional Studbook Studbook. Studbook data current as of 11/16/2011. Compiled by David B. Hamilton; dhamilton@monroecounty.gov. PopLink Studbook filename: riverotter_2011_with2010overlay_17May12; PopLink User Who Exported Report: dhamilton. Date of Export: 5/22/2012. PopLink Version: 2.3

Harris, C. J. 1968. *Otters, A Study Of Recent Lutrinae*. Weidenfeld & Nicolson, London, England.

Hershkovitz, P. 1972. *The Recent Mammals Of The Neotropical Region: A Zoogeographical And Ecological Review*. 311-421. In: Evolution, Mammals and Southern Continents. A. Keast, F. O. Erk, B. Glass, editors. New York State Univ. Press

ISIS (International Species Information System), *Lontra canadensis Species Abstract 31 December 1999*. 12101 Johnny Cake Ridge Road, Bldg. A, Rm. 6, Apple Valley, MN 55124-8151. 952-997-9500. Fax: 952-432-2757. isis@isis.org

Jenkins, J. H. 1983. *The Status And Management Of River Otter (Lutra canadensis) In North America*. Acta. Zool. Fennica 174:233 – 235.

Lariviere, Serge & L. R. Walton, 1998. *Lontra canadensis*. Mammalian Species No. 587, pp. 1 – 8. American Society of Mammalogists.

Melquist, W. E. & M. G. Hornocker. 1983. *Ecology of River Otters in West Central Idaho*. The Wildlife Society Monographs, No. 83, 60p.

Nilsson, G. & A. S. Vaughan. 1978. *A turning point for the river otter*. National Parks and Conservation Magazine 52(4):10 – 15.

Park, E. 1971. *The World of the Otter.* J. B. Lippincott Co., New York.

Raesly, E. J. 2001. *Progress and Status of River Otter Reintroduction Projects in the United States*. Wildlife Society Bulletin 29(3):856-862.

Reed-Smith, J. 1994/95. *North American River Otter, Lontra canadensis, Husbandry Notebook*. John Ball Zoo, Grand Rapids, MI 49504

Reuther, C. 2000. *Status Of Otters In The World, With Special Reference To Their Popularity And To Education And Public Relations Activities For Their Conservation*. In: Proceedings of the Workshop on CONSERVATION AND PUBLIC AWARENESS OF OTTERS. National Museum of Nat. Sci., Taichung, ROC & Tatachia Visitor Center, Yushan Nat. Park, ROC. 09 – 12 December 1999. C,. Santiapillai & H. Sasaki editors. Otter Research Group, Japan, email: i79677g@wisdom.cc.kyushu-u.ac.jp (Sasaki).

Serfass, T. L., 1994. *Conservation Genetics And Reintroduction Strategies For River Otter*. An unpublished Ph.D. dissertation, Penn. State Univ., Happy Valley, Pennsylvania.

van Zyll de Jong, C. G., 1972.. *A Systematic Review Of The Nearctic And Neotropical River Otters (Lutra, Mustelidae, Carnivora).* Royal Ontario Museum, Life Sci. Contrib. 80:1-104.

van Zyll de Jong, C. G., 1987. *A Phylogenetic Study Of The Lutrinae (Carnivora; Mustelidae) Using Morphological Data*. Can. J. Zool. 65:2536-2544.

Wilson, D. E. & D. M. Reeder, 1993. *Mammal Species Of The World A Taxonomic And Geographic Reference*, 2nd Edition. Smithsonian Institution Press, Washington D. C. & London.

CHAPTER 4 IDENTIFICATION & 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)

SKIN

The integument, or skin, is important to maintaining body temperature. Three qualities are important to preventing hypothermia:

1) Glands produce a lipid squalene to enhance water-repellent quality of the fur.
2) The skin contains piloerector muscles.
3) The skin contains more subcutaneous fat, important for insulation, than terrestrial mammals. (Original sources cited in Melquist et al. 2003)

Average skin thickness has been reported to be 2 mm on the tail and body and 0.9 mm on the feet" (Baitchman and Kollias 2000).

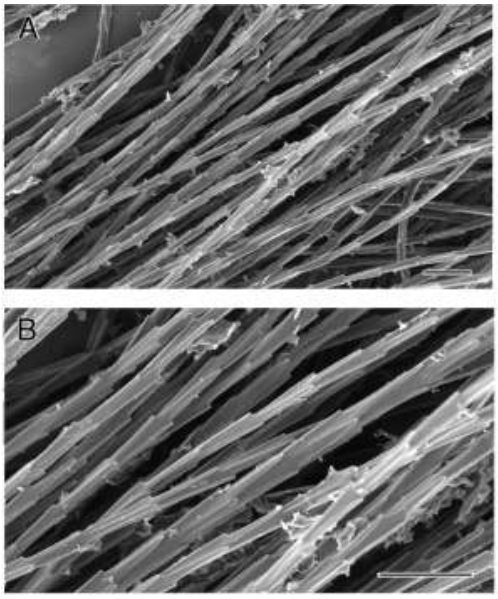
COAT

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.

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 cm^2 for *L. lutra*. Tarasoff et al. (1972) give a figure of 57,833 hairs/cm^2 for the mid-back area of *L. canadensis*. The guard hair is thick at 17 – 20mm (.6693 - .7874 inches); the under-fur is 8 – 9mm (.315 - .3543 inches). *"Average hair density has been reported to be 62,144 hairs/cm^2 on the tail, 58,250 hairs/cm^2 on the body, and only 1,648 hairs/cm^2 on the foot* (Baitchman and Kollias 2000).

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…"*. The river otter pelt is considered the standard by which quality and durability of other furs are judged (original references in Melquist et al. 2003).



Hair structure

"The cuticle surface structure of the under-hairs and base of the less-abundant guard hairs are distinctively shaped to interlock, with wedge-shaped fins or petals fitting into wedge-shaped grooves between fins of adjacent hairs."

"The fins of one hair loosely insert into the grooves between fins of an adjacent hair, thus permitting the hairs to form a web-like pattern that keeps water from the otter's skin and decreases heat loss. Also, the grooves between fins trap air bubbles, which help increase the thermal insulation of the otter's coat."

"A common otter behavior, next to their playfulness, is their constant grooming. This behavior is another important aspect of an otter's heat-sparing abilities. In addition to the interlocking structure of the underhairs, these hairs are coated with a thin layer of body oil from the otter's sebaceous glands, thus providing another barrier to water. The fins of the underhairs are also aligned away from the body, which is consistent with the direction in which otters run their paws through their hair during this self-grooming, thereby ensuring that their claws do not get caught on the fin-like projections."
(Weisel et al. 2005; Taken from: University of Pennsylvania School of Medicine (2005, September 4). Otter Adaptations: How Do Otters Remain Sleek And Warm. *ScienceDaily*. Retrieved September 21, 2008, from http://www.sciencedaily.com /releases/2005/08/050819124510.htm) Photos: *John W. Weisel, Chandrasekaran Nagaswami, Rolf O. Peterson, University of Pennsylvania School of Medicine; Michigan Technological University; NRC Research Press*

As described in the Weisel et al. article (2005), insulative and waterproof qualities of the coat are maintained by frequent grooming. It is important the otters are given ample dry grooming substrates to encourage good coat maintenance. Water adhering to the tips of the guard hair beads off and causes the coat to form spikes upon leaving the water. See also Kuhn & Meyer (2010)

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.

> *"The pelage of the river otter provides it primary means of insulation. The density of the hairs, sebaceous gland secretions, and air trapped by the underhairs all reduce heat loss by preventing water-to-skin contact. The feet may be an important source for heat loss because of their relatively thin skin and sparse hair. Body fat is of secondary importance for insulation and is distributed only in areas that require additional thermal protection, such as the tail, which has an increased surface area."*(Baitchman and Kollias 2000)

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). Kuhn (2009) discusses coat characteristics of the otter and its role in heat loss.

Coat coloration

Coloration of the dorsal pelage of river otters is classified slightly differently by the fur industry and naturalists, respective color categories are:

- Extra dark = jet black
- Dark = dusky brown
- Dark brown = dark grayish brown;
- Brown = dark grayish brown-fuscous
- Pale = burnt umber
- Extra pale = hair brown
- Piebald = "white with burnt umber-raw umber spots
- Albino or lucistic = white

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. (2002) found that river otters involved in a captive study in Alaska shed their under fur from May to August and their guard hair shed between August and November.

SIZE

Head and Body Length (Head to rump)

661mm – 1270 mm (26 in. to over 50 in.) (Harris 1968)
22 - 31 inches (Walker et al. 1964) (55.88 - 78.74 cm)
26 - 30 inches (Burt & Grossenheider 1952) (66.04 – 76.2 cm)
23 - 36 inches (Wilson 1959) (58.42 – 91.44 cm)

Tail Length

305 mm – 457 mm (12 in. – 17 in.) (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 (35.56 – 49.53cm) (Park 1971 citing Wilson 1954, 1959, 1961)
12 to 20 inches (30.48 – 50.8cm) (Hall & Kelson 1959)

Total Length

35 – 54 inches (Park 1971) (88.9 cm – 1.3716 m)
1000 mm – 1530 mm (3.28 – 5.02 ft.) (Foster-Turley 1991)
1100 mm – 1525 mm (Harris 1968)

35 - 51 inches (3.61 – 5 ft.) (88.9 cm – 1.295 m) (Hall & Kelson 1959)
42 - 54 inches (1.067 – 1.3716 m) (Cahalane 1947)
89 – 137 cm (2.9 ft. – 4.5 ft.) (Melquist et al. 2003)

Maximum length reached at four to five 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 et al. 2003).
The ideal weight for all animals will vary and should be established on an individual basis. Subcutaneous fat is not widely distributed but is located primarily at the base of the tail and caudally on the rear legs. Smaller deposits are located in the axillary regions and around the external genitalia" (Baitchman & Kollias 2000). 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).

The photo shows an example of otters close to an ideal weight. (Photo: Jessie Cohen, National Zoo).

See Chapter 7, Animal Management, Weight for weight range photos. These should be considered as a guideline only.

	Body Mass (kg)			Total Length (mm)	
Sex and Age Classes	*n*	$\bar{x}$	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 7.9 kg. (17.4 lb.) for females. Melquist et al. (2003), state that weights and measurements indicate that females are between 3% and 21% smaller than males of a similar age (original references cited by Melquist et al. 2003).

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

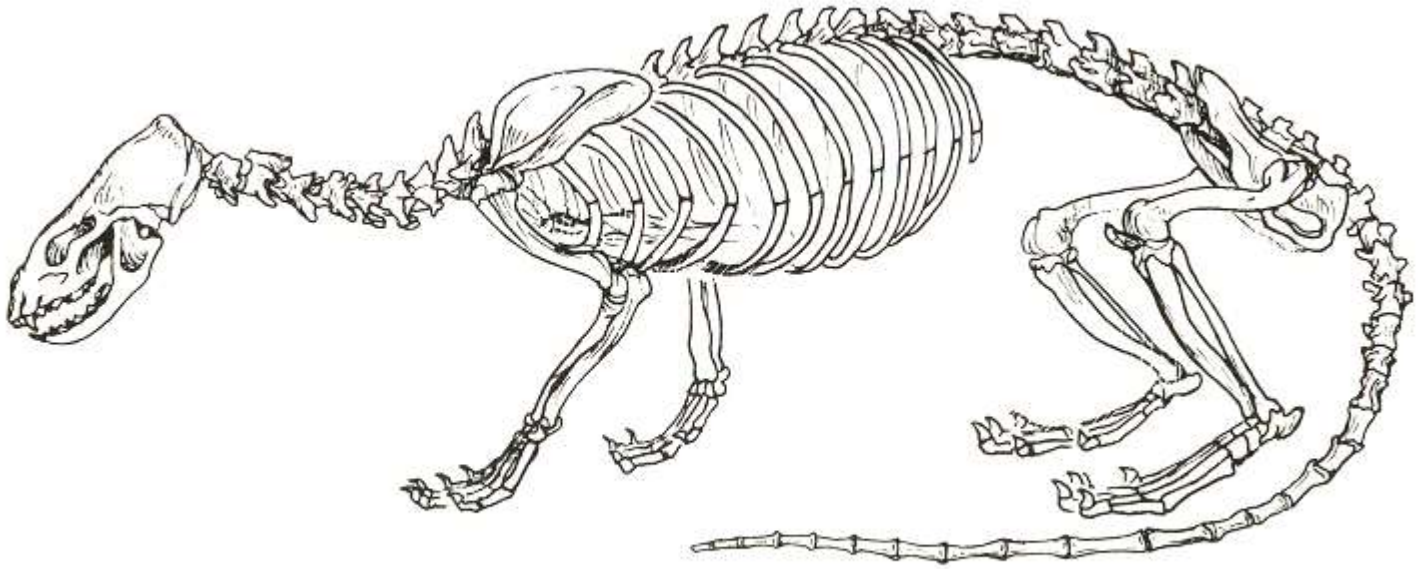
The teeth are adapted for crushing; the upper fourth premolar and lower first molar, and the carnassials are adapted for shearing (Toweill & Tabor 1982). Supernumerary premolars have been reported (Toweill & Tabor 1982). Layering in the cementum of the teeth and tooth wear can be used to age animals.

SKELETAL ADAPTATIONS

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

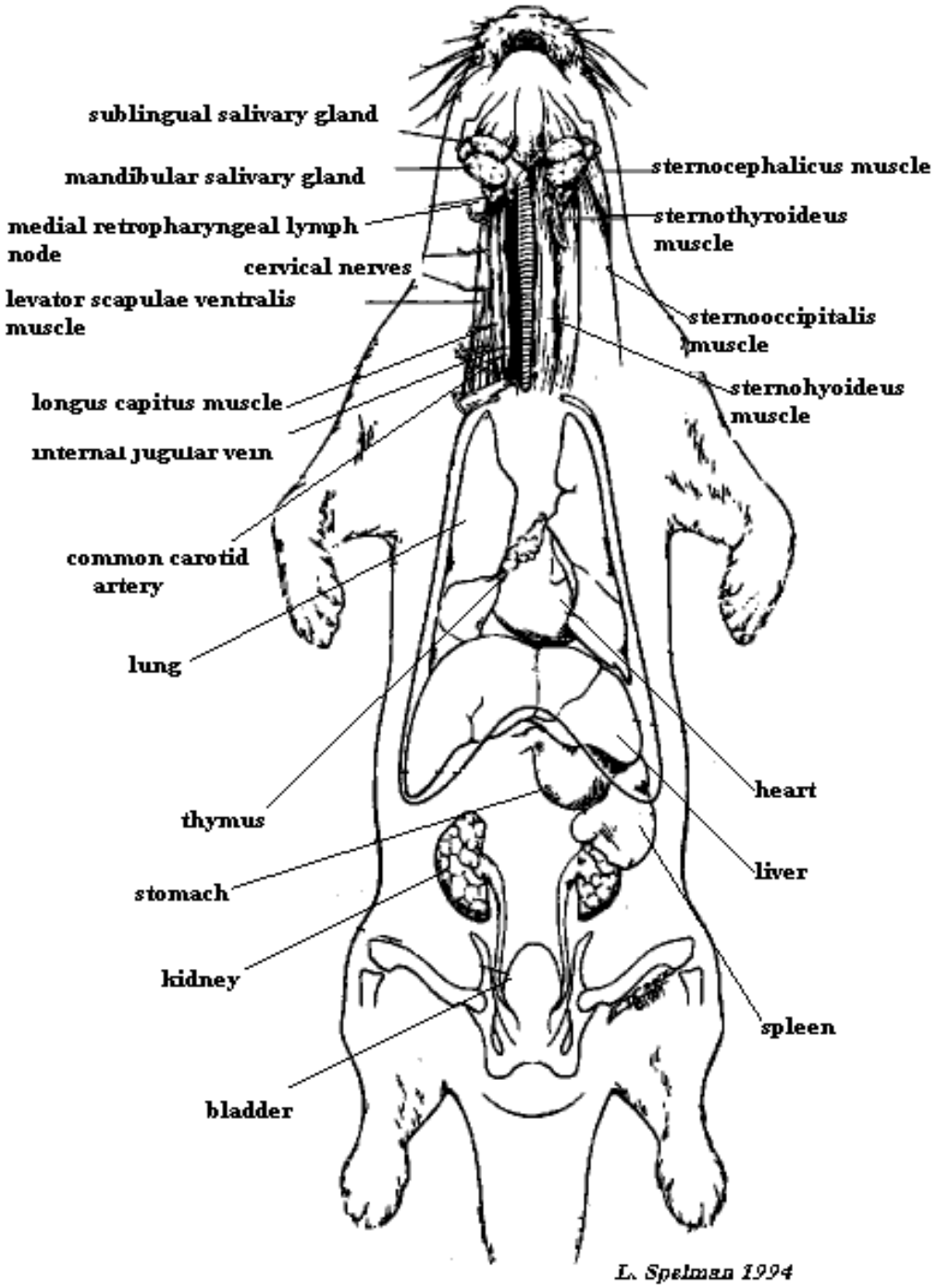
- The fore limbs are highly mobile on the chest wall because they do not have a clavicle.
- *"Both the metatarsals and phalanges are elongated, and a generous web of skin exists between the digits of the hind feet, so that the foot becomes twice as wide when the digits are spread. The length of the individual digits of the river otter are IV=III>V=II>I."* (Taylor, 1989)
- Normally 52 vertebrae, including 14 rib-bearing vertebrae. There are 7 cervical, 14 thoracic, 6 lumbar, 3 sacral, and 22 caudal vertebrae.
- Chevron bones are found from the 4th caudal vertebrae on, and are associated with greater vascularization of the tail.

River Otter Skeleton



Illustrations by Michael Clark
From: Chanin 1985, The Natural History of Otters, page 4.
Reprinted with permission from P. Chanin and M. Clark

GENERAL ANATOMY



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). *"Otter intestines (are) lined with about ¼ "* (6.35 mm) *of mucous for protection from fish spines and other sharp edged foods…"* (Wilson 1954).

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 is frequently deposited as scent marks in prominent locations throughout an otter's 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 ¾" in diameter and characteristically in 2, 3, or 4 curved segments each about 1 ½ to 3" long…"* (Greer 1955) (3.81 – 7.62 cm)

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 as the animal ages. Plantar glands located on the bottoms of hind feet (see Feet) also are believed to be used for scent marking.

FACIAL CHARACTERISTICS

(Photo: Debbie Stika)

Eyes

Directed forward allowing for binocular vision

Vibrissae

Numerous, long, thick vibrissae located on the muzzle are used for locating prey in dark, murky waters. (See Senses)

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 "*moustachial maculations"*. These spots which appear after about one year of age are unique to each individual, although, not all individuals develop them. 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 slightly over time so this method should only be used for identifying animals in which these changes can be monitored and traced.

FEET

Pentadactyl and plantigrade. "*Skin and fur are thinnest on the feet, with the skin of the foot less than half the thickness of that on the torso. The skin of the foot is not highly vascularized compared with other aquatic mammals such as the sea otter and pinnipeds*" (Baitchman & Kollias 2000). *"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)

(Photo Above: G. Myers, top of foot)

(Photo Left: J. Reed-Smith, plantar pads)

Metatarsal and metacarpal pads are absent, but plantar, palmar, and digital pads are present on all feet. There are 3 or 4 small, rough protuberances on the plantar surface of each hind foot. These plantar glands are seen in several other North American mustelids and are believed to function as chemical transmitters and possibly to prevent slipping (Melquist & Dronkert 1987).

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). 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)

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

Blood Adaptations

The blood of Nearctic river otters has a fast clotting time and a high number of thrombocytes which enables clotting even under water. Also, the oxygen carrying capacity of their blood is higher than that of terrestrial mammals (Melquist et al. 2003 citing Brandes et al. 1983).

Respiratory System

Respiratory rate ranges from 10 – 60 breaths/minute (Spelman 1999). See Coat and Maximum Dive Time

Historically and in current literature you frequently see quotes like the one following which was offered in the original versions of the NARO Husbandry Notebook: *"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). See Dive Time below for more accurate dive times. 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 compete 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)." Ben-David et al. (2000) state: *"Dive duration for otters chasing fast schooling-fish was significantly lower (14.2 ± 2.3 seconds; n = 10) than when they were chasing slow non-schooling-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."*

The longest dive recorded during 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 ± SE (Ben-David unpublished data). In light of documented evidence the maximum dive time of 4 minutes previously listed in this manual is likely in extreme situations only; **a maximum dive time would more probably range from 50 seconds to something just over 1 minute**.

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 (see Hair Structure). This layer of air prevents penetration of cold water to the skin and may secondarily serve to aid in floatation (Estes 1989). The integument, or skin, is important to maintaining body temperature. Three qualities are important to preventing hypothermia:

1) Glands produce a lipid squalene to enhance water-repellent quality of the fur.
2) The skin contains piloerector muscles.
3) The skin contains more subcutaneous fat, important for insulation, than terrestrial mammals. (Original sources cited in Melquist et al. 2003)

LOCOMOTION

Hump-backed gait when traveling overland. Propulsion in the water is accomplished by paddling with the feet and thrusting with the tail and vertebral column; the latter is especially important when swimming underwater. 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 (toboggan) on their stomachs. Often popularly seen as play behavior in zoos (Crandall 1964, Harris 1968), it has been reported as primarily being an efficient means of transportation (Field 1970, Beckel-Kratz 1977, Melquist and Hornocker 1983, Chanin 1985, Fish 1994, Melquist et al. 2003) in scientific literature. However, Stevens and Serfass (2005) documented three otters intentionally, repeatedly sliding down a snowy hill interspersed with play bouts. While sliding 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 (personal communication anon.).

Jumping

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 18 mph (29 km/h) was reported by Nowak (1992) and confirmed by Severinghaus & Tanck (1948) who determined a top land speed for the otter of 15 to 18 mph (24 – 29 km/h) using a combination of gliding and running.

Top Speed in water

Six to 7 mph (10 to 12 km/h). (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 male's 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 breeding 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. AZA studbook data records successful reproduction by three males under the age of two years; it should be remembered that this data could be suspect, but should still be noted. It may 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 baculum, these young males require a longer period of intromission to successfully stimulate ovulation. Due to their inexperience, subordinate role, or position as a territorial interloper, they are not able to maintain the same length of intromission time 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!

Males experience seasonal elevations (late winter to early spring) in testosterone, lasting for approximately 3 months with peak levels for 1 month (Bateman et al. 2009). The timing of this peak appears to vary with the latitude of the holding institution, and/or latitude of animal's origin. Sperm production occurs only

during these elevated testosterone periods which corresponds to observed increase in size and decent of testes. Research looking at fecal testosterone levels by Bateman et al. (2009) indicates:

> *"In male NARO, elevations in fecal testosterone levels were observed during the late winter–early spring months. The timing of seasonal increases was coincident with the increasing amount of daylight occurring after the winter solstice. Testosterone levels peaked for each male (n=58) at different times of the year, apparently corresponding to the geographic latitude of the housing institution. As latitude increased, peak testosterone values appeared to occur later in the calendar year. For all NARO males, testosterone levels were elevated above baseline for an average of 101.80±8.97 days with peak levels being maintained for 25.50±7.51 days."*

The Bateman et al. study also looked at seminal fluid and sperm production using electroejaculation and blood serum.

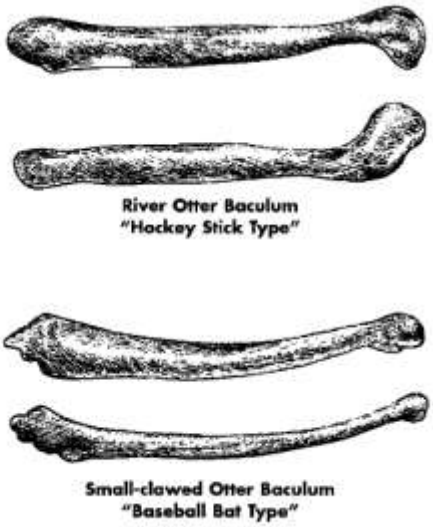
> *"For this study, four male NARO were subjected to electroejaculation on a total of 16 occasions. Seminal fluid was recovered during 100% of the collection procedures. In three of the four males collected multiple times based on season, no semen was recovered in the summer or fall months and only small ejaculate volumes (i.e. 3–10 ml) were obtained during the winter period. Peak sperm recovery and seminal quality occurred in the spring months, with most ejaculates (75%) containing in excess of $80x10^6$ motile spermatozoa. Testosterone and semen volumes differed (P<0.05) among seasons of the year, with peak values in serum testosterone occurring in the winter and semen volume in the spring. Testicular volume was also significantly higher (P<0.05) in winter than summer or fall months. Trends of higher sperm concentrations (million motile/ml; P=0.066) and total sperm per ejaculate (P=0.094) were observed in the spring compared with the other seasons. Across seasons, serum testosterone levels were positively correlated with testicular volume (r=0.84, P<0.05) and with fecal testosterone concentrations (r=0.82, P<0.0001); fecal testosterone concentrations were also correlated with testicular volume (r=0.79, P<0.0001)."*

In conclusion, Bateman et al. (2009) state:

> *"Longitudinal monitoring of endocrine and seminal traits simultaneously in NARO males found that fecal testosterone levels were correlated with seasonal changes in serum testosterone concentrations and testicular volume. Of importance, our results showed that electroejaculation was an effective method for semen recovery in NARO during the breeding season. Spermic ejaculates were obtained only coincident with periods of elevated testosterone, with the highest quality semen recovered during the spring. Semen samples collected during the spring months had ample semen volume (~600 µl) and contained large numbers of spermatozoa (~90 million/ejaculate) with good motility (~90% progressively motile) and morphology (~70% normal). In contrast, only minimal seminal fluid or spermatozoa were recovered from collections performed in other seasons. During periods of basal testosterone, testicular volume also was markedly smaller and the testes appeared to be positioned closer to the abdominal wall than seen during periods of peak testosterone and semen production. Interestingly, serum testosterone and testicular volume were higher in winter months, whereas sperm concentration and semen volume were higher in the spring. These seasonal differences may be indicative of the lag time between starting sperm production and producing mature spermatozoa ready to be ejaculated. These findings are typical of those seen in other seasonally breeding mammals [Bronson, 1985], including another mustelid, the badger [Ahnlund, 1980], and other carnivore species [Brown et al., 2001] and are consistent with our observations of pronounced reproductive seasonality in female NARO."*

Their findings confirm the season fluctuation in size of males' testes reported by Toweill & Tabor (1982) and observed by professionals working with *ex-situ* Nearctic otters.

Otter Baculum



Illustrations by Michael Clark
From: Chanin 1985, The Natural History of Otters, page 8
Reprinted with permission from P. Chanin & M. Clark

Male penis
(Photo: D. Hamilton)

Basal Seminal Characteristics of North American River Otters

(Bateman 2012)

Characteristics	Mean ± SEM	Range
Testicular volume (cm^3)	32.67 ± 2.11	24.03 – 51.55
Semen Volume (µl)	514.16 ± 138.58	283 - 1960
Sperm motility (%)	78.75 ± 3.98	60 - 90
Normal sperm morphology (%)	72.85 ± 5.06	32 - 89
Concentration ($x10^6$ motile/ml)	202.26 ± 26.54	26.6 - 415.8

FEMALE CHARACTERISTICS

Females are also sexually mature at about two years of age. Liers (1951) did report one female who bred successfully at 15 months and AZA studbook data reflect a female just under two years of age giving birth.

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 (Bateman et al. 2009 report one case of apparent spontaneous ovulation in a female housed with another female who experienced a pseudo-pregnancy), *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) Since their writing, records research conducted by Reed-Smith (2001) and studies conducted by H. Bateman et al. (2009) have shown that the total gestation (unimplanted and implanted phases) can range from 309 to 367 (Reed-Smith 2001) or 302 – 350 (Bateman et al. 2009). Both estimates were based on date of last observed breeding. The duration of active implantation appears to be roughly 68 to 74 days (Bateman et al. 2009).

Mammae

Four total, two pairs; inguinal.

Estrous

November to May; in general, estrus appears to be dependent on latitude. The period lasts roughly 42 to 46 days, average 35 days (Bateman 2012) with peaks of receptivity every six days or so. (See Reproduction for more detail)

The ""post-partum" estrus 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). This estrus actually is the normal estrus cycle and not a true "post-partum" estrus; it can begin two to four weeks post-partum (Bateman et al. 2009, Bateman 2012). In captivity behavioral signs of this estrus do 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. In captivity whether or not a female breeds annually depends on a number of management factors and appearance of a behavioral estrus. See Reproduction.

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

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

Michigan – Estrus is usually seen in April or May, more rarely in early 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 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 estrus females, or, a neutral hold-over of a previously useful evolutionary adaptation. Thom et al. (2004), Lindenfors et al. (2003), and Ferguson et al. (2007) discuss the maintenance of delayed implantation in modern mustelids/carnivores and possible reasons for this including its association with highly seasonal environments. See Chapter 6 Reproduction.

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 (Duplaix-Hall 1975); 309 – 367 days (Reed-Smith, 2001); 302 – 350 days (Bateman et al. 2009).

Actual Gestation

60 – 63 days (Lancia & Hair 1983); 50 days (Toweill & Tabor 1982); 68 – 74 days (Bateman et al. 2009).

Parturition

Parturition occurs November to May, with peaks in March or April at northern latitudes and December or January at more southern latitudes (see Reproduction for date estimates associated with latitude). 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, and April 12th every other year; April 10, 1993 and April 10 1997.

Inter-birth Intervals

The shortest inter-birth intervals, for litters born to the same female in consecutive years, range from 327 to 386 days (number of days based on last of a litter to the first born of the next litter) (D. Hamilton personal communication).

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 Nearctic otters are considered 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 to be a *"single-prey loader"* (Houston & McNamara 1985); which 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. Other studies have reported most foraging occurring at night.

LONGEVITY

In the wild otters live a maximum of about 10 to 13 years. Mortality rates for wild otters increase at three to five years, the reasons for this are unknown (Polechla 1989). Historically, longevity in captivity is given as 25 years (Melquist & Dronkert 1987), and 23 years (Park 1971, Nowak 1991). While these figures are supported by an entry of a 25 year old animal in the N. A. river otter studbook, the median age is 12.3 years with lifespans of 16 to 20 years fairly common (D. Hamilton personal communication).

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 following are those calls found in the literature and heard by the author.

Call	Usual context/meaning
savage, snarling growl	angry or disturbed
explosive snort	alarm call, similar to cough, made by expelling air through the nostrils (Park 1971)
scream	frightened, uneasy, threat
low growl	threat
bird-like chirp	call note, contact call between dam and pups; may be made by injured animals calling group members. (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	could be same as grunts or chuckles
caterwaul	used by female during mating
grunts or chuckles	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. *"To imitate it, close the lips & utter huh! huh! huh! as deeply as possible in rapid groups of several sounds at a time."* (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. *"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)

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). Rostain et al. (2003) conducted scat scent preference tests in a group of wild-caught (later returned to their locations of origin) male Nearctic otters at the Alaska Sea Live Center. They tested for: spraints as signals of species identity; spraints as a form of male-female communication allowing males to recognize sexual partners; and to test if spraints are used as a territorial signal or form of intra-group communication. Their results suggested that*, "…olfactory signals in L. canadensis probably communicate species and sexual identity."*

Tactile

Touch is 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). The 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 led 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 scoptic, 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.

Based on work done at the Otter Zentrum in Germany on Lutra lutra, Kasprzyk (1990) determined: *"The results of aerial and underwater studies on the colour vision of Lutra lutra indicate the highest spectral sensitivity for the colour blue, a reduced sensitivity for green and a very little sensitivity for red and yellow."*

Mortality

There is no question that the future of river otter populations is dependent on man. In addition to the impacts 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 (personal observation of attack that did not end in the otter's death). There are reports (substantiated* and unsubstantiated**) of predation on river otters by: alligator*, American crocodile**, bald eagle*, orca*, gray wolf*, coyote**, domestic dog*, red fox* (juvenile otter), bobcat*. Mountain lion*, black bear**, brown bear**, and wolverine** (Melquist et al. 2003 cite original sources).

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. See Section 2, Chapter 10 (Health Care) for *ex-situ* mortality information.

References – Identification & Description

Baitchman, E. J., DVM & G. V. Kollias, DVM, PhD. 2000. *Clinical Anatomy of the River Otter (Lontra Canadensis)*. Journal of Zoo and Wildlife Medicine 31(4):473-483.

Ballard, K. A., J. G. Sivak & H. C. Howard. 1989. *Intraocular muscles of the Canadian river otter and Canadian beaver and their optical function.* Can. J. Zool. 67:469 – 474.

Balliet, R. F. & R. J. Schusterman. 1971. *Underwater and aerial visual acuity in the Asian "clawless" otter (Amblonyx cinerea cinerea).* Nature, London 234:305 – 306.

Beckel-Kratz, A. 1977. *Preliminary observations of the social behaviour of the North American otter*. Otters: The Journal of the Otter Trust (annual report):28-32

Ben-David, M., T. M. Williams & O. A. Ormseth. 2000. *Effects of oiling on exercise physiology and diving behavior in river otters: a captive study.* Canadian Journal of Zoology 78:1380 – 1390.

Blundell, Gail M., Merav Ben-David, and R. Terry Bowyer. 2002. *"Sociality in River Otters: Cooperative Foraging Or Reproductive Strategies?"* Behavioral Ecology 13(1), Jan-Feb 2002:134-141. 13.1 (2002): 134-41. Zoological Record Plus (1978-Current). Web. 27 Apr. 2010

Bowyer, R. Terry, et al. 2003. *"Effects of the Exxon Valdez Oil Spill on River Otters: Injury and Recovery of a Sentinel Species."* Wildlife Monographs 153, July 2003:1-53. 153 (2003): 1-53. Zoological Record Plus (1978-Current). Web. 27 Apr. 2010.

Burt, W. H. & R. P. Grossenheider 1952. *A Field Guide to the Mammals.* Houghton Mifflin Co., Boston, MA.

Cahalane, V. H. 1947. *Mammals of North America.* MacMillan Co. New York, NY.

Chanin, P. 1985. *The Natural History Of Otters*. Facts on File Publications, New York, New York.

Coues, E. 1877. *Fur-bearing Animals.* 294 – 348 Washington, D. C. Government Printing Office.

Crandall, L.S. 1954. *The Management of Wild Mammals in Captivity*. University of Chicago Press, Chicago, IL. 769 pp.

Davis, H., R. Aulerich, S. Bursian, J. Sikarskie, & J. Stuht, 1992. *Feed Consumption and Food Transit Time in Northern River Otters (Lutra canadensis).* J. Zoo Wildl. Med. 23: pp. 241 – 244.

Dunstone, N. 1998. *Adaptations to the semi-aquatic habit and habitat.* In: Behavior and Ecology of Riparian Mammals, N. Dunstone & M. Gorman editors. pp. 1 – 17. Cambridge Univ. Press, Cambridge.

Duplaix-Hall, N. 1975. *River Otters In Captivity: A Review*. In: Breeding Endangered Species in Captivity. R. D. Martin editor, Academic Press, New York.

Estes, J. A. 1989. *Adaptations For Aquatic Living By Carnivores*. In: Carnivore Behavior, Ecology, and Evolution. Gittleman, J.L. editor. Comstock Publ. Assoc., Cornell Univ. Press, Ithaca, New York.

Field, R. J. 1970. *Winter Habits Of River Otter (Lutra Canadensis) In Michigan*. Michigan Academician, Vol. 3#1, pp 49 – 58.

Fish, F. E. 1994. *Association Of Propulsive Swimming Mode With Behavior In River Otters (Lutra Canadensis*). J. of Mammal. 75(4):989 – 997.

Foster-Turley, P. et. al, editors. IUCN/SSC Otter Specialist Group. 1990. *Otters, An Action Plan For Their Conservation*. Kelvyn Press, Inc. Broadview, IL.

Greer, K. R. 1955. *Yearly Food Habits of the River Otter (Lutra canadensis) in Montana.* Am. Midl. Nat. 54:299 – 313.

Hall, R. E. & K. R. Kelson. 1959. *The Mammals of North America*. Ronald Press Co. New York.

Hall, R. E. , 1981. *The Mammals Of North America*. Vol. 2, 2nd edition, John Wiley & Sons, New York.

Hamilton, W. J. & W. R. Eadie, 1964. *Reproduction In The Otter, Lutra canadensis*. J. Mammal. 45(2): 242 – 252.

Harris, C. J., 1968. *Otters: A Study Of The Recent Lutrinae*. William Clower & Sons, Lmtd., London, England.

Hoover, J. 1985. *Electrocardiograms of American River Otters (Lutra canadensis) during Immobilization.* J. Wildl. Dis. 21(3) pp 331 – 334.

Hoover, J. P. & R. D. Tyler. 1986. *Renal Function and Fractional Clearances of American River Otters (Lutra canadensis).* J. Wildl. Dis. 22(4):547 – 556.

Houston, A. I. & J. McNamara. 1985. *A general theory of central place foraging for single-prey loaders.* Theoret. Popul. Biol. 28:233 – 262.

IUCN/SSC. 1992. *Otters of the World*. Pamphlet. Gland, Switzerland.

Iversen, J. 1972. *Basal Energy Metabolism of Mustelids.* J. Comp. Physiol. 81:341 – 344.

Jackson, H. T. 1961. *Mammals Of Wisconsin*. Univ. of Wisconsin Press. Madison, WI.

Jenkins, J. H., 1983. *The Status And Management Of The River Otter (Lutra Canadensis) In North America*. Acta. Zool. Fenn. #174: 233 – 235.

Kruuk, H. 1995. *Wild Otters Predation And Populations*. Oxford University Press, Oxford, England & New York, New York.

Kuhn, R. 2009. *Comparative analysis of structural and functional hair coat characteristics, including heat loss regulation, in the Lutrinae (Carnivora: Mustelidae)*. PhD dissertation, Univ. of Hamburg, Germany.

Kuhn, R. & W. Meyer. 2010. *A Note on the Specific Cuticle Structure of Wool Hairs in Otters (Lutrinae).* Zoological Science 27:826-829 (2010).

Kuhn, R. & W. Meyer. 2010. *Comparative hair structure in the Lutrinae (Carnivora: Mustelidae).* Mammalia 74(2010):291-303.

Lancia, R. A. & J. D. Hair. 1983. *Population Status Of Bobcat (Felis Rufus) And River Otter (Lutra canadensis) In N. Carolina*. N. Carolina State Univ. Proj. E-1, Raleigh, N.C.

Lauhachinda, V. & E. P. Hill, 1977. *Winter Food Habits Of River Otters From Alabama And Georgia*. Proc. Annu. Conf. Southeast Assoc. fish Wildl. Agencies. 31: 246 – 253. 1977(1979).

Liers, E. 1951. *Notes On The River Otter (Lutra canadensis*). J. Mammal. 32:1 – 9.

Lindenfors, P., L. Dalèn, A. Angerbjörn. 2003. *The monophyletic origin of delayed implantation in Carnivores and its implications*. Evolution 57(8):1952-1956.

Melquist, W. E. & M. G. Hornocker. 1983. *Ecology Of River Otters In West Central Idaho*. Wildlife Monographs 83, April 1983.

Melquist, W. E., P. J. Polechla and D. Toweill. 2003. River Otter. In: *Wild Mammals of North America: Biology, Management, and Conservation, 2nd Edition.* Editors: Feldhamer, G. A., B. C. Thompson, J. A. Chapman.Johns Hopkins University Press.

Merilees, W. J., 1981. *Berry Eating Otters.* Discovery (Vancouver Nat. Hist. Soc.): 10(3): 69 – 70. Sep. – Nov. 1981.

Nowak, R. M. 1991. *Walker's Mammals Of The World*. 5th edition. Vol. II. Johns Hopkins Univ. Press.

Obbard, M. E. 1987. *Fur Grading and Pelt Identification.* In: Wild Furbearer Management and Conservation in North America. ed. M. Novak, J. Baker, M. Obbard, & B. Malloch. pp 717 – 826. Ontario Ministry of Natural Resources, Toronto.

Ormseth, O. A. & M. Ben-David. 2000. *Ingestion of oil hydrocarbons: effects on digesta retention times and nutrient uptake in captive river otters.* Journal of Comparative Physiology B. 170: 419 – 428.

Park, E. 1971. *The World of the Otter.* J. B. Lippincott Co., New York.

Polechla, P., Jr. 1988/89. *The Nearctic River Otter*. Audubon Wildlife Report 1988/89. The National Audubon Soc., Academic Press.

Reuther, C. 1989. *Otters In Captivity – A Review With Special Reference To Lutra lutra*. In: Proceedings V International Otter Colloquium, Hankensbüttel, Germany. C. Reuther & R. Röchert editors. HABITAT publication of Aktion Fischotterschutz, Hankensbüttel, Germany. 269 – 307.

Rostain, R. R., M. Ben-David, P. Groves, J. A. Randall. 2003. *Why do river otters scent-mark? An experimental test of several hypotheses.* Animal Behaviour 68:703-711.

Schreber, J. 1778. *Die Säugetiere 3*: 455 – 470, Erlangen

Serfass, T. 1994. *Conservation Genetics And Reintroduction Strategies For River Otters*. Ph.D. Thesis, Penn. State Univ.

Severinghaus, C. W. & J. E. Tanck. 1948. *Speed and Gait of an Otter.* J. of Mammalogy 29(1):71.

Spelman, L., D.V.M., W. Jochem, M.S., P. Sumner, M.S., D. Redmond, M.D., Col. M.C. & M. Stoskopf, D.V.M., Ph.D. 1997. *Postanesthetic Monitoring of Core Body Temperature Using Telemetry in North American River Otters (Lutra canadensis).* J. Zoo & Wildl. Med.28(4): 413 – 417.

Spelman, L., D.V.M. 1999. *Otter Anesthesia*. In: Zoo & Wild Animal Medicine, Current Therapy 4. Fowler, M., D.V.M. & R. E. Miller, D.V.M. editors. pp 436 – 443.

Stephenson, R.; P. J. Butler; N. Dunstone & A. J. Woakes. 1988. *Heart rate and gas exchange in freely diving American mink (Mustela vison).* J. Exp. Biol. 134:435 – 442.

Stevens, S. S. and T. L. Serfass. 2005. *Sliding Behavior in Nearctic River Otters: Locomotion or Play?* Northeastern Naturalist 12(2):241-244.

Tarasoff, F. J., A Basaillon, J. Pierard, & A. Whitt. 1972. *Locomotory Patterns and External Morphology of the River Otter, Sea Otter, and Harp Seal (Mammalia)*. Canadian J. Zoo, 50:915 – 929.

Tarasoff, F. J., 1973. *Anatomical Observations On The River Otter, Sea Otter And Harp Seal With Reference To Thermal Regulation And Diving.* Ph.D. dissertation, McGill Univ. 1973. Diss. Abstr. Int. B. Sci. Eng. 34(10): 1974.

Tarasoff, F. J. & G. Kooyman. 1973. *Observations on the Anatomy of the Respiratory System of the River Otter, Sea Otter, and Harp Seal. Part 1: The Topography, Weight, and Measurement of the Lungs.* Can. J. Zool. 51:163 – 170.

Tarasoff, F. J. & G. Kooyman. 1973a. *Observations on the Anatomy of the Respiratory System of the River Otter, Sea Otter, and Harp Seal. Part 2: Trachea and Bronchial Tree.* Can. J. Zool. 51:171 – 177.

Taylor, M. E. 1989. *Locomotor Adaptations By Carnivores*. In: Carnivore Behavior, Ecology, and Evolution. Gittleman, J. L. editor. Comstock Publ. Assoc., Cornell Univ. Press, Ithaca, New York.

Thom, M. D., D. D. P Johnson, D. W. MacDonald. 2004. *The Evolution and Maintenance of Delayed Implantation in the Mustelidae (Mammalia: Carnivora)*. Evolution 58(1):175-183.

Toweill, D. E. & J. E. Tabor. 1982. *Wild Mammals Of North America Biology, Management, Economics.* Chapman, J. A. & G. A. Feldhamer editors, Johns Hopkins Univ. Press.

University of Pennsylvania School of Medicine (2005, August 19). Otter Adaptations: How Do Otters Remain Sleek And Warm, *Science Daily*. Retrieved September 21, 2008, from http://www.sciencedaily.com-/releases/2005/08/050819124510.htm.

Walker, E. P., F. Warnick, K. I. Lange, H. E. Uible, S. E. Hamlet, M. A. Davis, and P. F. Wright. 1964. *Mammals of the World*. Johns Hopkins Press, Baltimore, Maryland.

Walls, G. L. 1942. *The vertebrate eye and its adaptive radiation.* Cranbrook Press, Bloomfield Hills, NY.

Weisel, J. W., C. Nagaswami, R. O. Peterson. 2005. *River otter hair structure facilitates interlocking to impede penetration of water and allow trapping of air*. Canadian Journal of Zoology May 2005 83(5):649-655.

Wilson, K. A. 1954. *The Role of Mink and Otter as Muskrat Predators in Northeastern North Carolina.* J. Wildl. Mgmt. 18:199 – 207.

Wilson, K. A. 1959. *The Otter in North Carolina*. Presented at 13th Annual Conference Southeast Assoc. Game & Fish Commissioners, October 26 – 28, 1959, Baltimore, Maryland.

Wilson, K. A. 1961. *The Otter Is Nature's Playboy*. Wildlife in North Carolina. January 1961.

Wilson, D. & S. Ruff. editors, 1999. *The Smithsonian Book Of North American Mammals.* Smithsonian Institution Press, Washington, D.C. & London, England. pp 179-180.

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 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. In the Rehabilitation chapter of Section 3 an article by Clio Smeeton of Cochrane Ecological Institute offers advice if an otter needs to be trapped and moved. Appendix A offers a list of articles dealing with otter exclusion techniques.

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 AND SEASONAL MOVEMENTS

River otters are 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. The editor has observed otters active during the day, in winter, in Yellowstone National Park.

> *"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).

Martin et al. (2010) concluded the otters in their Minnesota study area were likely visiting latrines or moving between resting/foraging sites during the bimodal periods (2200 to 2300 H, or just after sunset during their study, and ~0400 H or just before sunrise) when they exhibited up to 3x more movement than during the rest of the diel period. Their radio telemetry data indicated the otters in their study area were primarily nocturnal foragers.

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. 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). Blundell et al. (2002) offers further detailed evaluation of dispersal. Melquist and Hornocker (1983) 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"*. (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); this maximum daily distance recorded, 42km (26.1 miles) was for a dispersing yearling male. They 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."*

Martin et al. (2010) report that, "*male otters moved at greater rates than females, and males moved at greater rates during the breeding season than during winter and summer. The greatest rates of movement by male otters were during breeding season when movement rates were approximately 24% greater than for females and were 18- 25% greater than for males during other seasons".* Females moved more during breeding season and during summer (likely coinciding with increased energy needs due to the presence of young). See also Home Ranges & Activity Cycle and Seasonal Movements.

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 show 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 otter's body when sliding through mud or snow often accompanied by otter tracks. (Photo: http://www.dec.ny.gov/animals/9355.html)

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 15.8km^2 (6.1 miles^2) (adult female with young) to 271.9km^2 (105miles^2) (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. Scent posts are often located near den entrances, slides, runways or other frequently used places. They are most frequently seen on elevated sites like fallen logs, rocks, or small mounds (Park 1971).

Natal Den Characteristics

Gorman et al. (2006) monitored 8 (>2 years old) radio tagged females during the natal denning season in Minnesota (March – May). They report: "*Females began denning in March, with a mean initiation date of 31 March, and used natal dens for a mean of 49 days (SE=3). Two females used man-made brush piles as dens, four used small limestone caves, one used a cavity in the roots of a big-toothed aspen (Populus grandidentata), and one used a beaver (Castor canadensis) bank den. Dens were located a mean of 316 meters* [346 yards] *(SE=79) from the nearest body of water and averaged 61 meters* [200ft.] *(SE=15) of elevation higher than the nearest body of water. Seven of eight females placed dens outside of their normal activity areas, and all females appeared to select sites that were protected from flood events*."

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 et al. 2002).

> *"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.

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, 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. There are no documented reports of males accompanying a female with pups. Home (1982) described family groups as being led by adult males although the method of determining sex and group composition was unspecified.

"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).

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 an actual family grouping 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 et al. 2002). In 2004, Blundell et al. reported further on the association of large male groups observed in the marine otters in Prince William Sound, Alaska. They observed that these large aggregations were composed primarily of males but that some males remained solitary year around.

> *"By using DNA microsatellite analysis and radiotelemetry, we were able to reject the hypothesis that social groups of otters were kin based. In addition, we found no evidence of kin avoidance, as would be expected from low dispersal and high local competition. Sociality conferred no reproductive benefits or costs to otters; number of offspring and number of relatives in the population did not differ between social and solitary animals. Solitary males were not older or larger than were social males, and there was no relation between male's size and number of offspring, indicating that sexual selection did not mask a potential relation between sociality and reproductive success. Among coastal river otters in this region, sociality could be explained by the benefits obtained from cooperative foraging on high-quality schooling pelagic fishes. Such benefits did not require association with kin, resulting in no selection pressure for kin-based groups."* They concluded that their prediction that the degree of sociality would fluctuate with the abundance of schooling pelagic fishes requires further research.

"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."*

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

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 (Personal communication).

In captivity, care needs to be taken when introducing a new animal into a group, especially with females; however, in recent years several facilities have had success with this type of introduction. (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 (which may or may not be accompanied by immature females or non-reproductive females). Also seen but, less frequently are two females traveling, or foraging with associated pups. Reports of male and female pairs are verified only as occurring during breeding season.

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 many 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 likely also serves to establish the involved animal's 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. This behavior is interpreted as 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).

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. Group foraging for schooling pelagic fish has been reported by Blundell et al. (2002, 2004).

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 antagonistic.

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.

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 nuzzling, or a bite. The **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 that then sniff the latrine and deposit their own urine/feces/anal gland scents (personal observation). (See Behavioral below)

Behavioral

- **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/nuzzling**

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.

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. Stevens and Serfass (2008) reported on an apparent "play bout" of sliding and gamboling in the snow by three otters at a latrine.

> *"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, Toweill & Tabor 1982), *are among the most common evidence of otter activity."*

"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 wate."* (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 the female is receptive, copulation generally occurs in the water (but also can occur on land) and can last 15 to 30+ minutes taking place repeatedly over the course of a few days personal observation of bouts lasting 60 min.+). 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. 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. 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.

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 rock; abandoned, or little used buildings, and duck blinds. 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.

"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 dens under Parental Care.

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 then 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 Chapter 6 Reproduction Section.

PARENTAL CARE AND BEHAVIORAL ONTOGENY

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, Landis 1997). 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 followed for over seventeen years. Several females live in close association with one another, all related.)

Natal Dens

Females frequently use dens dug by other animals as natal holts. These natal dens 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, later may be more typical), than in the wild (it could be swimming lessons this early in the wild have gone unobserved, but unlikely); 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, or have something to rest their weight on.

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. Note: It is recommended that pups are proficient swimmers before reintroduction of the male to the family group. (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.

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 sub-adult 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.

References – Behavior, Social Organization, Natural History

Beckel, A. L., 1982. *Behavior Of Free-Ranging And Captive River Otters In Northcentral Wisconsin.* Ph.D. dissertation Univ. Minn., Madison, 198pp.

Beckel, A. L., 1990. *Foraging Success Rates Of North American River Otters, Lutra Canadensis, Hunting Alone And Hunting In Pairs.* Can. Field-Nat.:104(4):586-588.

Beckel, A. L., 1991. *Wrestling Play In Adult River Otters, Lutra Canadensis*. J. Mammal.:72(2):386 – 390.

Ben-David, M. 1998. *Social behavior and ecosystem processes: river otter latrines and nutrient dynamics of terrestrial vegetation.* Ecology, October 1998. From: FindArticles.com a LookSmart™ Service @ www.findarticles.com.

Bowyer, R. T., W. J. Testa, & J. B. Faro. 1995. *Habitat selection and home ranges of river otters in a marine environment: effect of the Exxon Valdez oil spill.* J. of Mammal. 76:1 – 11.

Blundell, G. 1999. Personal Communication. Institute of Arctic Biology, Depart. of Biol. & Wildl., Univ. of Alaska, Fairbanks, 99775.

Blundell, G, M Ben-David, & R. T. Bowyer. 2000. *Sexual Dietary Partitioning in River Otters: Dimorphism or Cooperative Foraging.* Summary only from: Furbearers and Biodiversity, The 10th Northern Furbearers Conference, April 17 & 18, 2000, Univ. of Alaska, Fairbanks, Alaska.

Blundell, G., M. Ben-David & R. T. Bowyer. 2002. *Sociality in River Otters: Cooperative Foraging or Reproductive Strategies?* Behavioral Ecology 13(1):134-141.

Blundell, G., R. T. Bowyer, M. Ben-David, T. A. Dean, & S. C. Jewett. 1999. *Effects of Food Resources on Spacing Behavior of River Otters: Does Forage Abundance Control Home-Range Size?* Proceedings International Biotelemetry Symposium, June 1999, Juneau, Alaska.

Gorman, T. A., J. D. Erb, B. R. McMillan, D. J. Martin, J. A. Homyack. 2006. *Site Characteristics of River Otter (Lontra canadensis) Natal Dens in Minnesota.* The American Midland Naturalist, July 2006, 156:109-117.

Harris, C. J., 1968. *Otters: A Study Of The Recent Lutrinae.* William Clower & Sons, Lmtd., London, England.

Home, W. S., 1982. *Ecology of River Otters (Lutra canadensis) in Marine Coastal Environments*.M.S. thesis, Univ. of Alaska; Masters Abstr. 23(1): 121.

Jackson, H. T. 1961. *Mammals of Wisconsin*. pp382 – 389.

Johnson, S. & K. Berkley. 1999. *Restoring River Otters in Indiana*. Wildl. Soc. Bull. 27(2):419 – 427.

Kruuk, H. 1996. *Wild otters.* Academic Press. London, England.

Landis, B. 1997. *Yellowstone Otters.* A Film made for Nature. Produced by: Partridge Films, Ltd. and Thirteen/WNET. New York, NY.

Larsen, D. N. 1983. *Habitats, Movements and Foods of River Otters in Coastal Southeastern Alaska*. M.S. thesis, Univ. of Alaska, Fairbanks.

Liers, E. E., 1951. *Notes On The River Otter(Lutra Canadensis*). J. of Mammal. Vol. 32(1): 1 – 9.

Liers, E. E., 1958. *Early Breeding in the River Otter.* J. Mammal. 39(3): 438 – 439.

Martin, D. J., B. R. McMillan, J. D. Erb, T. A. Gorman, D. P. Walsh. 2010. *Diel activity patterns of river otters (Lontra canadensis) in southeastern Minnesota.* Journal of Mammalogy 91(5):1213-1224.

Melquist, W. E. & M. G. Hornocker, 1979. *Methods And Techniques For Studying And Censusing River Otter Populations*. Univ. Idaho For. Wildl. Range Exp. Stn. Tech. Rep. 8, mar. 1979.

Melquist, W. E. & M. G. Hornocker, 1983. *Ecology Of River Otters In West Central Idaho.* The Wildlife Society Monogr. #83. Apr. 1983.

Melquist, W. E. & A. E. Dronkert, 1987. *River Otter.* In: Wild Furbearer Management and Conservation in North America. M. Novak, J. A. Baker, M. E. Obbard, & B. Mallock editors, 626 – 641.

Mowbray, E. E., D. Pursley, J. A. Chapman, & J. R. Goldsberry, 1977. *Preliminary Observations on Otter Distribution and Habitat Preferences in Maryland with Descriptions of Otter Field Sign.* Trans. Northeast Sect. Wildl. Soc, 33: 125 – 131.

Mowbray, E. E., D. Pursley, & J. A. Chapman, 1979. *The Status, Population Characteristics And Harvest Of The River Otter In Maryland.* Md. Wildl. Admin. Publ. Wildl. Ecol. #2 Dec. 1979. Univ. Md., Frostburg State Coll., Gunter Hall, Frostburg 21532.

Park, E. 1971. *The World of the Otter.* J. B. Lippincott Co., New York.

Polechla, P. J., Jr., 1987. *Status of the River Otter (Lutra canadensis) Population in Arkansas with Special Reference to Reproductive Biology.* Ph.D. dissertation, Univ. Arkansas

Reid, D. G., W. Melquist, J. Woolington, & J. Noll. 1986. *Reproductive Effects of Intraperitoneal Transmitter Implants in River Otters.* J. Wildl. Manage. 50:92 – 94.

Reid, D. G., T. Code, A. Reid, & S. Herrero. 1994. *Spacing, Movements, and Habitat Selection of the River Otter in Boreal Alberta.* Can. J. Zool. 72:1314 – 1324.

Rock, K., E. Rock, R. Bowyer, & J. Faro. 1994. *Degree of Association and Use of a Helper by Coastal River Otters, Lutra canadensis, in Prince William Sound, Alaska.* Can. Field Nat. 108(3): 367 – 369.

Stevens, Sadie S., and Thomas L. Serfass. 2008. *"Visitation Patterns and Behavior of Nearctic River Otters (Lontra canadensis) at Latrines."* Northeastern Naturalist 15(1) 2008: 1-12. 15.1 (2008): 1-12. Zoological Record Plus (1978-Current). Web. 27 Apr. 2010.

Testa, J. W., D. F. Hollman, R. T. Bowyer, & J. B. Faro. 1994. *Estimating populations of marine river otters in Prince William Sound, Alaska, using radiotracer implants.* J. of Mammal. 75:1021 – 1032.

Toweill, D. E. & J. E. Tabor, 1982. *River Otter: Lutra Canadensis.* In: Wild Mammals of North America: Biology, Management and Economics. J. A. Chapman & G. A. Feldhamer editors. 688 – 703.

Woolington, J. D. 1984. *Habitat Use and Movements of River Otters at Kelp Bay, Baranof Island, Alaska.* M.S. thesis, Univ. of Alaska, Fairbanks.

CHAPTER 6 REPRODUCTION

Breeding: Season, Physiology, & Behavior

BREEDING SEASON

Monestrus; season ranges from November to May (rarely early June at latest). These otters are seasonal breeders. Females mature reproductively as early as 12-15 months (rare reports of successful breeding at this age) to two years of age (typical). They are believed to be induced ovulators and experience delayed implantation (Chanin 1985; Reed-Smith 2001, personal observation, Bateman et al. 2009). Recent evidence suggests that this species also may be capable of spontaneous ovulation (Bateman et al. 2009). See also Chapter 3 *Ex-Situ* Status for litter size, Dam/Sire age at reproduction (oldest and youngest), inter-birth interval.

There is evidence that breeding season varies somewhat with latitude. In general, breeding occurs in late spring (late March, April, and May, to early June*) at northern latitudes, and during late November, December, January, or February at more southern latitudes (Reed-Smith 1997, Bateman et al. 2009). The first editions of the notebook reported that: "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 estrus in some of his females, also, there are a few historic records of December/January breeding in New York." Based on the work by Bateman et al. (2009) at C.R.E.W. it is now likely that these otters originated at more southerly latitudes. One study, (Crait et al. 2006), speculated that breeding season may be influenced by seasonal availability of food resources; however, the authors of this study speculating on the influence of food availability acknowledge there could have been other things occurring, and their sample size was small. * Breeding in June in was reported from Yellowstone Lake, Wyoming (Latitude 44° 23') by Crait et al. (2006). See Estrous Cycle & Length below, Chapter 5 Breeding/Reproductive Behavior, Chapter 4 Female and Male Characteristics, and Chapter 3 Dam and Sire Information

ESTROUS CYCLE & LENGTH

Previously it was reported that the estrus period lasts approximately 42 - 46 days, unless mating occurs (Chanin 1985). Bateman et al. (2009) found that "*…peaks in fecal estrogen values occurred only during the defined breeding season from December to March*". They also report, "*…the estrus phase of their [females] cycles [N=11] was observed just once per year with an average duration of 15.33±1.98 days (range: 6–54 days). The average duration of estrus elevation coincident with observed breeding (n=4) was a 22.00±1.22 day (range: 19–24 days).*" During this time, observations of *ex-situ* populations suggest peaks of maximum receptivity are roughly 3-6 days apart with intervals of only mild receptivity during which the female may completely reject the male (Liers 1951; Reed-Smith 2001). The work done by Bateman et al. calls into question the estrus duration of 42 to 46 days traditionally cited; this is an area that should be researched further. Worth noting is the slightly longer estrus (21-23 days) reported in breeding versus non-breeding females (14-17 days); also the widely varying range of estrus duration (6-54 days) reported in the Bateman et al. (2009) study.

A "post-partum" estrus occurs soon after parturition of a similar duration of a typical estrus. Hamilton & Eadie (1964) give this estrus as occurring not long after parturition. Most zoos that have observed "post-partum" estrus see behavioral signs one to two weeks after parturition. Bateman et al. (2009) report: *"The time from parturition to first postpartum elevation in estradiol averaged 19.00±8.06 days (range 2-38 days)."* Bateman et al. (2009) also state that while in other species an estrus occurring shortly after parturition is properly termed a "*post-partum estrus*", in *"...the NARO the timing of this estrus also*

corresponds to the expected seasonal cyclicity seen in this species. These findings indicate that lactation, estrus, and the early stages of the subsequent pregnancy may occur simultaneously in the NARO, a characteristic shared by another mustelid the European badger (Rowlands and Weir 1984)."

The Bateman et al. (2009) studies reported some additional interesting results from fecal hormone studies:

> *"In the observed pregnancies and pseudopregnancies (n= 12), the date of initial progesterone increase ranged from September 4 to January 14, and the timing was not correlated (r=0.53, P>0.05) with the female's geographic latitude (range: 27–41°N) at the time of the pregnancy or pseudopregnancy. However, the date of the progesterone increase was correlated (r=0.66, P<0.05) with the female's geographic latitude at the time of her own birth (range: 27–42°N)."*

The finding of a possible genetic component tying the timing of progesterone elevation in pregnant and pseudopregnant females to the female's birth latitude (instead of to their geographic location) is significant and requires further study. This may potentially impact *ex-situ* population management practices (transfers of animals to create breeding pairs).

SIGNS OF ESTROUS

Females may show any, all, or occasionally none, of the following signs of estrus: vulvular swelling; a slight pinking of the vulva area; increased rubbing, rolling, and allo-grooming; increased interest in the male or the male's quarters; increased interaction between the female and the male to include chasing, tumbling, mutual-grooming, sleeping together (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. (Photo: pinking and swelling of vulva)

A vaginal discharge associated with estrus 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 estrus. If this kind of discharge is seen the female should be closely observed and the condition monitored by a veterinarian. (See also Health Care.) However, some institutions report slight blood spotting associated with estrus. See also Copulation Characteristics.

> *"When our breeding female is in estrus, 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 estrus, 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)

MALE SEXUAL CHARACTERISTICS

Males mature sexually at about two years; the production of spermatozoa begins at this age. The male's testes begin to enlarge and spermatozoa production begins sometime in October/November, (or earlier at more southern latitudes) and testes remain distended until the end of the breeding season (Liers 1951;

Reed-Smith 2001). Bateman et al. (2009) have shown that male testosterone levels increase seasonally (late winter to early spring) to coincide "…*with the increasing amount of daylight occurring after the winter solstice*." Testosterone levels peaked at different times of the year corresponding with the male's latitudinal location; *"As latitude increased, peak testosterone values appeared to occur later in the calendar year*" (Bateman et al. 2009). They found that *"for all NARO males, testosterone levels were elevated above baseline for an average of 101.8±78.97 days with peak levels being maintained for 25.50±7.51 days*."

It is believed by many who worked extensively with *ex-situ* otters 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 other four were over six years of age). 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. Studbook data shows four males breeding successfully at less than 2 years of age. Of these four records, two are old enough the data may be suspect. See Chapter 3 Sire Information and Chapter 4 Male Characteristics.

FEMALE SEXUAL CHARACTERISTICS

Generally, females also mature sexually at two years of age; although, Liers (1958) mentions one female who was bred at the age of 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. As previously stated females are induced ovulators and experience delayed implantation. However, Bateman et al. (2009) reported pseudo pregnancies in females that were not housed with males leading them to speculate this species may be capable of spontaneous ovulation under certain conditions. See Chapter 3 Dam Information, Chapter 4 Female Characteristics, and earlier in this chapter.

AGE OF SEXUAL MATURITY

Both males and females are sexually mature at the age of two years; several authors believe that males may not reach full breeding potential until they are 5 to 6 years of age. However, for management purposes pups over one year of age should be monitored or removed from the adult pair. Breeding between a dam and her 13 month old son was observed. It did not lead to pregnancy but the female did experience a pseudopregnancy (personal observation). (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 60+ 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.

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.

Total gestation lasts from ~317 to 370 days reported by Liers (1951) and Reed-Smith (2001) or 302-351 (average 333.3 ±15.7) days reported by Bateman et al. (2009); actual gestation is about 68-73 days (average 71.67±1.48) (Bateman et al. 2005, 2009).

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. Thom et al. (2004), Lindenfors et al. (2003), and Ferguson et al. (2007) discuss the maintenance of delayed implantation in modern mustelids/carnivores and possible reasons for this including its association with highly seasonal environments. See Chapter 4 Female Characteristics.

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.)

"The energy requirements and food intake of pregnant females are from 17 to 32% higher than non-reproducing 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).

EMBRYOS AND INTRAUTERINE MORTALITY

Once the egg is implanted, embryonic growth proceeds rapidly (Huggett & Widdas, 1951). Data suggests 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)
	309 – 367 days (Reed-Smith 1997 captive survey)
	302 – 351 days (ave. 333.3±15.7) (Bateman et al. 2009)
Actual gestation:	60 – 63 days (Lancia & Hair, 1983)
	50 days (Toweill & Tabor, 1982)
	68 – 73 days (Bateman et al. 2009)

INTER-BIRTH INTERVAL

Due to delayed implantation there is at least a years (theoretically this could be 10 to 11 months but there are no records of intervals less than 327 days [Hamilton 2012]) 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" estrus 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 primarily facilities that allow the male to stay in the enclosure with the female and pups, but not all of them

TABLE : EX-SITU POPULATION BREEDING PARAMETERS OF *LUTRA CANADENSIS* IN NORTH AMERICAN ZOOLOGICAL FACILITIES 1980'S THRU 2000'S

(Reed-Smith & Polechla 2002, Bateman et al. 2009)

Lutra canadensis	
Estrus cycle	Monoestrus; can occur Nov-May* based on latitude (rarely June) Post-partum elevations in estradiol levels occur 2 – 38 (ave. 19 ± 8.06) days after parturition (Bateman et al. 2009)
Estrus length	42-46 days unless mating occurs; "…the estrus phase of their cycles [N=11] was observed just once per year with an average duration of 15.33±1.98 days (range: 6–54 days). The average duration of estrus elevation coincident with observed breeding (n=4) was 22.00±1.22 days (range: 19–24 days)." (Bateman et al. 2009) Receptivity peaks roughly 6 days apart have been reported but not reflected in Bateman study.
Ovulation	Unclear if they are induced ovulators (Bateman et al. 2009), but suspected; may also ovulate spontaneously (Bateman et al. 2009)
Copulation frequency	Several times a day for a few days
Copulation duration	20-70+ minutes, varied. Shorter bouts typically not successful.
Copulation position	Dorsal/ventral most common, also ventro/ventral.
Copulation location	Most frequently in the water, also seen on land
Copulation initiated by	Both. Female advertises, cooperates only when she is ready. She may initiate with invitations to play chase.
Age at 1st breeding	Sexually mature by 2 yrs. Several 2 yr. old males and a few <2 years; a 1.5 yr. old female have bred successfully.
Breeding behavior	Female may rub, mark or vocalize to advertise; male/female may initiate w/ play, chase, splashing, genital sniffing, or "butterfly stroke".
Gestation	Total gestation: 332-370 days, documented for 12 litters. 285-380 (Liers 1951); 302-351 (ave. 333.3 ±15.7) days (Bateman et al. 2009) Actual gestation: 68 – 73 (ave. 71.67±1.48) days (Bateman et al. 2009)
Pseudopregnancy	Pseudopregnancies seen with and without breeding and does not always result when breedings are unsuccessful. The period of elevated progesterone ranges from 68 to 72 days as in true pregnancies. (Bateman et al. 2009)
Pair management	Most facilities separate the male from the female, for his safety. A few leave the male in exhibit with female and she keeps him away from pups until they can swim well. One facility offered pair selection; females showed preference for certain males.
Group management	Sire can be reintroduced to female and pups after pups are swimming well. Generally done at about 3-6 months.
Signs of parturition	Females may show visible weight gain, teats may show through coat, increased nesting behavior, change in attitude to keeper &/or male. She may go off food as parturition nears.

Pupping boxes	Pupping boxes should be filled with dry bedding (straw or hay). A choice of birthing boxes should be available.
Contraception	See Contraception below and Section 2, Chapter 10 Health Care

Pup Birth and Female Behavior

BIRTH SEASON

Parturition may occur from November through May, however, the peak time appears to be March or April in the northern latitudes (40º - 50ºN) and January to February at more southern latitudes (23º- 30ºN). There are always exceptions, if not, they would not be otters. It is not known what role, if any, captivity played in the early births seen in some of the more northern latitudes. In these cases the females may have come in pregnant from more southern latitudes, or, the pair may have originated at more southern latitudes and been housed inside at their current location. What this does mean is that we cannot be certain that a female in New York will not give birth in January if she comes from southern latitudes. However, early births at the more northern latitudes should be considered rare or outliers.

The recent work carried out by Bateman et al. (2009) at C.R.E.W. (Cincinnati Zoo) indicates: "*A similar influence of latitude* [as that seen in other Mustelids and male river otters] *appears to affect the seasonality of reproduction in female NARO, with estrus and breeding occurring earlier in the year at southern latitudes than at northern latitudes [Humphrey and Zinn, 1982; Crait et al., 2006; Gorman et al., 2006]. We suspect that the timing of implantation following diapause also might be affected by latitude. In this study, for example, parturition was noted in December for a female housed in Florida (latitude: 27° N), whereas a female in Massachusetts (latitude: 42° N) gave birth in March. These observations are consistent with those seen in European badgers (Meles meles), another mustelid with obligate delayed implantation. In Sweden, wild badgers living at higher latitudes (58–60° N) were found to give birth 1 month later compared with badgers located at lower latitudes (44° N and 50–52° N) [Ahnlund, 1980; Rowlands and Weir, 1984]. However, our data also suggest that seasonality of NARO may include a genetic component influenced by the dam's birth location. In pregnant and pseudopregnant NARO, the timing of the initial progesterone rise was positively correlated with the female's original birth location (i.e. latitude) but not with their current geographic location.*

The Latitude and Known or Estimated Birthing Dates table can provide a guideline as to when births are likely at your latitude. The Latitude and Litter Birth Date graphs which follow depict the known birth dates, by month, of litters listed in the N. A. River Otter Studbook (information provided by D. Hamilton). Again, the outliers are likely births to females that arrived pregnant at that particular location. This information is currently under evaluation to assess dam and sire's latitude of origin and is scheduled to be published.

Latitude and Known or Estimated Birthing Dates

Table: *Lontra canadensis* Latitude & Anticipated Birthing Season (H = Harris, 1968, B = Breeding Survey 1993; R = Review; E = Estimate [given as Peak, actual births may occur a month earlier or later; typically not later than May except for the far north**])**				
Zoo	City (Region)/State (Country)	Latitude	Birth Dates	Outlier
Abilene Zoological Gardens	Abilene, TX	32° 26' N	Feb/March (E)	
Akron Zoological Park	Akron, OH	41° 4' N	March/April (E)	
Alameda Park Zoo	Alamagordo, NM	32° 53' N	Feb/March (E)	
Alexandria Zoological Park	Alexandria, LA	31° 18' N	Feb/March (E)	
Alaska Zoo	Anchorage, AL	61° 13' N	March/June (E)	
North Carolina Zoological Park	Asheboro, NC	35° 42' N	Feb/March (E)	
Western NC Nature Center	Asheville, NC	35° 36' N	Feb/March (E)	
Bear Hollow Wildlife Trail	Athens, GA	33° 57' N	Feb/March (E)	
Capron Park Zoo	Attleboro, MA	41° 56' N	March/April (E)	
The Maryland Zoo in Baltimore	Baltimore, MA	39° 18' N	Feb/March (E)	
BREC's Baton Rouge Zoo	Baton Rouge, LA	30° 27' N	February (B) Dec/Jan (R)	
Oregon High Desert Museum	Bend, OR	44° 3' N	March/April (E)	
ZooMontana	Billings, MT	45° 46' N	March/April (E)	
Binghamton Zoo at Ross Park	Binghamton, NY	42° 5' N	March/April (E)	
Birmingham Zoo	Birmingham, AL	33° 30' N	Feb/March (E)	
Dakota Zoo	Bismarck, ND	46° 48' N	March/April (E)	
Miller Park Zoo	Bloomington, IL	40° 29' N	Feb/March (E)	
Connecticut's Beardsley Zoo	Bridgeport, CT	41° 10' N	March/April (E)	Jan. (B)
Chicago Zoological Park	Brookfield, IL	41° 49' N	March/April (E)	
Prospect Park Zoo	Brooklyn, NY	40° 47' N	Feb/March (E)	
Buffalo Zoological Gardens	Buffalo, NY	42° 55' N	March/April (E)	
Caldwell Zoo	Caldwell, TX	30° 31' N	Dec/Jan (E)	
Calgary Zoo	Calgary, Canada	51° 1' N	April/May (E)	
South Carolina Aquarium	Charleston, NC	32° 47' N	Feb/March (E)	
Tennessee Aquarium	Chattanooga, TN	35° 2' N	Feb/March (E)	
John G. Shedd Aquarium	Chicago, IL	41° 50' N	March/April (E)	
Lincoln Park Zoological Gardens	Chicago, IL	41° 50' N	March/April (E)	
Cincinnati Zoo & Botanical Garden	Cincinnati, OH	39° 8' N	Feb/March (E)	
Clearwater Marine Science Center	Clearwater, FL	27° 57' N	Dec/Jan (E)	
Cheyenne Mtn Zoological Park	Colorado Springs, CO	38° 50' N	Feb/March (E)	

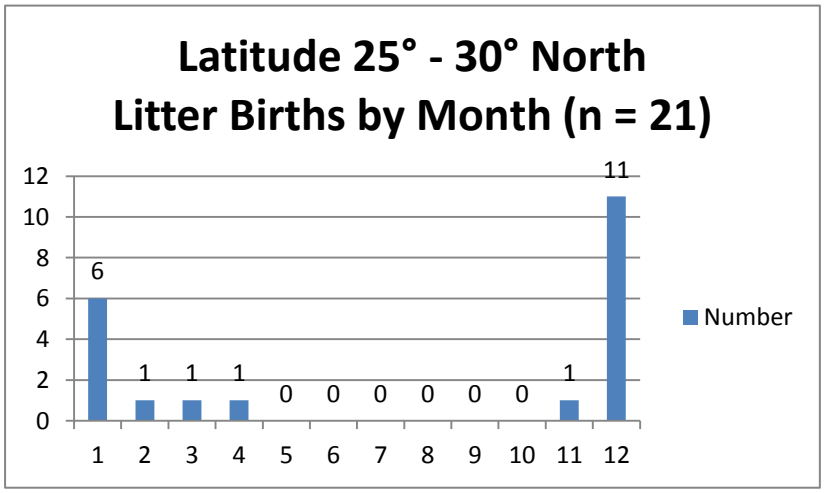
Table: *Lontra canadensis* Latitude & Anticipated Birthing Season **(H = Harris, 1968, B = Breeding Survey 1993; R = Review; E = Estimate** [given as Peak, actual births may occur a month earlier or later; typically not later than May except for the far north**])**				
Zoo	City (Region)/State (Country)	Latitude	Birth Dates	Outlier
Texas State Aquarium	Corpus Christi, TX	27° 48' N	January (B) Dec/Jan (E)	
Landry's Downtown Aquarium	Denver, CO	39° 45' N	Feb/March (E)	
Denver Zoological Gardens	Denver, CO	39° 45' N	Feb/March (E)	
Blank Park Zoo of Des Moines	Des Moine, IA	41° 35' N	March/April (E)	
Detroit Zoological Institute	Detroit, MI	42° 20' N	March/April (E)	
Zoo New England / Franklin Park Zoo	Dorchester, MA	42° 17' N	Mar/April (E)	
National Mississippi River Museum & Aquarium	Dubuque, I	42° 31' N	Mar/April (E)	
Lake Superior Zoological Gardens	Duluth, MN	46 ° 39' N	April/May (E)	
Northwest Trek Wildlife Park	Eatonville, WA	46° 52' N	April/May peak (E)	
Erie Zoological Gardens	Erie, PA	42° 7' N	March/April (E)	
Mesker Park Zoo	Evansville, IN	37° 58' N	February (B) Feb/March (E)	
Fort Wayne Children's Zoological Garden	Fort Wayne, IN	41° 7' N	March/April (E)	
Fort Worth Zoological Park	Forth Worth, TX	32° 43' N	Feb/March (E)	
Lee Richardson Zoo	Garden City, KS	37° 58' N	Feb/March (E)	
John Ball Zoological Garden	Grand Rapids, MI	42° 58' N	Late April (B, R) Mar/April (E)	
NEW Zoo	Green Bay, WI	44° 31'	March/April (E)	
The ZOO, Northwest Florida	Gulf Breeze, FL	30° 21' N	Dec/Jan (E)	
ZooAmerica (No. American Wildlife Pk.)	Hershey, PA	40° 17' N	Feb/March (E)	
Houston Zoo, Inc.	Houston, TX	29° 45' N	Dec/Jan (E)	
Hutchinson Zoo	Hutchinson, KS	38° 3' N	Feb/March (E)	
Tautphaus Park Zoo	Idaho Falls, ID	43° 30' N	Mar/April (E)	
Jackson Zoological Park	Jackson, MS	32° 17' N	Feb/Mar (E)	
Kansas City Zoo	Kansas City, MO	39° 6' N	Feb/March (H) March/May (E)	
Wildlife Prairie State Park	Kickappo Twnsh., IL	40° 45' N	Feb/March (E)	
Bays Mountain Park	Kingsport, TN	36° 32' N	Feb/March (E)	
Knoxville Zoological Gardens	Knoxville, TN	35° 57' N	Feb/March (E)	
Los Angeles Zoo & Botanical Gardens	L. A., CA	34° 3' N	Feb/March (E)	
Potter Park Zoological Gardens	Lansing, MI	42° 43' N	Mar/April (E)	End Jan (H)
Folsom Childrens Zoo	Lincoln, NE	40° 48' N	March/April (B)	

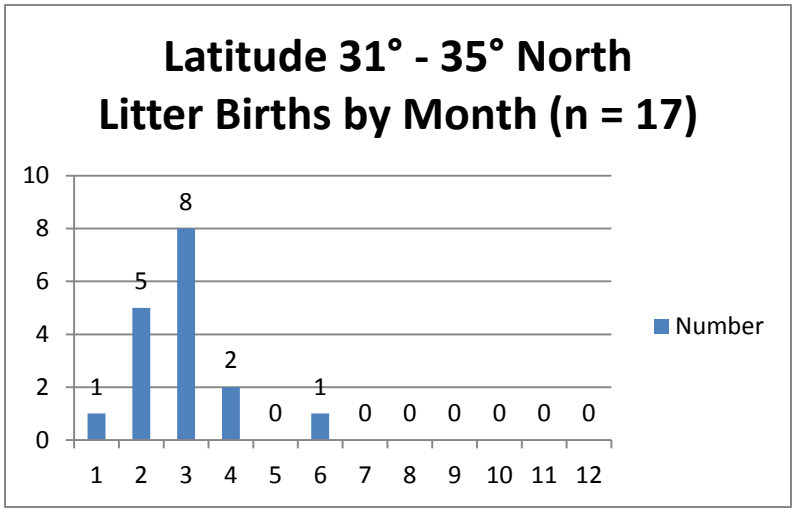
Table: *Lontra canadensis* Latitude & Anticipated Birthing Season (H = Harris, 1968, B = Breeding Survey 1993; R = Review; E = Estimate [given as Peak, actual births may occur a month earlier or later; typically not later than May except for the far north**])**				
Zoo	City (Region)/State (Country)	Latitude	Birth Dates	Outlier
			Feb/March (E)	
Little Rock Zoological Gardens	Little Rock, AR	34° 44' N	March/April (B) Feb/March (E)	
Ellen Trout Zoo	Lufkin, TX	31° 20' N	Feb/March (E)	
Henry Vilas Zoo	Madison, WI	43° 4' N	Mar/April (E)	
Brevard Zoo	Melbourne, FL	28° 5' N	Dec/Jan (E)	
Trevor Zoo	Millbrook, NY	41° 47' N	Mar/April (E)	
Milwaukee County Zoological Gardens	Milwaukee, WI	43° 2' N	March (B) Mar/April (E)	
Minnesota Zoological Garden	Apple Valley, MN	44° 59' N	March/April (B)	
Roosevelt Park Zoo	Minot, ND	48° 13' N	April/May (E)	
Montgomery Zoo	Montgomery, AL	32° 22' N	Feb/March (E)	
Biodome de Montreal	Montreal, Canada	45° 30' N	March/April (E)	
Brookgreen Gardens	Murrells Inlet, SC	33° 33' N	Feb/March (E)	
Audubon Zoo	New Orleans, LA	29° 57' N	Dec/Jan (E)	
Virginia Living Museum	Newport News, VA	36° 58' N	Feb/March (E)	
Elmwood Park Zoo	Norristown, PA	40° 7' N	March/April (E)	
Maritime Center at Norwalk	Norwalk, CT	41° 7' N	March/April (E)	
Provincial Wildlife Park	Nova Scotia, Canada	45° 6' N	March/April (E)	
Oakland Zoo	Oakland, CA	37° 48' N	Feb/March (E)	
Oklahoma City Zoological Park	Oklahoma City, OK	35° 28' N	Feb/March (E)	
Omaha's Henry Doorly Zoo	Omaha, NB	41° 15' N	March/April (E)	
NC Aquarium at Pine Knoll Shores	Pine Knoll, NC	34° 58' N	Feb/March (E)	
Pittsburgh Zoo & Aquarium	Pittsburg, PA	40° 27' N	Feb/March (E)	
Oregon Zoo	Portland, OR	45° 31' N	March/April (E)	
Columbus Zoo and Aquarium	Powell, OH	40° 0' N	Feb/March (E)	
Pueblo Zoo	Pueblo, CO	38° 15' N	Feb/March (E)	
NC Aquarium On Roanoke Island	Roanoke Island, NC	35° 52' N	Feb/March (E)	
Seneca Park Zoo	Rochester, NY	43° 9' N	Spring (B) March/April (E)	
Fort Rickey Children's Discovery Zoo	Rome, NY	43° 12' N	Mar/April (E)	
Sacramento Zoo	Sacramento, CA	38° 34' N	March (B) Feb/March (E)	
Salisbury Zoological Park	Salisbury, MD	38° 21' N	Feb/March (E)	
San Diego Zoo	San Diego, CA	32° 42' N	Feb/March (E)	

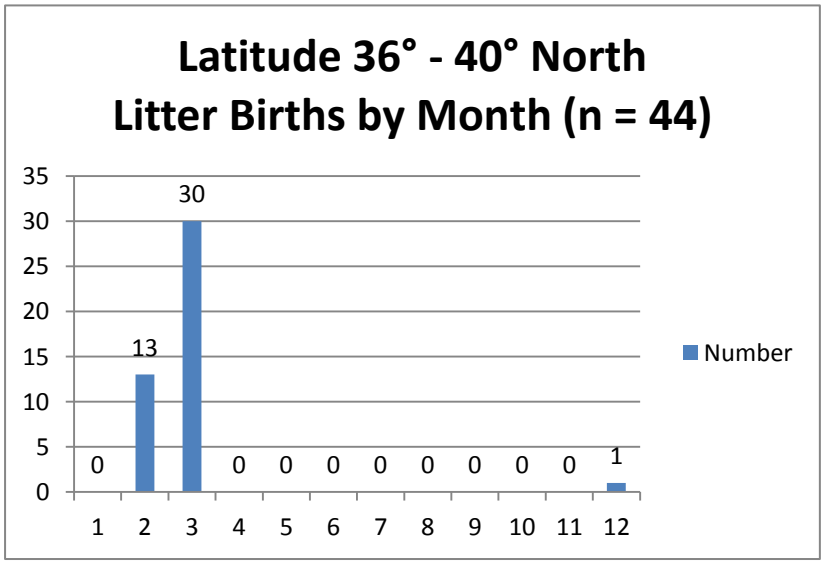
Table: *Lontra canadensis* Latitude & Anticipated Birthing Season (H = Harris, 1968, B = Breeding Survey 1993; R = Review; E = Estimate [given as Peak, actual births may occur a month earlier or later; typically not later than May except for the far north**])**				
Zoo	City (Region)/State (Country)	Latitude	Birth Dates	Outlier
San Francisco Zoological Gardens	San Francisco, CA	37° 47' N	Feb/March (E)	
CuriOdyssey, aka: Coyote Point Museum	San Mateo, CA	37° 33' N	Feb/March (E)	
Lehigh Valley Zoo	Schnecksville, PA	40° 40' N	Feb/March (E)	
Woodland Park Zoological Gardens	Seattle, WA	47 ° 37' N	April/May (E)	
Seattle Aquarium	Seattle, WA	47 ° 37' N	April/May (E)	
Silver Springs Park	Silver Springs, FL	29° 12' N	Dec/Jan (E)	
Calvert Marine Museum	Solomons, MD	38° 19' N	Feb/March (E)	
Henson Robinson Zoo	Springfield, IL	39° 48' N	Feb/March (E)	
Dickerson Park Zoo	Springfield, MO	37° 12' N	Feb/March (E)	
Saint Louis Zoological Park	St. Louis, MO	38° 37' N	February/March (B), (E)	
Stamford Museum & Nature Center	Stamford, CT	41° 3' N	Mar/April (E)	
Rosamond Gifford Zoo at Burnet Park	Syracuse, NY	43° 2' N	Early April (B) March/April (E)	
Tallahassee Museum of History and	Tallahassee, FL	30° 26' N	Dec/Jan (E)	
Florida Aquarium	Tampa, FL	27° 57' N	Dec/Jan (E)	
Tampa's Lowry Park Zoo	Tampa, FL	27° 57' N	Dec/Jan (B) (E)	
Topeka Zoological Park	Topeka, KS	39° 2' N	Feb/April (E)	
Toronto Zoo	Toronto, Canada	43° 40' N	April (B); March/April (E)	Nov .(B)
Tulsa Zoo & Living Museum	Tulsa, OK	36° 9' N	Feb/March (E)	
The Wild Center	Tupper Lake, NY	44° 13' N	March/April (E)	
Arizona-Sonora Desert Museum	Tucson, AZ	32° 13' N	Feb/March (E)	
Texas Zoo	Victor, TX	32° 12' N	Feb/March (E)	
Virginia Aquarium&Marine Science Ctr	Virginia Beach, VA	36° 51' N	Feb/March (E)	
Cameron Park Zoo	Waco, TX	31° 32' N	Feb/March (E)	
Chahinkapa Zoo	Wahpeton, ND	46° 15' N	April/May (E)	
Smithsonian National Zoological Park	Washington, D.C.	38° 53' N	Feb/March (E)	Dec/Feb (H)
NY State Zoo at Thompson Park	Watertown, NY	43° 58' N	Mar/April (E)	
Turtle Back Zoo	West Orange, NJ	40° 47' N	Feb/March (E)	Jan/Feb (B)
Palm Beach Zoo at Dreher Park	West Palm Beach, FL	26° 42' N	Nov/Jan (R) Dec/Jan (E)	
Oglebay's Good Children's	Wheeling, WV	40° 3' N	Feb/March (E)	

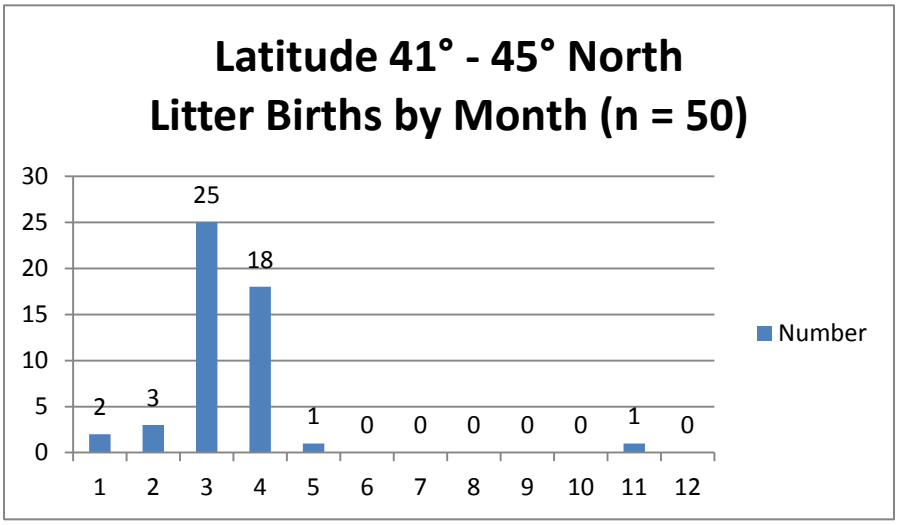
Table: *Lontra canadensis* Latitude & Anticipated Birthing Season **(H = Harris, 1968, B = Breeding Survey 1993; R = Review; E = Estimate** [given as Peak, actual births may occur a month earlier or later; typically not later than May except for the far north**])**				
Zoo	City (Region)/State (Country)	Latitude	Birth Dates	Outlier
Zoo				
Sedgwick County Zoo	Wichita, KS	38° 28' N	Feb/March (E)	
Brandywine Zoo	Wilmington	39° 44’ N		
Science Center & Environment Park	Winston-Salem, NC ?	36° 5' N	Feb/March (E)	
ECOTARIUM	Worcester, MA	42° 15' N	March/April (E)	
	Homosassa Springs, FL	28° 48' N	December/January (B) Dec/Jan (E)	
	California	34° - 42°	March/April (H)	
	Bristol, England		April (R)	
	Florida	26° - 30°	February (H) Dec/Jan (E)	
	Manhattan, KS	39°	March/April (B) Feb/April (E)	
	Manitoba, Canada	50°	Late April (H) April/May peak (E)	
	Michigan	42° - 46°	Peak March/April (H); March/April (E)	
	Winnona, Minnesota	44°	March/April (E)	Jan. (H)
	Minnesota	44°	Early spring (H) March/April (E)	
	New York City	41°	March/April (E)	Jan. (H)
	New York State	41° - 45°	Mid-end March (H); March/April (E)	
	North Mackenzie	62° - 67º	?Jan/March (H) May/June (E)	
	Oregon State	42° - 46°	April/May (H) March/April (E)	
	Memphis, TN	35°	March (B), Feb/March (E)	
	Nashville, TN	36°	February (B) Feb/March (E)	
	Texas State	28° - 34°	End February (H) Dec/Mar (E)	
	Texas State	28° - 34°	February/March (B) Dec/Mar (E)	
	Utah State	37° - 41°	Mid-April (H) Feb/March (E)	
	Virginia	37° - 39°	April/May (H) Feb/March (E)	
	Virginia	37° - 39°	March (B) Feb/March (E)	

Latitude and Litter Birth Dates by Month

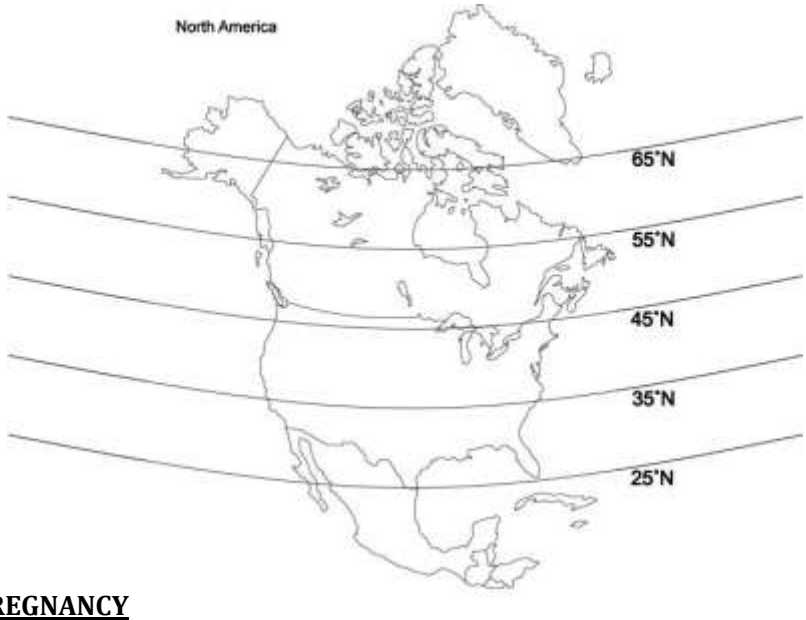








Latitude Map for North America



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 were 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 estrus 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. Pseudo pregnancies also were reported in a female housed only with another female by Bateman et al. (2009).

PRE-PARTUM WEIGHT GAIN

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, and 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. 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).

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.**

DIET AND A PREGNANT OR LACTATING FEMALE

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

An increase of 10 to 20% in a pregnant female's diet should be considered during the last trimester and an increase of 30% of base diet offered during early lactation. The female's diet throughout lactation should be monitored closely and increased as necessary. (See Diet & Nutrition) An increase in the fish portion of the diet generally should precede the proportional increase in the rest of the diet.

SIGNS OF IMMINENT PARTURITION

The female may exhibit a number of different signs including: increased 'nest' building, aggression towards exhibit mates or keepers, depressed appetite, frequent floating in the pool, refusal to leave the nest box, restlessness, or lethargy. No pregnancy associated pelage changes have been noted but abdominal distension has always been noted and usually mammary development. No pre-partum discharge has ever been noted.

In one institution, 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. This pre-partum behavior will vary between females and between successive litters for a single female. There are reports of females showing no signs of immanent birth with no obvious physical changes to a more typical reporting of mammary development at least one week prior to birth which is associated with increased nesting, and behavioral changes such as lethargy, increased appetite, and aggression towards enclosure mates or keepers.

Getting Ready for Parturition

There are several steps that may need to be taken; including provision of multiple denning boxes/locations, removal of the male from the enclosure, separating the male and female by alternately allowing them onto exhibit, etc. The next several pages provide an example of one institution's protocol. See Appendix A for Columbus Zoo's Impending Birth Plan Template.

(Photo: Pittsburgh Zoo)

Photo: Scott Shelley, Columbus Zoo and Aquarium

Columbus Zoo North American River Otters Birth Plan 2012

This document is reviewed annually and changed to fit the current circumstances and/or animals involved. This current version was designed for management of an experienced female; inexperienced females may require a more hands-on approach, at least initially. It is important that a birth plan is developed to anticipate the individual animal's needs, personality, enclosure situation, institutional policies, and care-giver experience with the expectant female.

OVERVIEW:

1.1 North American otters are currently housed at the N. A. Wetlands exhibit. Although they still had their 2010 pups during the breeding season of 2011, there is still the possibility she could be pregnant. Audrey and Babar were together during the breeding season, and there was confirmed breeding observed on April 5, 2011 (the pups had been removed from the exhibit for the day and taken to the hospital for pre-ship exams). Based on a gestation of 302-362 days, we were thinking that puts us at possible dates between **February 1 and April 2, 2012**. All three of her past litters have come in March (3/3/06, 3/13/08, 3/19/10).

Helen Bateman emailed, "Since your river otter, Audrey, has given birth before I am going to suggest that you use her last parturition date as your guide for this year. Females tend to stick very close to the same parturition date from year to year - but there is a possibility it could fluctuate by a week or two. So you would be looking at an estimated potential birth of **March 6th - April 2nd.** And given her history I would concentrate on mid-March".

Previous pregnancies timeline:

- Breedings were observed throughout the month of March.
- Fecal samples were collected November through mid-January for analysis.
- Increased defecation in the pool December and January.
- Audrey kicking Babar out of dens December and January
- Audrey showed increased appetite December through February.
- All three pregnancies resulted in birth during early to mid-March.
- Eyes began opening at 32 days.

- First swimming lessons at 37 days.
- Lots of playing and exploration by early summer.
- Male (Babar) reintroduced to Audrey and pups in exhibit
- Pups transferred to new homes by early fall.

GOALS:

To once again have Audrey give birth and successfully rear her own litter, but with the acceptance of the keeper staff when necessary. In the past Audrey has been very cooperative in letting Keepers monitor the pups health and progress.

STAFF ASSIGNMENTS:

Keepers:

- Will be responsible for: preparing/reviewing this birth plan
- Preparing the "otter pup prep box"
- Setting up an incubator at wetlands
- Seeing that the dens are ready and the area is cleaned up
- Work with the Media Dept. to see that the 3 cameras, monitor, and DVR are installed and ready to go by Feb.1
- Observations of any behavioral changes from Audrey, towards Babar or otherwise, should be noted in a tablet at Wetlands
- Continue to monitor Audrey's health and behavior and make recommendations based on these observations
- Review overnight video recordings where necessary
- Take turns with observations and/or 24 hour care (pre- or post-birth) as needed/scheduled
- Communication of observations to co-workers, curators and vets.

Curatorial Staff:

- Review and approve Birth Plan
- Receive daily updates from keepers and vets on observations and progress.
- Assign shifts as needed on 24 hour care.
- Will make decision with input from keepers and vets on if we need to pull the pups for first health check or hand rearing.
- Will contact other institutions should advice and/or recommendations be needed.
- Will make recommendations and organize transfer of pups as needed.
- Will be there to give the keeper staff whatever they may need to appropriately accomplish their jobs and make them happy.

Animal Health Staff:

- Review Birth Plan
- Receive daily updates from keepers on observations and progress.
- If there are concerns with the general thriftiness of the pups after 12 hours, they will be pulled for a well-baby check.
- Will make recommendation based on input from keepers and curatorial staff if we need to pull the pups for hand rearing.
- If pups are pulled, will do a physical exam to determine health and will recommend whether to hand raise or put back with mother.
- May be needed to assist in 24 hour care if pups are in critical condition.
- If pups are doing well with mother, pups should be pulled at 2 weeks for physical exams and returned to mother as quickly as possible.

REPRODUCTIVE HISTORIES:

Babar: 1.0 ISIS # 972073

* Captive born on 3/17/93 at the St. Louis Zoo.
* Arrived at the Columbus Zoo on 11/17/97, at 4 ½ years of age.
* He was introduced to the Columbus Zoo's 7 year old female, "Birdie" (912073), in Jan. 1998. Numerous breedings were observed in 1999 and 2000. The female exhibited denning and other pregnancy behaviors, but no births occurred in 1999 or 2000.
* Columbus Zoo transferred "Birdie" to another institution and received 0.1 "Audrey" on loan from the Nashville Zoo (see below for her history).
* Babar successfully sired 3 litters with "Audrey" : 3 pups in 2006: (only 1 survived): 3 pups in 2008 (1.2): and 3 pups in 2010 (3.0). See Audrey below.

Audrey: 0.1 ISIS # 204095

* Was wild born in Feb. 2001 (est) and parent raised in Kentucky. (some of the paperwork says she was hand-reared later by rehabbers) She was obtained by the Nashville Zoo from Kentucky rehabbers. She was housed with an older male and breeding was observed in Spring 2004.
* Introduced to current cagemate "Babar" (1.0) November 2004
* Gave birth to 3 pups on 3/3/2006: 1st was stillborn, 2nd pup died 3/3/06, 3rd pup pulled and sent to a surrogate mother at another institution to be placed with her pups. Audrey did not nurse the pups although she was very attentive to them.
* Gave birth to 3 pups on 3/13/2008: This time Audrey was able to raise all three pups on her own. She was a very attentive mother and seemed to do all the right things including teaching them to swim at 37 days old!
* Gave birth to 3 pups (3.0) on 3/19/2010:Audrey again raised all three pups on her own.

** The first date we have **noted** for breeding was April 5, 2010 (the pups were taken to the hospital for a pre-ship exam) So, based on a gestation of 302-362 days, we were thinking that puts us at possible dates between February 1 and April 2 , although, the male was in the exhibit and breeding could have occurred earlier than this.

PRE-PARTUM PREPARATIONS FOR 2012:

- **2 months before** – Have a plan in place and supplies ready should we need to again move the male out of the area. If this is necessary, Babar will be moved to Polar Building/maternity side.
- Needed modifications:
    - hotwire mesh panel needs to be re-hung outside of Door #
    - board or something on inside of that transfer door, as a failsafe, to keep his feet from getting "pinched" should brown bears bang on that door
    - hallway transfer chute between maternity and brown bear needs closed and secured so cannot be mistakenly opened
    - 2' wide piece of "Sintra" placed 2' high on front of indoor *and outdoor* caging to prevent climbing/falling
    - top made for food chute to prevent climbing out
    - recycled plastic 2x4 pieces under transfer door frames where he could possibly get under
    - pool steps very steep – a log or plastic ramp needed to get in and out of pool
    - signs placed on brown bear side as a reminder not to use the hallway transfer. (will be locked down as well)

- **1-2 months before** - Notebook placed at wetlands to jot down any notes reflecting on her behaviors
- **1 month before** - Media department to install 3 cameras, 1 over each of the dens. These are connected to a video monitor in the keeper area (separate room from otter room) with a DVR for recording activity. This will enable us to monitor the birth and behaviors 24 hours a day, without disturbing the otters during this sensitive time.
- **1 month before** – Maintenance will install a plywood wall in front of public viewing den to give Audrey more seclusion. A window in this will give keepers ability to check on her without going in back.
- **1 month before -** Prepare a plastic container labeled "OTTER PUP PREP BOX" and fill with the following items: (for health checks and if hand-rearing necessary).

Volufeeder	Volufeeder nipples(red,yellow, peach)
Pet nurser	eye dropper
vinyl gloves	blankets
scrub shirts	hot water bottle
heat pad	thermometer
KY gel	alcohol wipes
Esbilac – Canine	Pedialyte
sterile water	infant record sheets
flashlight	Scale

  - ✓ Latest copy of the "N.A. River Otter Husbandry Manual"
  - ✓ A copy of the "2012 N.A. River otter Birth Plan"
  - ✓ A copy of the "Birth Plan Tracking Summary" outline to follow

PLAN:

- **Audrey functions best if there is little change to her routine**
- Increase her diet 1-2 months before expected parturition *if* showing an increased appetite.
- Due to her last 2 births being in the back den, we assume, and will plan that that is where she will be the most comfortable having her pups. Bed both back pens and give otters access to all day.
- Some things to watch for that may indicate we need to think about moving Babar out would be; aggression towards pups or Audrey, interference with maternal care such as nursing, sleeping, transferring pups or any other undue stress on mother or pups that is causing diminished care for the pups.
- When birth appears imminent, we will set up a 24 hour/7 day staff watch using the monitors outside the otter room. Notes should be kept of all observations – note if mother aggressive or ignoring pup(s), pups nursing, mom grooming pups, are pups active with strong vocalizations, etc.
- If the male needs to be moved, we will continue giving her access to the front and back dens with the tunnel open. We will not use the 2 den boxes in the yard at this time.
- Only full-time keepers who she is familiar with should be servicing the area
- After the birth is confirmed, she appears to be done having the pups, and they are nursing, we need to BRIEFLY pull the pups to confirm they are successfully nursing and that Audrey is producing milk.
- Other reasons we may consider pulling the pups would be:
  i. Audrey's lack of interest in 1 or all of the pups
  ii. Aggression towards 1 or all of the pups
  iii. Pups do not appear to be nursing
  iv. Pup(s) appear weak or in distress
- Do not need to dump the pool. Audrey has shown that she has control and will take them there when she/they are ready. Pups can crawl out using the log or the overflow. Would be more worried about a pup falling into an empty pool.

SIGNS OF COMING PARTURITION:

(Could include any, all, or none of these signs)

- Increased aggression towards cagemates and/or keepers, increased nest building, decreased appetite, swollen nipples, frequent floating and stooling in pool, refusal to leave den, restlessness, excessive grooming of genital area. At this time a birth watch schedule should be set up.
- Notify Curators, Hospital staff, and keeper staff of any of these signs

AFTER PARTUITION:

- Immediately after birth notify-
    i. Vet staff
    ii. Curators
    iii. Keeper staff
    iv. Animal Nutrition staff (to be on their toes should anything dietary be immediately necessary)
- Note time of birth and any relevant details in the notebook.
- Write the "Birth Plan Tracking Summary" (see outline to follow)
- We will not intervene unless there is a problem (such as: if mother is aggressive or ignoring pups, pups not nursing, pups seem weak when they vocalize, etc.). It was decided that we would do a 24 hour check. If it is deemed necessary: Weigh them, mark them, be prepared to tube them. The procedure should not take more than 10 minutes, total. Gloves should be worn when handling the pups. It will then be decided when the next check will be depending upon the findings on the initial well check. Keepers on the watch should review the tapes and talk to the previous watchers about their shift. Our goal of course is to have mom rear them and this may mean we need to help her along by supplemental feedings. Have the husbandry manual available for reading while keepers are on watch, there is much information on mother reared babies including weight gain and development. The incubator at wetlands should be turned on at any time now in case of emergency hand rearing.
- Otter moms will often move their pups, so she should have access to all three dens.
- If Curator/vet staff decides animal(s) to be pulled and hand reared, staff previously identified with hand-rearing experience or as designated care givers should be notified. Once pups are feeding on the bottles and a routine/schedule is established the keeper staff can assist with the care.
- Each morning, the tapes from night before should be reviewed by a keeper.
- Cleaning of the pens may or may not be done for 2 or 3 weeks after birth depending on the comfort of the mother and pups. Luckily Audrey was very comfortable with her normal keepers transferring her and removing the pups for exams and cleaning of the pens with her last two litters.

HAND-REARING:

If pup(s) are pulled to be hand-reared, the "OTTER PUP PREP BOX" should have all the necessary items and instructions.

If Curator/vet staff decide anima(s)l to be pulled and hand reared, appropriate staff should be contacted, including any with hand-rearing experience. Once pups are feeding on the bottles and a routine/schedule is established the keeper staff can assist with the care.

Contact Numbers:

Veterinarians, veterinary technicians
Appropriate Curators
Registrar
Keepers
Nursery staff if appropriate
Security
IT or photography staff

WEIGHT HISTORY SAMPLE FOR 0.1 AUDREY:

Report Date	Zoo ID	House Name	Common Name	Current Weight	Previous Weight	Weight Difference	Gender	Initials
12/5/2004	204095	Audrey	River Otter	19 lbs	No Entry	0.00 lbs	Female	SS
6/21/2005	204095	Audrey	River Otter	18 lbs	19 lbs	(1.00) lbs	Female	JZ
8/22/2005	204095	Audrey	River Otter	19 lbs	18 lbs	1.00 lbs	Female	as,df
Comments: last weight was on 6/21/05								
11/7/2005	204095	Audrey	River Otter	17 lbs	19 lbs	(2.00) lbs	Female	SS
Comments: Very hungry!! put in yesterday for diet increase.								
11/18/2005	204095	Audrey	River Otter	19 lbs	17 lbs	2.00 lbs	Female	DF
Comments: scale might have been off going to re-weigh on the 19th								
11/19/2005	204095	Audrey	River Otter	19 lbs	17 lbs	2.00 lbs	Female	DF
Comments: this weight is accurate!								
2/12/2006	204095	Audrey	River Otter	22 lbs	19 lbs	3.00 lbs	Female	SS
3/30/2006	204095	Audrey	River Otter	19 lbs	22 lbs	(3.00) lbs	Female	SS
Comments: 22 lbs. is when she was pregnant in Feb								
5/10/2006	204095	Audrey	River Otter	16 lbs	19 lbs	(3.00) lbs	Female	JZ
Comments: Diet increase will start tomorrow.								
9/18/2007	204095	Audrey	Otter, NARO	17.5 lbs	19 lbs	(1.50) lbs	Female	SS
Comments: The previous weight was actually 16# but we believe there was trouble with the scale. We have since used a new scale.								
1/15/2008	204095	Audrey	Otter, NARO	19.5 lbs	17.5 lbs	2.00 lbs	Female	SS
2/4/2008	204095	Audrey	Otter, NARO	20.4 lbs	19.5 lbs	0.90 lbs	Female	SS
2/23/2008	204095	Audrey	Otter, NARO	22.3 lbs	21.4 lbs	0.90 lbs	Female	ss
Comments: previous weight was on 2/15 and weight before that was 20.4 on 2/4								
5/6/2008	204095	Audrey	Otter, NARO	20.5 lbs	22.3 lbs	(1.80) lbs	Female	ss dp
5/27/2008	204095	Audrey	Otter, NARO	19.8 lbs	20.5 lbs	(0.70) lbs	Female	SS, JZ

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.

One institution reports that their female exhibited changes in appetite after giving birth, with a sporadic decrease both before and after parturition, usually starting one to two months before and continuing one to two months after. This led her to come for meals only once per day and periodically refusing food entirely during this four month period. A prolonged refusal to eat should not be anticipated and should lead to examination of the female.

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.

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. Between 1969 and May 2000 there were 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) (Reed-Smith 1994-1995, 2001). A review of the records by Reed-Smith (1994) and Bateman et al. (2009) indicates that a female will frequently give birth within a two week window of previous births; some females have given birth on the same day in alternating years.

(Photo: Graham Jones, Columbus Zoo)

Pups and Pup Development

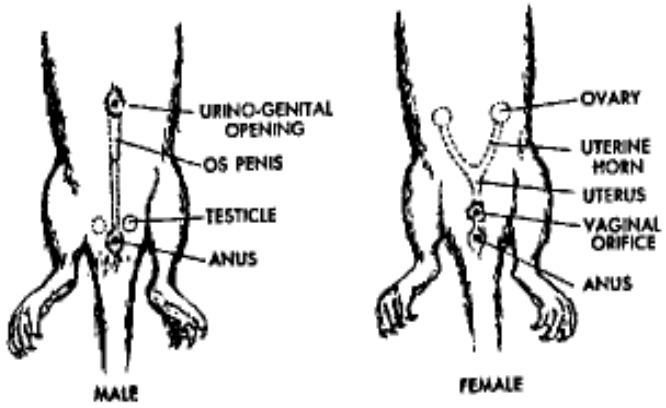
NEONATAL MORTALITY
As with most animals, mother neglect, injuries from the mother's exhibit mates, cold, and dampness must be watched for. Facilities responding to the 1994 Breeding Survey listed the preceding reasons, or unknown, for most neonatal deaths. K. Petrini reported being notified of a neonate's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

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.



Reprinted with permission from the Wildlife Society, 1980.

Female otter pup (Photo: Herb Reed, New York State Zoo Volunteer)

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. See also Section 2 Chapter 8.

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)
	Day 50 (GR) i.e. appeared to be opening
Eyes focus	Day 50 - 60 eyes focusing
First walk	Day 36 unsteady (range 35 – 42 days)
Pelt change	Day 46 – beginning to show light hairs around the face (Johnstone, 78)
	Day 26 – muzzle hairs lightening (JBZ); range 28 – 56 days
Leave the nest box	Day 38/50 (JBZ) carried by mother (see swim); range 38 – 70 days
	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
	Range ~ 28 – 58 days
	Day 58 (GR) in female's water tub
	Day 28 to 55 (LR) lessons got longer by day 42
	Day 62 (JBV) pups putting heads under water
Localized latrine use	By around day 49 (Liers, 1951)
First solid food	Day 57 & Day 66 (JBZ – 2 litters)
	Day 59 (GR)
	Day 60 (LR)
	Range ~42 – 56 days
Total nursing time	Three to four months (Nowak, 1991); may begin ~75 days
Weaning age	Day 91 – or about that time (Liers, 1951)
	Day 73 – Female separated so pups can eat
	Day 75 – started weaning (GR)
First molt	Day 119 – began molting for 1st time

FIRST SWIM

Otter pups must be taught how to swim. In captivity, females may begin these lessons earlier (day 38 plus or minus a few days up to 45+ 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. The Institutional charts reflect exact day weights taken. (See Hand-rearing for additional weight data.)

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)
	428 – 496 (LR)
Day 21	687 (MIN)
	566 – 687 (LR)
	721 – 912 (JBZ)
Day 28	930 (MIN)
	907 – 910 (JBZ) – 1993 litter
	952 – 1180 (JBZ) – 1995 litter
	756 – 890 (LR)
Day 35	1045 (MIN)
	1115 – 1230 (GR)
	997 – 1043 (JBZ) – 1993 litter
	1232 – 1562 (JBZ) – 1995 litter
	1030 – 1151 (LR)
Day 42	1343 (MIN)
	1230 – 1290 (GR)
	1200 – 1300 (JBZ) – 1993 litter
	1215 – 1428 (LR)
Day 49	1161 (MIN)
	1339 – 1478 (GR)
	1473 – 1649 (LR)
	1736 – 2072 (JBZ) – 1995 litter
Day 56	1656 – 1814 (JBZ) – 1993 litter
	1742 – 1907 (LR)
Day 63	1914 – 2247 (LR)
Day 70	1678 – 1996 (JBZ) – 1993 litter
	1845 – 2419 (GR)
	2410 (LR)

N. A. River Otter Pup Weights – Table Institution 1

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

N. A. River Otter Pup Weights (Males /n = 6) Table Institution 2

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 Institution 2

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.

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 estrus and the implantation of the embryo; Bateman et al. (2009) speculate it may be tied to lengthening days after the winter solstice. Photoperiods in indoor exhibits should mimic a natural day/night cycle regardless of breeding or non-breeding goals. M. Ben-David (personal communication) has theorized that temperature change could play a role in prompting the onset of estrus.

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). 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). Since the mid-1990's zoological institutions have improved their breeding of this species with a goal towards a self-sustained captive bred population with room for non-releasable orphans.

Housing Multiple Otters to Allow for Choice

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. 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 several 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. Another facility annually brought in a male for the breeding season leading to a litter a year from one or the other of their two resident females.

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. Typically, pairs prove to be more successful breeders if they are not introduced when very young, i.e. 2 years or less. Following are six examples of pair management practices from facilities that have had successful otter breeding at their institutions:

Example One – Single pair left together for rearing

At least two institutions have used this approach successfully. In both cases the enclosures were designed in a way that allowed for this management technique and/or were large enough to accommodate this approach. . The animals were kept together all of the time, the pairs reproduced annually. 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 den. Essentially, the female decided when it was all right for the male to approach the pups, generally when they were swimming fairly proficiently.

> *"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 more 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)

Example Two – Single pair housed together year-around

In one case the pair was maintained together for 11 years before they bred successfully in 1998. The institution was unaware that the female was pregnant until the day before she gave birth. The morning of parturition the female 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. Typically, this approach works less well if the animals are housed together from a young age.

Example Three – Single pair or male w/multiple females separated then reintroduced prior to breeding season

In this example 1.2 otters were held; females were rotated on exhibit with the male because they did not get along. The pair (the second female showed no interest in the male and never produced a litter) was kept together during the

day and all animals were separated at night. The protocol was to stop putting a female with the male during the day in December and begin reintroducing them in March (for Michigan). The introductions occurred every second to third day and lasted only ½ to 1 hour unless breeding was seen, at which time the pair was left together all day. Pups were produced every-other year. After the 1st litter the separation period prior to estrous season was no longer employed.

Based on behavioral records and Helen Bateman's reproductive physiology studies the following guidelines are suggested if you utilize this separation method to promote interest in breeding.

- Otters should be separated two to three months prior to typical breeding season.
- Breeding season typically lasts 19 to 24 days (Bateman et al. 2009).
- In the chart below the peak month for breeding is in **bold type**; but introductions should begin prior to and extend after this period for several weeks.
- The male and female(s) can be rotated on exhibit or, the male can be removed to another location.
- Introductions should occur every 2nd or 3rd day for ½ to 1 hour. If breeding is not observed the otters should be separated and reintroduced again in 2 or 3 days. This should continue until breeding is observed. If there is any serious physical aggression the animals should be separated immediately.
- The breeding column indicates when breeding should be observed by; however, they could occur several weeks earlier or later.
- Successful breeding bouts should be of ~15 minutes or more duration and occur several times over the course of a day. Once definite breeding has been observed the otters should be left together for their normal period (e.g. 24 hours, during the day only, etc.). Breeding typically occurs over several days
- If breeding is not observed by the end of latitude appropriate breeding season the otters can be left together or normal routine resumed.

Location	Begin Introductions	Breeding
Florida (roughly 25 to 30' parallel)	November	December, **January**
Southern & Southwestern U.S. (roughly 31 to 36' parallel)	December	January, **February**
Northern U.S. & Southern Ontario	February	March, **April**, May
Canada (North 49' parallel)	Late February, early March	April, May

Example Four – Multiple pairs (2.2) or otters (1.2)

In at least one case 2.2 otters were routinely housed together. These animals are kept together 24 hours year around except during feeding, estrus, and when a female has pups. During a female's estrus 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, there were no serious injuries. In this case the females produced a litter in alternate years so they were never in estrus simultaneously. 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 were not reintroduced to the group; but likely could be if the introduction process is based on the temperament of the otters involved, done slowly, and staff is responsive to signals from the otters.)

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."

A variation on this would be holding 2.2 or more otters and mixing pairings for exhibiting and for breeding. Compatible females should not be separated for extended periods as they may not get along after lengthy separations. However, mixing enclosure groupings and introducing females to different males may stimulate more breeding interest as well as more activity.

Example 5 – All females

In one case, the institution housed only females but brought in a male each spring for several months. The male bred successfully with both females but never in the same year.

Example 6 – Males and females separated all year

This example, from the Minnesota Zoo was the basis for Example 3. Once breeding was confirmed the male and female were separated again. When signs of "post-partum" estrus were observed the pair was again introduced.

"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."

CONTRACEPTION

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 or email: Contraception@stlzoo.org (Sally Boutelle). See also Section 2, Chapter 10.

ENCLOSURE DESIGN AND PUPPING BOXES/DENS

See also Section 2 Chapter 7.

Institution 1 Den Arrangement

"*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.)

Institution 2 Den Arrangement

The holding consists of four stalls (10 x 10 ft.) provided with fire-hose hammocks and at least one Vari Kennel; one of these is a sound-proof whelping den with an attached den box (this stall has always been selected by the female for giving birth). Each stall has a 50 gallon, above ground pool. See Section 2 Chapter 7.

Denning Boxes

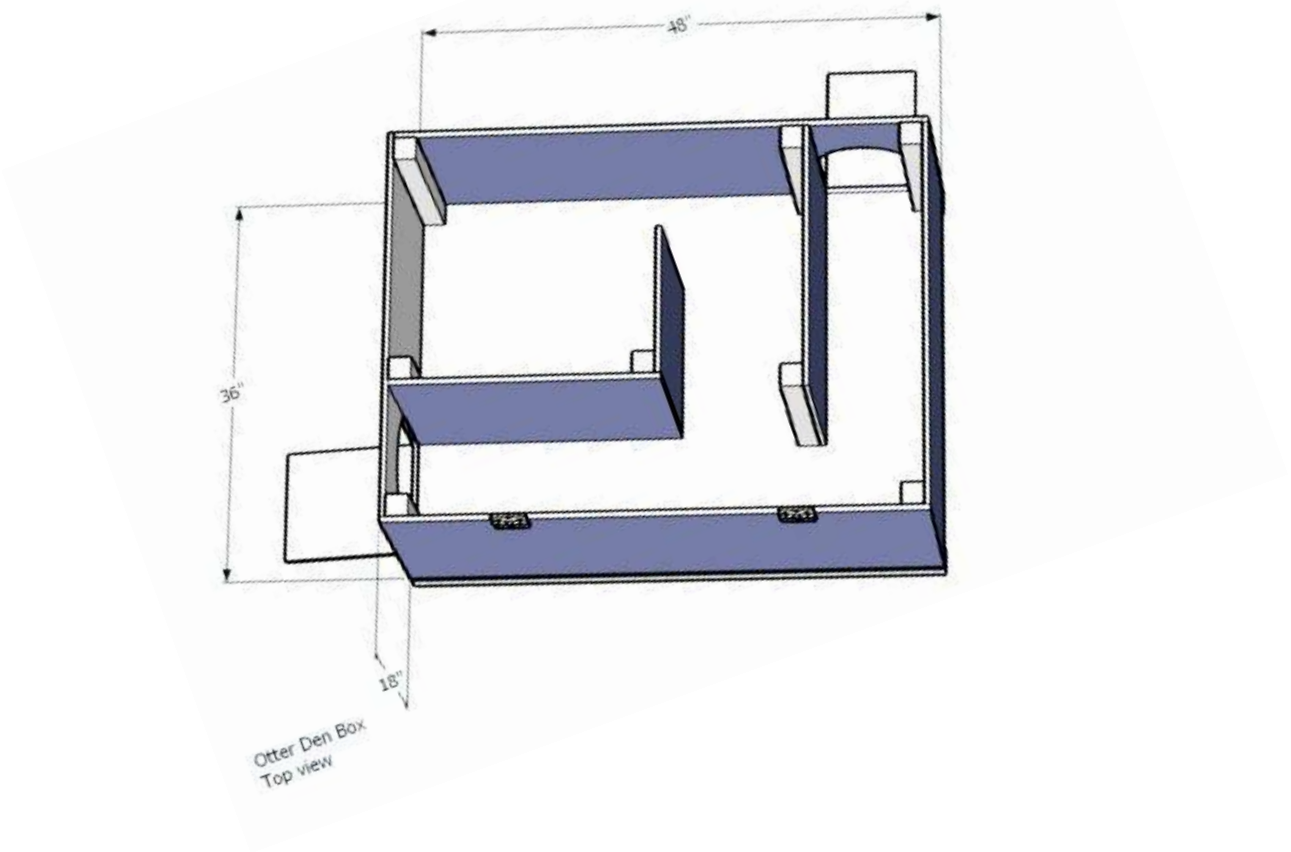
Also see Section 2, Chapter 7, Sample Denning Boxes for additional photos and examples.

Institution 1 - 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.

Institution 2 – A self-dug on-exhibit den and two nest boxes (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) are provided.

Institution 3 – Photos: Jennifer Galbraith, Tampa’s Lowry Park Zoo

Top View: 48” long x 36” wide x 18” high



References - Reproduction

Bateman, H.L.J., Bond, B., Campbell, M., Barrie, M., Riggs, G., Snyder, B., Swanson, W.F.. 2009. *Characterization of basal seminal traits and reproductive endocrine profiles in North American river otters and Asian small-clawed otters*. Zoo Biology 28:107-126

Crait, J.R., Blundell, G.M., Ott, K.E., Herreman, J.K., Ben-David, M. 2006. *Late seasonal breeding of river otters in Yellowstone National Park.* The American Midland Naturalist 156(1) July 2006:189-192.

Davis, J. 1985. N. A. river otter talk given at *River Otter Breeding Symposium.* Turtle Back Zoo April 3, 1985. Proceedings.

Duplaix-Hall, N. 1975. *River Otters In Captivity: A Review. In: Breeding Endangered Species In Captivity*. R. D. Martin editor. Academic Press, New York.

Eadie, W. R. & W. J. Hamilton, 1964. *Reproduction In The Otter, Lutra canadensis*. J. Mammal., Vol. 45, May 1964.

Ferguson, S. H., J. A. Virgl, S. Larivière. 1996. *Evolution of delayed implantation and associated grade shifts in life history of North American carnivores.* Ecoscience 3(1):7-17

Frazier, H. & K. Hunt, editors. 1994. *AAZK Infant Development Notebook*, American Association of Zoo Keepers, Topeka, Kansas. pp 667-694.

Huggett, A. St. G. & W. F. Widdas. 1951. *The relationship between mammalian foetal weight and conception age.* J. Physiol. 114(3):306 – 317.

Johnstone, P., 1978. *Breeding And Rearing The Canadian Otter, Lutra canadensis*. Internat. Zoo Yearb. 18: 143 – 147.

Lauhachinda, V. 1978. *Life history of the river otter in Alabama with emphasis on food habits.* Ph.D. Dissertation, Auburn Univ., Auburn, Alabama. 169pp

Lindenfors, P., L. Dalèn, A. Angerbjörn. 2003. *The monophyletic origin of delayed implantation in Carnivores and its implications*. Evolution 57(8):1952-1956.

Liers, E. E., 1951. *Notes On The River Otter.* J. Mammal. Vol. 32(1), pp 1 – 9.

Liers, E. E., 1958. *Early Breeding In The River Otter.* J. Mammal. 39(3): 438 – 439.

Liers, E. E., 1960. *Note On Breeding The Canadian Otter*. Intern. Zoo Yearb. 2: 84 – 85.

Liers, E. E., 1966. *Note On Breeding The Canadian Otter (Lutra canadensis) In Captivity And Longevity Records Of Beavers (Castor canadensis).* Internat. Zoo Yearb. 6: 171 – 172.

Mead, R. A. & P. L. Wright. 1983. *Reproductive Cycles of Mustelidae.* Acta. Zool. Fenica. 174:169 – 172.

Melquist, W. E. & A. E. Dronkert, 1987. *River Otter. In: Wild Furbearer Management & Conservation In North America*. Novak, M.; J. Baker; M. Obbard, & B. Malloch, editors. Ontario Ministry of Natural Resources.

Mowbray, E. E., Jr., D. Pursley, & J. A. Chapman. 1979, *The status, population characteristics and harvest of the river otter in Maryland.* Maryland Wildl. Admin., Publ. Wildl. Ecol. 2. 16pp.

Partridge, J., 1997. *North American River Otters At Bristol Zoo*. Inter. Zoo News Vol. 44, #8, pp. 466 – 472.

Reed-Smith, J. 1994/95. *North American River Otter (Lontra canadensis) Husbandry Notebook.* John Ball Zoo, Grand Rapids, MI.

Reed-Smith, J. 1997. *North American River Otter, Lontra (Lutra) canadensis, John Ball Zoo Husbandry Survey.* John Ball Zoo, Grand Rapids, MI.

Tabor, J. E. & H. M. Wright. 1977. *Population Status of River Otter in Western Oregon.* J. Wildl. Manage. 41(4):692 – 699. Oct. 1977.

Thom, M. D., D. D. P Johnson, D. W. MacDonald. 2004. *The Evolution and Maintenance of Delayed Implantation in the Mustelidae (Mammalia: Carnivora).* Evolution 58(1):175-183.

Toweill, D. E. & J. E. Tabor, 1982. *River Otter.* In: Wild Mammals of North America Biology, Management, Economics. Chapman, J. A. & G. A. Feldhammer, editors.

APPENDIX A - COLUMBUS ZOO IMPENDING BIRTH TEMPLATE

1. Overview
    - A. Description of present social and housing situation
    - B. Species Gestational Information
        1. Predicted due date
        2. History of past gestations
        3. Statement about what's known about species gestation (in general)
    - C. Goals statement
        1. Goals of birth management plan
        2. Goals of maternal training plan (if applicable)

2. Staff Assignments
    - A. Keepers/trainers
    - B, Hand Rearing staff
    - C. Animal managers
    - D. Veterinary staff
    - E. Nutrition staff
    - F. Other support staff
        1. Night keepers
        2. Volunteers
        3. Night keepers
        4. Medical specialists

3. Pre-partum preparations
    - A. Physical facility review
        1. Needed modifications to manage birth
        2. Areas of concern for an impending birth
        3. Lighting/audiovisual review if videotaping birth
    - B. Hand-rearing equipment review/needs
    - C. Notifications of impending birth
        1. Animal managers
        2. Veterinary staff
        3. Hand-rearing staff
        4. Night keepers
        5. Nutritionists
    - D. Animal management plan for onset of labor
        1. Notification tree of who to call when labor is confirmed
        2. Specifics for birth watch (who, how long, documentation)
    - E. Assessing the condition of the infant
        1. Physical condition of the animal
        2. Species norms (if known)
        3. Management plan for problem infants
    - F. Additional considerations
        1. Plan for medically compromised infant
        2. Scenarios for potential reintroduction
    - G. Plan B – if all scenarios fail
        1. Immediate reintroduction plan
        2. Removal of infant and plans for a future introduction to dam
        3. Surrogate mothers

Birth Plan Tracking Summary

1. Day of birth
    A. When labor is confirmed
    B. When the infant is born
2. After-hours birth
    A. If the night keeper discovers the parturient female is in labor
    B. If the night keepers discovers that birth has occurred
3. Post-partum
    A. If the infant is medically compromised
    B. If the dam is aggressive to the infant
    C. If other group members (if present) are aggressive to the infant
    D. If the dam is ignoring the infant or interested in the infant but not carrying/moving it
    E. If the infant nurses within 24 hours
    F. If no nursing is observed within 24 hours
    G. If the infant's condition deteriorates
    H. If the infant is healthy and a reintroduction could take place
    I. If the dam shows no interest in the infant
    J. If all efforts fail to get the dam to care for the infant