Eurasian Otter

Lutra lutra

HUSBANDRY GUIDELINES

Compiled by
Alfred Melissen
Otterpark Aqualutra
August 2000

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EEP/ Studbook for *Lutra lutra*

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PREFACE

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INTRODUCTION

These Husbandry Guidelines for the Eurasian otter (*Lutra lutra*) are a recording of their needs and demands. Inevitably, the curios and clever otter will make revisions necessary.
Research into the lives of otters in captivity and the wild will continue to take place, this will also create the need for updates. Furthermore, these guidelines do not pretent to be complete, for more detailed information on specific topics, references are given.
Experts on Eurasian otters have contributed to these guidelines through writing about their experiences with the animals, so occasionally several solutions are offered.
This version of the Husbandry Guidelines is based upon previous guidelines by P. Vogt, Krefelder Zoo.
Some recent data have been added with the help of a variety of otter keeping institutions and persons.
Gea Bloemhof edited the first version of these guidelines. After sending the preliminary version to several Otter-institutes, the recommendations and remarks were all processed by Esther Rijcken. Finally Mirte Kooistra revised the guidelines once more, searched financial supporters and performed the final layout. Simone van Velzen orginised the distribution.
The editor would like to invite anybody who feels he can contribute to a newer version of these guidelines, to send the information to the editor.

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I. BIOLOGY AND FIELD DATA

1.1 Biology

In this chapter some aspects of the Eurasian otter's biology will be dealt with; taxonomy, morphology, physiology and longevity. More details can be found in the Otter Action Plan 2000 (in press) of the IUCN Otter Specialist Group

1.1.1 Taxonomy

Order: Carnivores
Family: *Mustelidae*
Genus: *Lutrinae*
Species: *Lutra lutra*
Common name: Eurasian Otter
Subspecies: there are some subspecies known, table 1.1

Table 1.1. The subspecies of *Lutra lutra*

Name	Distribution
lutra	Paleartic
aurobrunnea	Nepal
barang	Thailand, Vietnam, Malaysia, Sumatra, Java
chinensis	China
kutab	Kashmir
meridionalis	Iran, southern Russia
monticola	Nepal, Sikkim, Assam
nair	Sri Lanka, southern India
seistanica	Afghanistan, Russia-Pamir
whiteleyi	Japan

Note: Four other subspecies (*angustifrons, roensis, splendida, stejnegeri*) are of doubtful validity.
(source: Otters ecology and conservation, by C.F. Mason and S.M. Macdonald, 1986.)

1.1.2 Morphology

Otters are well adapted to a life in and near the water. They have an elongated, sinuous body, webbed feet, short leggs and a long, tapering and muscular tail.
The head of an otter is flat and the nostrills, eyes and ears are placed in one line. This enables the animal to swim and use all these three senses at the same time (see figure 1).

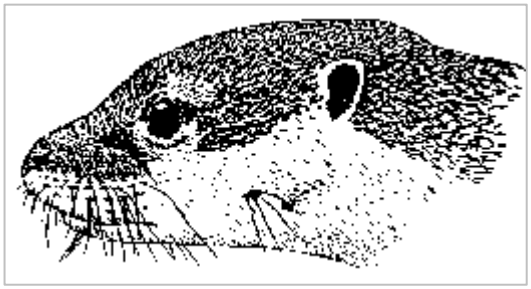

Figure 1: The flat head of an Eurasian otter (source: http://www.otternet.com)

The fur is medium to dark brown; the throat and underparts are pale. Every individual has different throat spots wich can be useful in identification.
The pelt has two types of hair; a dense underlayer with fine hairs 10-15mm long, which trap an insulating layer of air and helps to keep the body warm and dry during long swimming or diving. The second type of hair is longer (25 mm long) which is waterproof.

1.1.3 Physiology

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Table 1.2: parameters for Lutra lutra

	Males	**Females**
Weight	7-12 kg	4-8 kg
Total length	100-135 cm	90-125 cm
Body length	60-85 cm	55-80 cm
Tail length	40-50 cm	35-45 cm
Teeth	36	36
Dental formula	3 1 4 1 3 1 3 2	3 1 4 1 3 1 3 2

1.1.4 Longevity

In captivity an otter can reach an age of 12 to 14 years and in the wild they can live 4 to 5 years.
Mean life expectancies vary; 3,14 years in Scotland, 3,7 years in Norway and 6,1 years in Germany
Some researchers discuss about the mean age, as they claim it is based on otters that are found dead; they think it will mainly be younger individuals which move out that are found. Older otters might stay in their own region and will just die lonely somewhere, for example in a hole in the ground, thus interferring with the age-statistics.

1.2 Field data

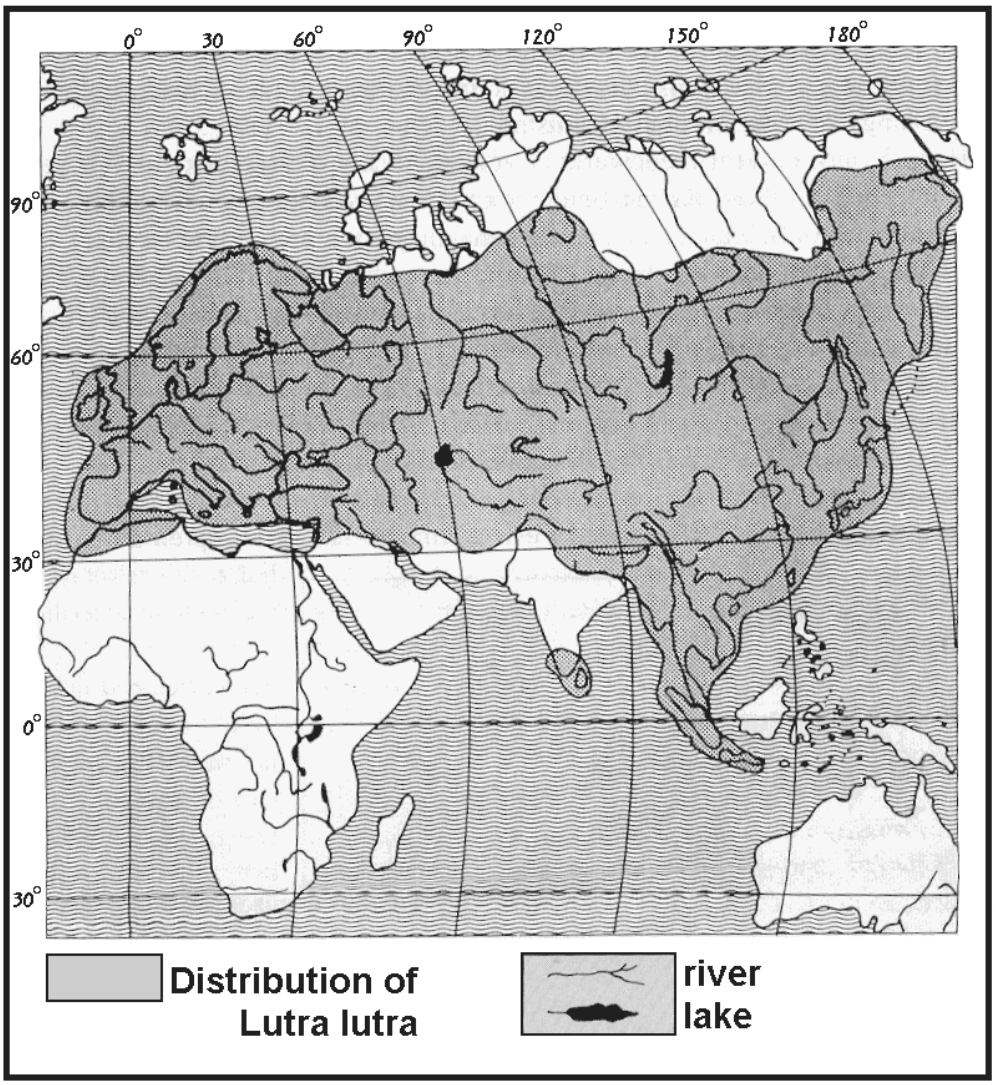
Besides biological aspects of the Eurasian otter, it is also important to know about its distribution and habitat. This chapter will deal with these subjects, as well as with the population, conservation, captive breeding, habitat protection and reintroduction of the Lutra lutra.

1.2.1 Zoogeography/Ecology

Distribution:

The former range of the Eurasian Otter covers parts of three continents: Europe, Asia and Africa (see map 1).

Map 1: Distribution range of the Eurasian otter (source: "In het spoor van de Otter by Addy de Jongh, 1995)



Habitat:

The wide distribution range of the Eurasian otter makes it difficult to describe a typical otter habitat. The varying countries and climates result in varying habitats. The base for an otter habitat, however, is a combination of land and water. It uses all kinds of wetlands: seacoasts, lakes, ponds, streams, small rivers, ditches, swamps, moor or swamp forests.

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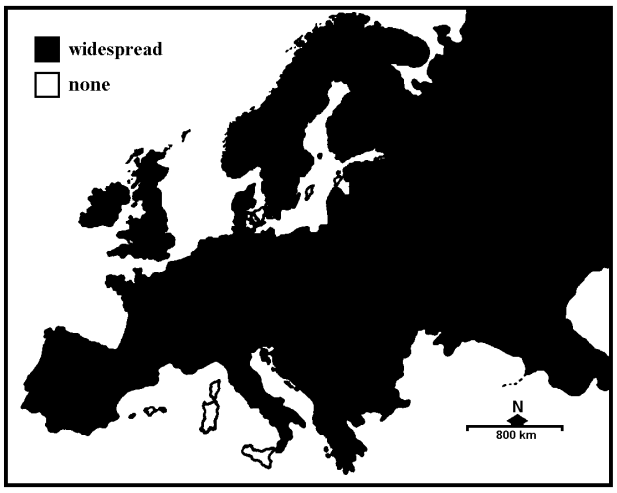
The otter seems to prefer a linear living space, on the border of land and water.
Otters seem to avoid deep water. According to REUTHER (1985) this is because of the negative energy balance when the animals are foraging in deep and cold water. The amount and availability of food is another limiting factor concerning otter habitats.

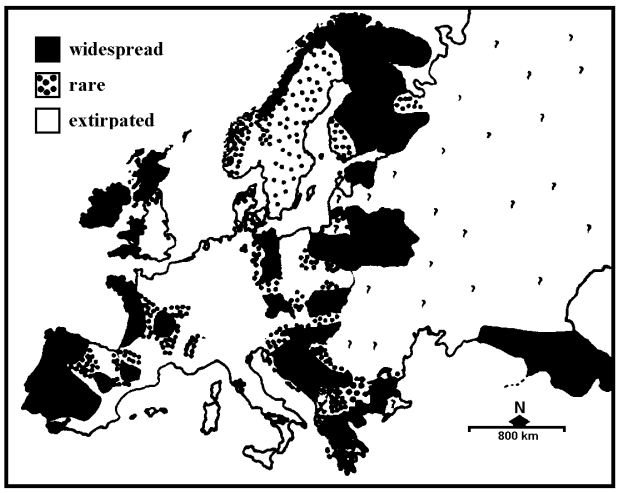
Population:

The maps below show the distribution of the Eurasian Otter in Europe. In 1900 the otter was widespread throughout Europe (see map 2). In the 1999 the otter population has declined drastically, though there are still several large populations in Southwest Europe (France, Portugal) and East Europe (see map 3).

Map 2. Estimated distribution of the Lutra lutra in 1900 in Europe



Map 3. Distribution of the Lutra lutra in 1999 in Europe



(source: Action Plan for European Otter by Sheila MacDonald and Chris Mason, 1999)

Conservation:

- CITES

The Convention on International Trade in Endangered Species of flora and fauna has enlisted the Eurasian otter in their Appendix I, which enlists the most endangered species: "Appendix I: Includes all species threatened with extinction which are or may be affected by trade". The first enlisting took place on the 22nd of April of the year 1976. The Eurasian otter was than enlisted as an Appendix III species, but a year later (04/02/1977) the species got "promoted" to Appendix I.

- EEP/EAZA

The European Species Programme (EEP) is a captive-breeding programme that aims at the conservation of endangered species. Within the EEP for the Eurasian otter, the Species Coordinator (who should be a member of one of the participating zoos/parks and an expert on the animal concerned) collects, proccesses and analyses all the data. Based on this, he/she gives recommendations concerning the breeding of the registrated animals. The Coordinator is supported by the Species Commision. This commision consist of 5 to 10 people who represent other zoos and parks which have experience with captive breeding of the otter. The Coordinator and the Commision plan the strategy for the next year.
The studbook for the Eurasian otter started quite late. This was mainly due to the dificulties of breeding otters in captivity. Another reason was that most people did not think captive breeding was very importance, since the wild otterpopulations in many countries seemed stable.
In 1982 Claus Reuther started collecting data about otters in Europe. Dr. Klaus Robin continued this and also started to give recommendations to institutes about exchanging otters. A studbook in wich 60 institutes with Eurasian otters in their collection participated, was made.
In 1990 the EEP for the otter became a fact. Dr. Paul Vogt (Krefeld Zoo) was assigned Species Coordinator. At this moment the coordinator is Alfred Melissen from Otterpark Aqualutra (also see chapter 2.7).

- National laws

Besides being protected by international laws, such as CITES, the Eurasian otter is also protected within several national laws (see § 2.6.1 Population status). In some countries licences are issued to kill otters living near fishponds.

Captive breeding:
Breeding otters in captivity will prevent zoos and wildlife parks to take otters out of the wild. Additionally, it will enable more zoos to keep otters and this will result in a greater audience that is familiar with the species and that will become aware of the need of conserving these species. Obviously, re-introduction of otters in the wild is the main aim of captive breeding.
Habitat protection:
With re-introduction being the main aim of captive breeding, it is crucial to remove all factors that caused the animal to go extinct in the first place. In case of the Eurasian otter, the reasons for its extinction or decline in numbers vary from hunting to habitat destruction and from water contamination with PCB's to recreational disturbance.
The restoration or creation of otter habitats is not the only important action to be taken in the re-introduction proces; it is vital to look at the region specific reasons to why the animal has disapeared or has declined in numbers. Only when all these factors are understood and when it is possible to eliminate their impact on otters, then it might be worth the effort to re-introduce the Eurasian otter in its natural habitat.
Re-introduction:
Re-introduction of captive bred animals into an area where they once lived, is difficult even if man has succesfully discovered and eliminated or controlled the factors that caused the extinction/decline in numbers. The difficulty is that the animals that will be reintroduced are captive bred, and will always be less "wild" than an animal that is born in the wild and raised without any human interferance. Therefore it is very important to keep the captive bred animals as wild as possible and prepare them for a life in the wild.

1.2.2 Diet and feeding behaviour
Food preference:
Fish tends to be the dominant prey, often making up over 80% of the diet. In addition, a whole range of other prey items have been recorded in the diet in variable proportions, including aqautic insects, reptiles, ampibians, birds, small mammals and crutaceans.
In the wild the most realistic estimate of a daily intake of an otter is probably around 15% of body mass per day.
Eating:
Otters have well-developed carnassial teeth. Live fish are usually eaten head first, just like frogs. The otter leaves the fat bodies and spawn. Crabs are dismembered and opened up. Toads are skinned and the skin is left inside out. The otter uses its paws to handle ackward prey, or to hold it down while chewing.
Large scale, tough or spiny skin, cartilaginious tissue, heads and vertebrae of large prey and roe may be left.
Feeding behaviour:
Otters that live in a coastal area dive to the bottom in shallow water looking for botom dwelling prey or they rummage about in seaweed neer the water edge at low tide.
In a small area of water, otters dive repeatedly; this is called patch fishing by Kruuk & Moorhouse (1990). The dives are very short, mean dive times are between 20.1 (Conroy & Jenkins) and 23.3 seconds (Nolet et al. 1993).
The otter locates its prey both by sight and touch and clutches it either by using its jaws and sharp teeth or its paws. Smaller prey items are eaten while floating; larger, spiny or ackward prey is taken ashore.
In order to catch birds, mammals and amphibians, the otter needs to use other strategies: rabbits are caught in their burrows (Kruuk 1995), voles are dug up, waterbirds are taken by swimming underwater and seizing them from below (Kruuk 1995), small birds roosting in reedbeds are also seized from below. During spawning time the otters leave the rivers and start hunting marshes and wet hillsides for amphibians.

1.2.3 Reproduction
Sexual maturity:
The age of sexual maturity seems to be quite variable
Reuther (1993) reports successful reproduction of an eighteen months old male and a twenty-four months old female in captivity. Jenkins & Harper (1982) estimated beginning of sexual maturity at an age of twenty to twenty-two months. Most otters (in captivity) breed when they are three and four years old (Reuther 1991). To be safe young otters should be regarded sexually mature at the age of 16 months.
Seasonality:
Eurasian otter females are non-seasonally polyoestrous.
Gestation period:
The gestation period is approximately 60 (+/- 3) days

To get a general idea about births, deaths, number of young per litter, mortality rates and ages, a short summary has been compiled, using data from a previous research. A trainee student who analyzed all the demographic data collected within 10 years of ZRBook carried out this research.
Data on European Otter studbookpopulations

1. Average number of young per litter:
   average number of young per litter from 1988 till 1998 is 1.86
2. Death age:
   average death age per year varies from 650 till 2150 days
   average death age is 1525 days (4,2 years; average age of death of all animals)
   average death age of cubs older then 6 months of age is 2385 days (6,7 years)
3. Juvenile mortality:
   27 % do not get older than 6 months

Development:
See appendix VII: Development of Eurasian otter cubs

1.2.4 Behaviour

Activity:
For the most part the otter is a nocturnal animal. A study, carried out by Rosoux (1995) showed that an adult wild male showed activity, either in the holt, in one place or active travelling in 30% of the total time. Rest or catnaps filled the remaining 70%.
Otters can travel large distances, but most adults will stay in their home range. This is their personal, well-defined area in which they feed, rest and reproduce.

Predation:
In a large part of their distribution in Europe, the adult otter has no natural predators and is on top of the food chain. The only threats they face are the indirect or direct effects of human behaviour. In other parts of their range (Russia, Asia) eagles, lynxs, etc, prey on them.

Competition:
Several other species, like kingfishers, herons and mergansers prey on the same fish species the otters prey on. Unless these animals are present in large numbers, they do not form serious competition for the Eurasian otter. Minks (European and American) also reley on the same prey as the otter.

Social behaviour:
Studies show that in general otters are solitairy animals. They only associate with other adults for reproduction. The most important unit of otter society is a mother and her offspring. Incidental reports are available on two adult otters meeting and playing with eachother.

Sprainting:
Otters mark their range with their faeces, betters known as spraints. Fresh spraints are often black, but have a variety of colours depending on the food and have a sweet-musky odour that can persist for several weeks. Otters deposit their spraints within their range and in this way communicate with other otters. The spraint possibly signals an otter's presence, its sexe, reproductional state and can even function as an individual recognision tool.

Sexual behaviour:
Otters that are intending to mate with eachother are together for 2 to 3 days. They play together and mate several times. The mating usually takes place in the water.

Grooming:
Otters do not have much body fat and therefore depend on the condition of their furcoats for insulation. Grooming and maintenance of the pelt is a vital part of their behaviour.
Without regular washing the pelt gets soaked and cold. Otters take care of their pelt by shaking water out of it, rubbing and rolling on grass or seaweed and using their teeth, tongue and paws. Coastal otters spent 6% of their time on grooming (Nolet & Kruuk 1989).

II. MANAGEMENT IN CAPTIVITY

2.1 Enclosure

The Eurasian otter is a semiaquatic mammal. It uses all kinds of rivers, streams, ponds, lakes, seashores, wetlands, etc. In captivity a sufficiently large enclosure has to be made available to provide space for running, swimming, segregation of individuals, foraging, avoiding disturbance by visitors, etc. **in conditions as natural as possible.** The more the otter feels "at home"in the enclosure, the more it will be outside and visible to the public.
The quality of the environment is equally important as the total given area available. The dimensions given below are regarded as recommendations.

2.1.1 Space

How much space does a captive otter need when, in the wild, it sometimes uses up to 40 km of rivers and covers distances of 20 km per night? An inquiry to more than 60 otter-keepers showed that the answers to this question are manifold (REUTHER 1984).
According to Kris Struyf (1987) a pair of otters should have at least two but preferable three enclosures:
-one enclosure for the male (outside the breeding season).
-one enclosure for the female (outside the breeding season, when she is pregnant or when she has cubs).
-one enclosure for the offspring which is seperated from the mother (the cubs will seperate from their mother at the beginning of a new breeding season and at the age of one year).

Claus Reuther (Aktion Fischotterschutz, Hankensbuttel) would prefer to suggest to have at a minimum two (seperated) enclosures of which one should be divided into two sections. The latter (one enclosure with two sections) could be used by the pair as long as it is kept together. If cubs are born, the sections can be devided so one can be used for the offspring which is seperated from its mother or it can be used to seperate the male for a while from the female. This is found useful if you want to breed. Breeding succes is in most cases much better if the male and female have had no contact over a period of several weeks.
Each individual should have available a minimum size of 100 m², but preferably 250 m² for one pair, respectively female with cubs.
Two enclosures are highly recommended for keeping the female when rearing the cubs seperately from the male. One big enclosure (e.g. of 350 m²) that can be divided in two parts (250 + 100 m²) by a gate might be an attractive solution for public enclosures.

2.1.2 Water and land

In European zoos and wildlife parks variation of the water:land ratio was found which ranged from 47:1 to 1:3 (REUTHER 1984). But more than 80 % of the enclosures offered more land than water areas. DUPLAIX-HALL (1975) suggests a minimum of 1:4, MAU (1985) reports en average ratio of 1:5.5 (range: 1:2.4 -1:7.8) for the breeding enclosures in the "Bavarian Forest" national park and REUTHER (1980) an average ratio of 1:3.4 (range: 1:1.1 - 1:8.8) for the Oberhaus Otter Research Enclosure. The water:land ratio of the enclosures at Hankesbüttel Otter Centre ranges from 1:0.75 to 1:9.43, and the ratio's at the Otterpark Aqualutra are 1:1.77 and 1:1.23 (see appendix Ia and appendix Ib) According to Paul Vogt (Husbandry Guidelines 1994) the water:land ratio should be lower than 1:1 (1:2 or even smaller, especially in small enclosures). It is better to have a lot of small islands in the water or side-canals area or some delta rather than one big open lake. REUTHER (1985) found that more than 60 % of the total activity in captivity happens in an area of 1.5-2.0 m left and right of the water-line. He came to the conclusion that the lenght of the banks seems to be more important than the water:land ratio.

2.1.3 Aquatic part

The depth of the water is preferably varying between 0.5 and 1.5 m. According to REUTHER it is not necessary to have a preferable maximum of 1.5 m. To him it also seems important to underline that the depth of the water should be adapted to regional temperatures and should guarantuee that the water will not freeze to the ground in winter time.
The bank should be as natural as possible (flat sandy parts, rocks, etc.)- no concrete canal with vertical walls!
Water has to be renewed constantly or filtered (sand-,coal- or cokes-filter- no chlorine). In muddy water the fur may lose it's protective quality and institutions in the USA that use chlorine filters report fur problems.
Water has to be accessible throughout the year, freezing has to be considered and prevented. In severe winters a fan, waterpump or airpump can be used to keep an icefree area. If there are young cubs in a winter period, make sure there are no steep rims in the ice-holes, otherwise they cannot climb out of the water (15 cm of an ice-wall can be a barrier for a young cub, causing it to get hypothermic and drown).

Underwater structures (e.g. large rocks with gaps), floating wood, islands, an underwater access to the nesting boxes, etc. are recommended. REUTHER is not sure that an under water acces to the nesting box is necessary. Wild otters use this very rarely and it increases the risk that the nesting box is flooded if they are situated below the waterlevel. Cascades and running water provide behavioural enrichment (explorative behaviour) and improve quality of the water. Water movement may also help to prevent ice-formation, but take into account the risk of "ice –cascades" that can work as an escape stairways for the otters (break the ice away daily).

2.1.4 Land part

Natural soil covered with vegetation, additional small areas with sand, gravel, etc. Concrete can also be used for construction in combination with natural soil, etc.

Vegetation:

grass, deciduous plants, bushes to be used for fur-rubbing and hiding. Vegetation is also gathered for bedding. Great care should be taken in the maintenance of the cover. The grassvegetation should never be cut down completely in the whole enclosure, because otters react very intensive to these changes. If it is really necessary it should be done in sections (REUTHER 1985).

Stones, sand-mounds and branches are necessary for spraint-marking behaviour.

Hollow tree-trunks, stone-caves and bushes as hiding-places are well appreciated by the otters and are therefore recommended.

Features such as tree-trunks, stones, bushes, etc. must not interfere with examination or control the animals.

2.1.5 Behavioural enrichment

In addition to the above mentioned if the enclosure is relatively small or not completely covered with soil and bush vegetation: boxes containing hidden food, floating objects, etc. are desirable.

Rocks with gaps give live fish a chance to hide and later to attract the otter's interest.

2.1.6 Fencing

REUTHER (1991) wrote: "The possibilities to fence an enclosure are numerous. Design, measurements and material of fences depend not only on the species kept in the enclosure and the personal taste of the zoo director but also on factors like:

- the function of the enclosure (show, research, quarantine),
- the climate (snow and ice in wintertime),
- the subsoil,
- the availability of electricity,
- the costs (of construction as well as of maintenance)."

Eurasian Otters are not only good jumpers, they are also very good climbers. They can surmount a 2 m high wire netting fence within some seconds. To prevent this two methods are mainly used:

- an overhang (see figure 2 and 3) or,
- an electric fence (see figure 5)

Figure 2: Sloping overhangs, for outside fences

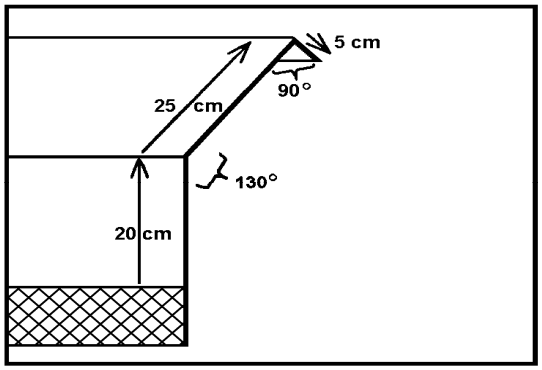
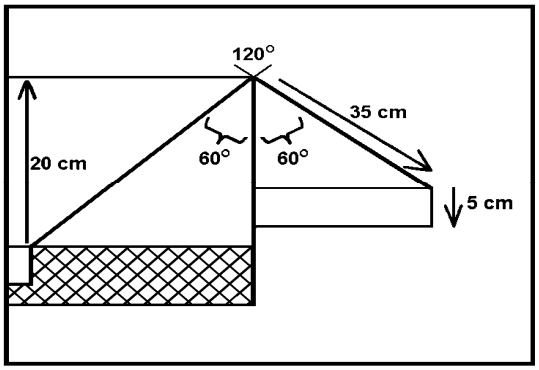


Figure 3: Overhang for inner fences



(source: Habitat, proceedings V. international Otter Calloquium Hankensbüttel 1989, edited by claus Reuther and Ralf Röchert)

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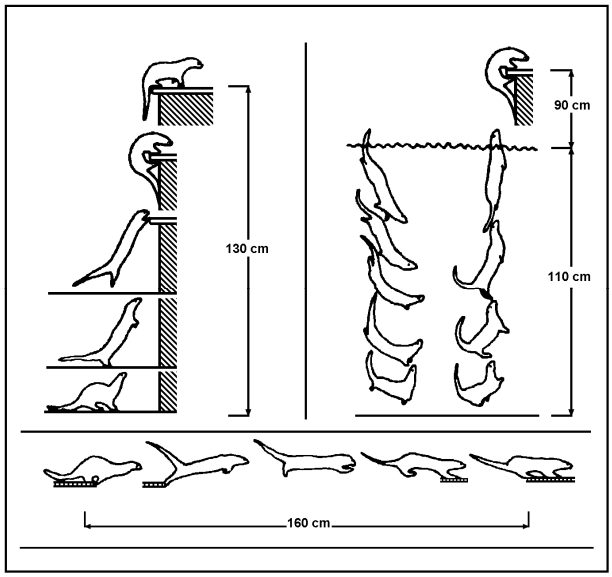
Overhang:
± 0.5 m made of plastic or galvanized metal in an angle, or made of wire-netting with hot-wire are also recommended.
Height:
1.8-2 m (fence or smooth wall), height of snow has to be considered so this height can be added to the minimum height of the fence. This species can jump well and leaping a distance from 130 cm in height when jumping from the ground to a platform. From land otters have jumped 160 cm in length, when jumping from one platform to another and 90 cm in height when jumping out of the water on to a platform if there is the possibility to push off from the bottom (see figure 4). Corners where the otters can climb easily must be avoided and require additional protection measures.

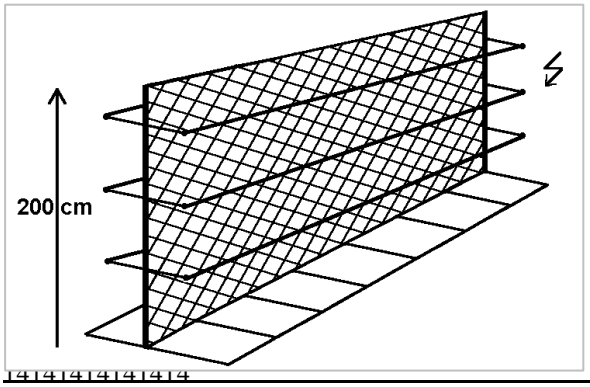
Figure 4: Jump-distances for *Lutra lutra*



(source: Habitat, proceedings V. international Otter Calloquium Hankensbüttel 1989, edited by claus Reuther and Ralf Röchert)

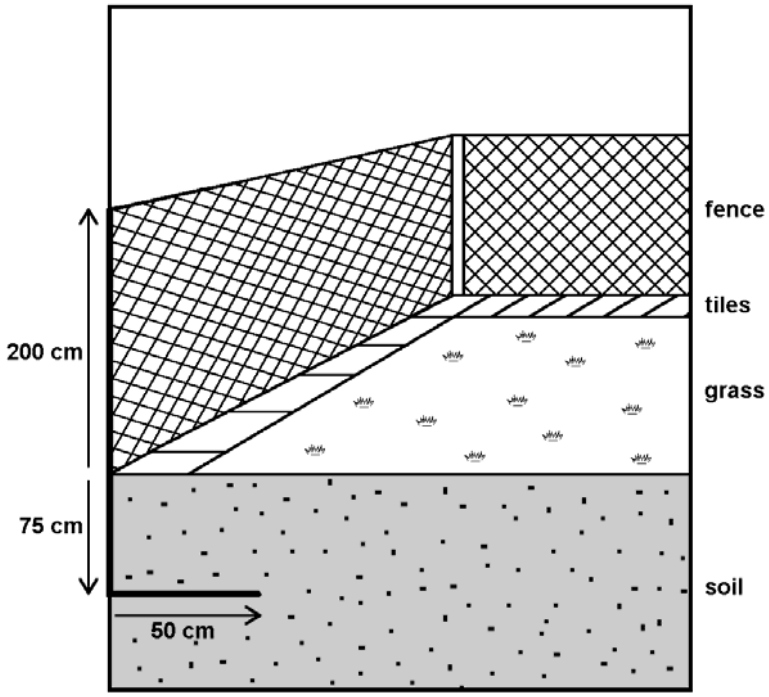
Mesh:
Preferably 40 x 40 mm. The minimum diameter of the wire is 3 mm (otters have strong teeth!). One case is known of an otter managing his way through 50 x 50 mm x 2 mm thick mesh wire by making an opening wider and wider by biting at the corners of one mesh-hole (see appendix XIII for a picture).
The seperation-fence (between two adjacent enclosures) can have a mesh of 10 x 10 mm, this must be this small to prevent bitings between the seperated otters. Another suggestion of a seperation-fence can be a double layer with 10 cm space in between. The problem with this kind of seperation is that there are some maintenance problems, it is difcult to remove vegetation or leafage. Another option is one layer of fence, with several electric-wires on both sides. This way, the otters will avoid coming near the fence, and are not able to bite eachother.

Figure 5: Electric fence



Wire:
Electric fencing is recommended, especially when wire-netting is used. When a plastified fence is used, an earth connected wire and one ore two current wires are needed. When a non-plastified metal fence is used, there will be no need for an earth connected wire. An emergency power back up (batteries or generator) has to be operational in case of a power failure.
Note: electric fencing may not be reliable if the environmental temperature is (below) –20°C!
Foundation:
Minimal 0.5 m deep put preferably 0.75 m because otters are very good diggers, and 0.5 m wide (see figure 6). There are also very good experiences with two additional rows of paving stones or tiles (50 x 50 cm) to avoid the digging at the fences.

Figure 6: An "underground overhang" is necessary to prevent otters from digging out under the fence



2.1.7 Additional safety
Minimum distance fence and trees 1.5 m (even 2.0 m), otters can climb trees up to 3 metres and jump off branches!! Beware of over-hanging branches! (see appendix XIV for a picture of a tree-otter).
Door-sluices for keepers are recommended (1 x 1.5 m groundsurface (both doors not turning into the sluice), so one can enter with a wheelbarrow safely).
Daily check for digging of tunnels and close the hole after checking there is no otter stuck in the tunnel.
If you have running water trough the fence, make sure everything around there is solid concrete, otters can dig very quickly in streaming water. Also pay special attention to all structures disturbing the wall, like doors, corners, pipes, rocks, flows of water, as otters will try these places to escape.
2.1.8 Procedure escapes of otters
Set the otter traps (see appendix II) immediately after the otter is found missing. Bait it with fresh fish and keep it near the enclosure. Change the fish daily for at least one week. There is a fair chance that the otter will stay in the neighbourhood for the first few days. Use fish that is odorous, like mackerel and offer fish the otter is adapted to by its diet. There are also very good experiences with "sand sheets". A sand sheet is a thin layer of dry sand that will show the footprint of all animals that walk accross it. With these sand sheeds near the otter traps, you can control the movements of the otter and set the trap at the most favourite place (REUTHER 1991). See also paragraph 2.5.1 + 2.5.2 "Trapping" and "Trapping box"

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2.2 Sleeping and breeding boxes

In general boxes with a "natural look" are recommended, instead of allowing the animal to dig a hole for itself. Control of animals is rendered more difficult if animals are allowed to have holes in the ground. If the holes they make are bigger every morning and ½ otter can fit in, than close the holes! A slide door in the nesting boxes is unavoidable. These can be closed not only to catch an otter in its nestbox, but also to keep the otter out if the box has to be cleaned or maintained. Preferably this should be a distance-triggered trap-like device, as otters are very quick and usually will not give you the time to insert the slide door manually.
In general the boxes should be:
-easy to clean,
-easy to reach and
-offer as much comfort and safety to the animal as possible (this will enhance animal well-being and public visibility).
In general a small looking window (peephole) for the public is of no burden to the animal.

2.2.1 Measurements

A pair of otters needs at least two sleeping box-complexes. Each sleeping box-complex should be divided in three units". The size of one unit must be at least 45 x 42 x 43 cm, so the total size will be ± 130 cm x 45 x 45 cm (see appendix III). One of the three units (with sliding door) should be removable for trapping and transport, wire-mesh underneath the lid allows the use of a blowpipe for anaesthesia or other treatment, causing less stress than a squeeze-box.

2.2.2 Material

Preferably wood or other non-heat conducting materials. The floor has to be equiped with drainage like a wooden grating that prevents the bedding from getting wet and gives additional isolation and comfort, the bottom should have a way to get rid of water (either condens or fur water).

2.2.3 Entrances

If possible from land as well as from water; long tunnels bring additional privacy, but can make it difficult to observe the animals. Tunnels must always be "inspectable" in case of sick otters or females with cubs that try to hide there. Tunnels may also limit humidity, but many times otters have been observed to carry wet material, especially water into the den.
Entrances should be open at any time for the animals, they should not be locked out to enhance public "visibility".

2.2.4 Climate

Protection against draft and humidity is required for the health of the animals. To be able to keep the nestboxes clean, it could be handy to keep it free from frost; otherwise the door of the nestbox might get frozen and can not be opened.
In case of sickness it would be wise to heat the room around the enclosure, but not the enclosure itself. The risk of keeping an otter in a heated room is that the heat keeping capacity of the fur can be reduced.
In cold regions the sleeping box should never be underground. The cold air in the enclosure will fall down to the box and decrease the temperature in the sleeping box (which can be dangerous for cubs).

2.2.5 Bedding

Hay, dry leaves and wood-wool are recommended. For a long time straw was not recommended because there has been choking danger reported; short straw sticking to the fish e.g. may cause choking of an otter. It is very important to make sure the otter does not eat at all inside its nestbox, as several cases of chocking or stomach impaction have been reported. In one case “sticking to fish” even wood-wool has caused stomach impaction to such a level the animal could hardly eat anymore and was wasting.
When the bedding gets wet, it should be replaced. Generally this should be checked once a week, if the bedding is still dry and clean it can be left for another week. Some otters do not need new beddings for several weeks.

2.2.6 Additional safety

An adult otter can demolish the nestboxes, several cases have been reported of otters breaking out of the plywood boxes of 20 mm thickness and glass of 4 mm thickness!
Always make sure that an otter can not escape after ruining his nestbox! Therefore make extra fencing around the nestboxes, build a sluice to the house where the nestboxes are, and put mesh wire in front of the ventilation openings, windows without double glass, etc.

2.3 Feeding

Feeding with fish only is not recommended! This is mainly due to the low quality of available fishes.
According to field studies otters eat, besides 75-95% of fish, a great variety of food (frogs, birds, rats, insects, etc).

2.3.1 Fish

Between 1/3 and 2/3 of total food maximum, on a weekly base, variation is possible but not neccesary if an animal is given a well balanced diet daily.
Freshwater-fish (cyprinids and salmonids) and seafish (pouting, cod, haddock, whiting) are reported to be part of otter diets; oily seafish such as mackerel or herring is in general not recommended but this depends on the quality of fish! As far as is legal live fish is highly recommended. Fish that is freshly deepfrozen and thawed in streaming water or air can also be accepted.

2.3.2 "Meat"

Preferably freshly killed, entire animals of good quality: chicken, pullets, ducks, guinea pigs, mice, rabbits, rats, frogs, beef-meat and heart (in large pieces to reduce the risk of asphyxia). If not the whole carcass is fed or the food has been frozen and thawed, it should be combined with a vitamin-mineral mixture to balance the nutrients.
Never feed **pigmeat**, because of the risk of Aujesky-disease.

2.3.3 Ballast-food

Rumen, carrots, snails and crustaceans have beeen recommended, but these should only be supplementary as enrichment

2.3.4 Quantity of food

The amount of food should be suited to the needs of the animal (i.e.; a fully grown male weighing aprox. 8 kg. should receive between 700 and 800 g per day in summer and between 900 and 1300 g per day in winter. These amounts are recommended if there is an avarage winter (average day-night temperature of 0 °C) and summer (average day-night temperature of 20 °C) for a diet considering of 60 % mackerel (195 Kcal/100 gram) and 40 % day-old chicken (162 Kcal/100 gram). If white fish (freshwater fish) is fed, the quantity must be higher because it contains less energy. Fasting has no biological basis in otters.
(see appendix IVa, b, c and d for examples of feeding-schedules of Aqualutra in the Netherlands, August 1996 and Januari 1997; of Blijdorp Zoo in the Netherlands; Hankensbüttel Otter Centre in Germany; and Planckendael Zoo in Belgium). Also see appendix V; "Variation in energy intake in Eurasian otters (*Lutra lutra*)."

2.3.5 Frequency of feeding

Due to rapid digestion (food passing time is about 2 to 3 hours) and long time spent looking for food at least two to three times a day is recommended.
It is best to feed **almost** ad libitum; excess weight should be avoided. If all food is given in just one feeding there is a big chance the otter will not eat it all at once, so the food might spoil or be stolen by birds or rats.

2.3.6 Food-supplements

Vitamin-mineral supplements are not necessary and should only be added when no live or freshly killed whole animals are fed, especially when frozen fish is used. For cubs cod-liver oil is recommended, calcium is recommended for lactating females, but accessive amount of calcium-supplement may predispose to the formation of renal calculi. Example diets are listed in appendices VIa until VIe, including nutrient compositions of the used supplements, the best way is to feed whole rats, chickens, one day old chicks and fish.
Some fish species have high levels of thiaminase, do not feed this in large quantities to the otter, or it will cause vitamine B1 deficiences, this will give neurological problems (see section 2.7.8.3).

2.4 Social structure and reproduction

As a rule otters can be kept in pairs, but a female rearing cubs should be kept seperate from the male. Some institutions though report breeding succes without the father being removed. There is always the risk of infanticide by the father or to much disturbance of the mother by an interested father. Severe fighting may occur! In one case it was also reported that a one-year-old daughter that was still with the mother killed the newborn cub. Keeping the father in the group is only possible in big enclosures, and may be of use for management (split the group into two one-sex groups to stop reproduction).
The male may only be brought back to the female after the juveniles have been seperated. Generally cubs from the same litter can be kept together (untill they are 16 months), or with the parent of the same sex for a prolonged period.
Also brothers or sisters can be kept in one-sex groups unless fighttings occur.

2.4.1 Introduction of new partners

In principle without special preperation, first contact through narrow wire-mesh between the two enclosures (10 x 10 mm) is recommended. If they seem to accept eachother, the wire-mesh may be removed. Occasionally serious fights may occur, frequent monitoring by an experienced keeper is therefore recommended during the first days and nights.
If two animals are put together with a breeding purpose, the females should be treated with an anti-helminthicum before breeding.

Never put adult members of the same sex together even if they are relatives that have been seperated for a longer period.

2.4.2 Mating

Before the actual mating between two otters takes place, there is a long period of chasing and vocalisation. When the male is sexually excited, it will slap its tail on the ground.
During the copulation the males holds on to the female by biting her in the neck and wrapping its front feet around her abdomen; they roll sidewise continuously. The copulation can take place in the water and on land and can last for 20 minutes (Wayre 1979) to 50 minutes (Pechlaner & Thaler 1983).

2.4.3 Birth

Breeding-boxes (at least two) must be placed at the rear of the enclosure to prevent disturbance by visitors, or a part of the visitors area should be closed.
A microphone or a small videocamera in the breeding-box is useful for monitoring.
The male and older cubs have to be removed from the breeding enclosure at least one week before the expected date of birth, but sometimes otters may hardly show signs of pregnancy and surprise you with a litter of cubs.
First (quick) check the cubs after one or two weeks and weigh them. Cubs should be sexed, vaccinated and inspected thoroughly at about seven or eight weeks of age. If this is delayed a restraint box or anaesthesia may be neccesary to implant the identification chip.
Average litter size: 2-3 cubs, gestation: ca. 60 +\- 3 days.
The recommended time between births is about 1 or 2 years. Growth-curves are given in appendix VII
The first check at the Otterpark Aqualutra is done at 2-3 weeks, the nestbox is not cleaned or touched in the mean time. The cubs are then sexed and microchipped. The first vaccination takes place at 6-8 weeks, the second at 9-12 weeks, the third at 12 weeks. Young otters can be handled without protection gloves until 10-12 weeks (watch your fingers from that point on!)

2.4.4 Development and rearing of cubs

Unless the veterinarian decides otherwise, the cubs shall not be seperated from the mother before they are at least six months old, but in nature the cubs leave their mother at an age of one year. After she has been seperated from her young, the mother has to be given three months time to recover before she is again kept together with a male. Hand-rearing as a basic rule should best be avoided, as there is a small chance of success to get a “normal” otter.
If unavoidable, especially in the case of orphaned cubs, a cat-milk replacer can be used (Esbilac, Cimilac, KMR), cubs older than 4 to 6 weeks have been reared with shred entire pullits or rabbits together with an infusion of camomile (see § 2.4.7!). See appendix VIIIa and VIIIb for the nutrient composition of KMR and Esbilac. Weaning should not be before about 8 weeks of age or approximately 1 kg bodyweight. For cubs, bones (pullets and rabbits) are dangerous. Weighing of the cubs and cleaning of the nest can be done at 2 to 3 weeks. After that, the cubs should preferably be weighed every 2 weeks, but at least at the first vaccination at 6 to 8 weeks and the second vaccination at 9-12 weeks.
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Table 1.3: development of young

Ontogenetic stage		**Source**
Body lenght at birth (nose to base of tail)	12 - 16 cm	Reuther (in press)
Weight at birth	70 - 120 gram	(Pechlaner 1980, Reuther 1986)
Age at first vocalisation	1 day	Reuther 1993
Age at emergency of first teeth	13 - 29 day	(Pechlaner 1980, Rogoschick 1992)
Age when eyes opened	15 - 41 day	(Pechlaner 1980, Rogoschick 1992)

The average weight-increase over the first 120 days is between 25 and 30 grams a day.
The young otters will leave the nest and go outside after aproximately 50-60 days.
See appendix VII: Development of Eurasian otter cubs.

2.4.5 Intervals between births
The recommended time of interval between births is 1-2 years.

2.4.6 Exchange of partners
If there is no breeding success after one year (the pair living together two times for three months) new partners may be brought together. Shorter intervals may disturb the pregnant females (gestation period: 60 +\ - 3 days).

2.4.7 Handrearing of cubs
As said before, hand rearing should always be avoided. If the unfortuned situation of making the choice between letting nature take its course or handrearing occurs, keep in mind the following
-always leave cubs with their mother; she is responsible
-only intervene if mother is no longer capable of taking care of her young e.g. when she is sick or dead
-answer the question “Is the life I can offer this animal worth it?”
-if the cubs are younger than 2 days, let nature take its course.
-try to pair the orphans with another otter as soon as possible; make sure that the animals remains to be an otter, not a domesticated pet; you will be responsible for it the next 10 years!
-orphans could fulfill an important PR/breedingresearch/education-role; but allways keep the otter's interest in mind!!

Recommendations based on the experiences by Jim & Rosemary Green at "The Vincent Wildlife Trust", 10 Lovat Lane, London EC3R 8DT, U.K:

Instead of a milk-replacer a "fish-soup" is given to the otter-cubs:
250 g White fish (cod, haddock, whiting etc.), skinned and boned liquidised thoroughly, if cubs are very young sieved through a fine wire. Give some fluid (boiled water, Duphalyte) has to be added to produce a thick pulp.
+ 1 tablespoon of milk powder (Esbilac, Lactol, Cimicat)
+ 1 tablespoon of codliver oil
+ 2 Mazuri fisheater tablets (well crushed)
(For the nutrients of Esbilac see appendix VIIIb).
The whole lot has to be thoroughly mixed and liquidized. Some of this mixture can be stored in the refrigerator or frozen, a portion has to be diluted with enough boiled water to produce a consistancy to go through a 10 ml syringe easily but does not run out when not pressing the plunger.

This "soup" has to be warmed up to 40 EC before feeding it to the cub. Fish soup is used because it is difficult to get enough nutrition into a cub using only available milk replacers properly diluted, while more concentrated milk mixes cause digestion upsets. The amounts given will make about a litre of thick paste that can be divided into aliquots and frozen. The paste needs to be diluted before use, using milk powder made up to the correct strength, for cubs under 5 weeks, to a consistency which will pass easily through a syringe.
The younger the cubs the more the consistancy of the 'soup' has to be smooth; for very young cubs (younger than 30 days of age) the soup should be diluted with made up milk substitute.

Cubs take a little while to adjust to the 'fish-soup' from a syringe after being used to their mother's milk - but as long as they take some water and Lectade there is still time for mutual adjustment to the new condition. Food-intake should be about 15-20% of bodyweight per day.

There are no hard and fast rules for feeding successfully - the best guide is the consistancy of the faeces! The spraints should be solid enough to hold their shape, no more than one or two per feed. The colour should be brown but if they are pale yellow or white and still fairly solid this would still be o.k.
If cubs are fed with "Multi-animal milk replacer base" the faeces can contain white granula in yellow slime.

Cubs are fed with a syringe to discourage them from getting addicted to mutual sucking. This also enables the carer to control the amount of food going into the cub's mouth. One finger at the cub's throat can be used to gauge the rate at which food is swallowed; if the mouth is over filled there is a danger of food going down the trachea and causing severe problems (pneumonia and death).

Young cubs cannot urinate or defaecate unaided; they should be hold up by the scruff and gently sponged on their lower belly and around the anal opening with a warm damp cloth after feeding to start urinating and defaecation 9watch out for sprayers).

Cubs are weaned at about six weeks or 700 gr body-weight, usual when the four canines are through. It then becomes difficult to provide enough nutrition with fish soup. Tiny baby trout are very useful, but other food should still be offered (e.g. 'fish-soup", finely minced fish, strips of skinned fillet). Each cub is different and progresses at a different rate, food given by the fingertips may be taken while a dish of food is ignored; it may take a week or two before they are eating solids properly. If the cub is fat and healthy a day without food (but do give water!) may increase its interest in solids.
Cubs should be kept warm, but giving them the option to get away from their heater - but not allowing them to wriggle too far away so that they cannot get back and are chilled.

Otter cubs suck not only to obtain food but for comfort and social bonding. Pairs of cubs without a mother will suck each other - nipples, penis, ears, folds of skin etc. - or a single cub may suck itself. This may be reassuring for the cub but if it becomes obsessive and damages the sucked areas the cubs must be separated as the potential damage from infections far outweighs the trauma of temporary separation.

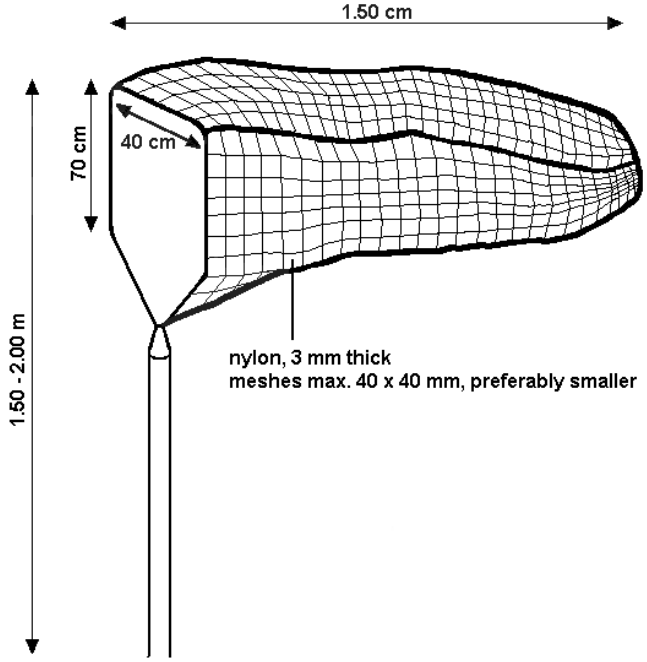
2.5 Handling

In a captive situation, handling of otters seems to be unavoidable. The animal needs to be weighed, sexed, injected with medicine or vaccine, transported, etc. How to trap, fixate and transport an otter, is delt with in the following chapter.

2.5.1 Trapping

According to REUTHER there are three reasons for livetrapping otters:
-to catch wild animals for zoos or for scientific studies (e.g. telemetry),
-to recapture animals which escaped from enclosures, and
-to catch animals in enclosures in order to handle them (e.g. transport to another zoo, transfer to another section or veterinarian care).
Each occasion requires its own techniques, but two principles are valid for all of them:
-the capture technique has to guarantee, that the animal will survive uninjured,
-to reduce stress, the duration of the capture and the handling of the animal has to be minimized to the absolute time minimum.
If nets are used for trapping these must have a padded rim to minimize the damage to the teeth. An "otter-catcher" may also prove to be of great help (see figure 7).

Figure 7: An "otter-catcher", the nylon net should be long enough to twist, once the otter is scooped up



2.5.2 Trapping-box

To catch wild or recapture escaped otters, box-traps (see appendix II) seem to be the most efficient and safe method. Well-tried are those traps which are more than twice the length of an otter, which open from both sides and which have the release mechanism in the middle of this trap-tunnel. They guarantee that the trap door cannot fall on the otter's tail so that the animal only has to go backwards to open the door and escape. They also ensure that the otter's tail cannot be broken. The techniques for trapping otters have to be adapted to the local situation. In the Norwegian sea coast for instance, fishermen followed a diving otter by boat and caught it with a fishing-net when it came up to breath.
The possibilities to catch an otter in an enclosure in order to handle it are multivarious. The simplest way is to use a part of the housing box or its associated tunnel system as a trap. It is also possible to deposit a box trap permanently in the enclosure and to offer food to the otter in this trap. All three methods have the advantage that the animals are familiarized with the "trap" and that no special preparations have to be made.
The use of nets or landing nets is not recommended. In most cases the otters become agressive in such a manner that injuries are the consequence (e.g. extraction of claws, broken teeth or cuts on the nose) (REUTHER 1991).

2.5.3 Fixation-box

The most effective method for the injection of a drug is the use of a blowpipe in the sleeping-box or a transportbox. By this method disturbance to the animal is minimal. A "crush-gate"/ squeeze-box/ fixation-box can also be used for short actions like vaccinations that can be done without anaesthesia (see Appendix IX).

2.5.4 Transport

Otters must always be transported seperately, except cubs younger than six months that have been reared together, or a mother with one cub younger than 6 months.
Crates (ca. 60 x 40 x 40 cm) made of solid plywood and without rims (resistant to biting)- preferably like the the sleeping-boxes the animal is acquainted to, aeration through wire-netting (10 x 10 mm). If necessary cool by spraying water. It is not recommended to transport the otter during hot days (night transports might be an option), unless the vehicle is airconditioned.
Tranquilized animals must have recovered completely before shipment. No food or water is required if the shipment takes no longer than 24 hours, provided the animal has been able to eat and drink sufficiently prior to shipment (see also the IATA-shipment regulations summary in appendix X).
Information on medical, dietary and husbandry details should accompany each animal.
The sliding door must be secured with a screw or a lock. Remember IATA "Live Animals Regulations".

2.6 Population management

2.6.1 Population status

Table 1.4: Population status and threats of Lutra lutra in European countries

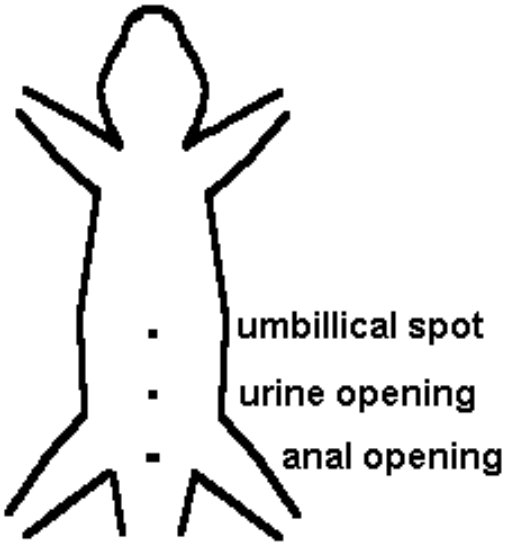
Country:	Status:	Threats:
Albania	legally hunted in winter, hunted for fur	habitat destruction, water pollution, legal hunting
Austria	under protection from hunting laws since 1914	no threats
Belgium	under protection	all major rivers polluted, habitat destruction, recreation on waterways is great
Bulgaria	fully protected	industrial pollution, illegal killing, habitat destruction
Czech Republic	protected	regulation of small and medium streams, pollution, illegal trapping
Denmark	fully protected	fish traps, road traffic, recreational activities
Finland	protected under "hunting law", so the ban could be temporary, and legal killed in fish hatcheries	hydroelectric power plants (act as dams), pollution, fish traps and fish hatcheries, road mortality, increasing demand s to resume otter hunting
France	fully protected since 1967	destruction and modification of habitat, water pollution, severe eutrophication, deaths on roads, death in fishing nets, death in American mink traps, hydroelectric dams
Germany	totally and fully protected in the highest category	fish traps, road traffic, mortality in traps for other animals, canalization of rivers, pollution, recreational activities
Greece	fully protected	major habitat destruction, intensive fish farming with legal persecution of otters, pollution, mortality in fish traps and on roads, disturbance due to recreation and hunting
Hungary	protected, but is legal to kill them at fish farms with permission	pollution, habitat destruction, high mortality at fish farms, most of which is illegal
Ireland	protected, though some licenses for sport-hunting with packs of dogs are given in some areas	habitat destruction, pollution, disturbance of habitat, accidental deaths and persecution
Italy	protected	habitat destruction, pollution
Liechtenstein	no otters	no otters
Luxembourg	no otters	no otters
Netherlands	protected (extinct since 1988)	pollution, PCB's, pesticide, habitat destruction, recreational activities, fish traps, traffic
Norway	protected, licenses may be given to kill otters at fish farms	pollution, poisonous marine algae, mortality in fish traps and on roads, illegal persecution at fish farms
Poland	protected, legal to kill them near fish ponds with license	pollution, poaching, persecution, fish traps
Portugal	protected	pollution, illegal persecution, recreational activities, oil spills
Romania	no recent information	no recent information
Soviet Union	protected only regional	
Spain	protected	habitat destruction, pollution, marsh drainage, illegal hunting/trapping, disturbance by tourism
Sweden	protected	contamination with organocholrines
Switzerland	protected	habitat destruction, water pollution
United Kingdom	protected	pollution, drowning in fish nets, habitat destruction, drainage of wetlands, recreational activities
Yugoslavia	fully protected (only partially protected in Bosnia)	habitat destruction, pollution, road traffic, disturbance, illegal killing

(source: http://www.otternet.com, July 2000)

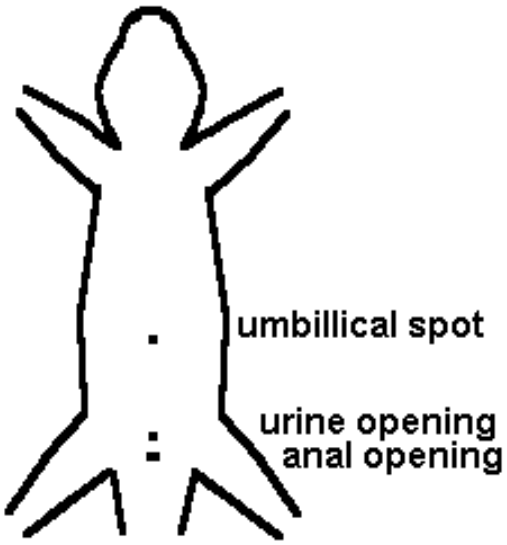
2.6.2 Species management programmes
See § 1.2.1 Zoogeography/Ecology; conservation

2.6.3 Individual identification and sexing
The marking of otters has been used in the wild as well as in captivity. In the first case it is mainly used to identify individuals from a distance (e.g. to investigate life history parameters) or to identify otters found dead or recaptured individuals.
Throat "spot" markings are quite distinctive and possibly unique. These have been used during surveys of wild otters and as a "key" ID in some zoos.
Identification with Euro-ID Trovan or compatible systems of microchipping (dorsal shoulder) will be required in the future for the studbook and reintroduction projects. Webbing tattoos have also proved to be effective.
Sexing of an otter is quite easy: from the first day the difference can be seen as long as one keeps an eye on the three markings: anal opening, urine opening and umbillical spot (belly button).

Male:



Female:



2.7 Veterinary care

Because in general detailed clinical histories are still missing and only few and incomplete post-mortem reports are available, sugestions are provisional.
All participants in the EEP and studbook are therefore requested to send copies of the post mortem reports to the studbook keeper (with a summary in English if not written in this language):
Mr. Alfred Melissen (Otterpark AQUALUTRA, De Groene Ster 2, 8926 XE Leeuwarden, the Netherlands).

2.7.1 Physiological parameters (not immobilized) (from: ROGOSCHIK & BRANDES 1991):

rectal temperature	37.0-39.5 EC
respiratory rate	30-50/min
heart rate	200/min

2.7.2 Haematological/ clinical-chemical parameters*

leucocytes:	5.0-10.0 x 10^3 /nl
erythrocytes:	5.3-8.0 x 10^6 /nl
haemoglobin:	15.0-21.0 g/dl
haemotocriet:	48-70%
sodium:	150.0-160.0 mmol/l
potassium:	4.5-5.0 µg/dl
calcium:	1.8-2.5 mmol/l
creatinine:	60.7-92.0 Φmol/l
carbamide:	6.3-13.0 mmol/l
uric acid:	2.8-5.75 mg/dl
cholesterol:	2.85-5.44 mmol/l
tryglyceride:	60.0-200.0 mg/dl
GOT:	70.0-130.0 U/l
GPT:	3.0-80.0 U/l
-GT:	10.0-35.0 U/l
AP:	25.0-115.0 (200?) U/l
bilirubin:	8.55-17.1 Φmol/l
protein:	7,0-7,7 g/dl
glucose:	1.21-4.4 mmol/l

*provisional data based on limited number of analyses
Source: ROGOSCHIK & BANDES (1991).

2.7.3 Clinical problems/suggestions

In general, therapy is analogous to the domestic cat in case of:
-bacterial infections (pneumonia, rhinitis, septicaemia)
-skin-injuries (intraspecific agression)
-paradontosis
-ecto-and endoparasites

2.7.4 Anaesthesia

According to REUTHER the most effective method for the injection of the drug is the use of a blowpipe and syringe with a short needle in the sleeping box or a transport box. By this method disturbance to the animal is minimal. The box must give the otter the possibility to move some steps away after the injection.
Another possibility to inject the drug is the use of a crush cage. This is a box with movable walls so that the animal can be restrained and injected through a grill. But, with a well-constructed crush cage like that shown in appendix IX, the stress is much higher to the otter than using a blowpipe through a grid.
Occasionally it is necessary to immobilize an otter, e.g. for a veterinarian check-up, the therapy of an injury or for fixation of a transmitter.

Recommendations based on the experience of International Zoo Veterinary Group**.
-isoflurane, (halothane) as gaseous anaesthetic
-for a light- moderate anaesthesia the following combinations proved to be useful:
1) zoletil* 10 - 20 mg/kg
2) ketamine 10 - 20 mg/kg + xylazine 1 - 2 mg/kg[2]
3) ketamine 10 - 20 mg/kg + diazepam 1 - 2 mg/kg
4) medetomidine Domitor® 150 µg/kg + ketamine 5 - 10 mg/kg[3] *
   reversed with atipamezole (Antisedan^{R}) at 300 - 450 µg/kg
   (preferably lower ketamine + higher medetomidine, because of the after-effects of ketamine)
5) medetomidine 100 µg/kg + ketamine 5 mg/kg + midazolam 0.2 mg/kg
6) Hellabrunner mixture[2]*

bodyweight (kg)	**Dosage "Hellabrunner Mixture" (ml)**	**corresponding dosage xylazin (mg)**	**corresponding dosage Ketamin (mg)**
< 5	0.2-0.3	25-37.5	20-30
5-8	0.3-0.4	37.5-50	30-40
>8	0.4-0.5	50-62.5	40-50

(REUTHER 1991)

The production of the "Hellabrunner Mixture" is simply done by dissolving the contents of one bottle of dry matter of 500 mg xylazine (Rompun^{R}) in 400 mg ketamine (4 ml Ketalar^{R}). The mixture stays stable for several months if it's stored cool and dark (Hatlapa and Wiesner, 1982)

Sources:

* M. Hoyer,
Veterinairy and Immobilisation Advice and Audits (Veterinaire en Immobilisatie Adviezen en Audits),
Wester Meeweg 28,
1697 KW Schellinkhout
The Netherlands
Mark Hoyer recommends:

[1] *Lutra canadensis*: 5.4 mg/kg Zoletil

[2] For the **Hellabrunner Mixture**:
When the dosages are calculated in mg/kg, they quite correspond with the dosages found in number 2, only the Xylazine dosage is 3 times to high and the Ketamine dosage 3 times to low, but the dosages given in number 2 are still oke. Moreover Xylazine as well as Medetomidine have to be reversed with atipamezole (Antisedan^{R}) with the dosage of about 0.5-0.7 mg/kg (= 500-700 µg/kg).
Instructions for the use of atipamezole:
-use after 15-20 minutes, when also Ketamine has been used in the anaesthetics.
-Always partly intra muscular or sub cutaniously, never only intra venous, otherwise the anaesthesia will be reversed to fast.

[3] *Lutra lutra*: Medetomidine 66 µg/kg + Ketamine 4 mg/kg

** International Zoo Veterinary Group,
Keighley Business Centre
Louise Pagan BSc
tel: 01535 692000
fax: 01535 690433
Keighley, West Yorkshire
UK

2.7.5 Bloodsampling
Blood can be taken from the vena cephalica antebrachii, the vena jugularis, or the ventral arteria of the tail.
Lucy H. Spelman, senior veterinarian and director of Smithsonian National Zoological Park, has good experiences with taking blood from the vena jugularis: Otters are easy to bleed from the jugular if you put them on their backs and wet the fur with alcohol, you can raise the vein easily. The vein rolls and you should use a 22 or 20 gauge 1 inch (2,5 cm) needle. They are quite dificult to bleed from other sites given small size of the veins; the femoral is possible, but you will get an excellent sample every time from the jugular.
Jesus Fernandez Moran has good experiences with taking blood from the vena jugularis, but also with the ventral arteria of the tail. He does not shave the animal, but cleans the hair and skin thoroughly with abundant alcohol. The chemically immobilized otters are placed on their back, and they usually take 5 to 10 ml of blood from both veins. With sedated otters (med-ket) the only problem is that when punching on the neck (vena jugularis) there are painful stimuli and in some cases the animal moves up his head. Therefore one person should hold the head fixed on the table to avoid any movement that could harm the animals neck during the procedure (see appendix XV for pictures).

2.7.6 Infectious diseases (ROGOSCHIK & BRANDES 1991)
A: Viral diseases:

1. Rabies/ Tollwut/la rage lyssa/ hondsdolheid
2. Canine distemper (CD)/ Hundestaupe/ maladie de jeune age/ Carré's disease/ hondeziekte
3. Infectious canine hepatitis/ Rubarth's disease/ hepatitis contagiosa canis (H.C.C.)
4. Parvo-virosis

1.
Rabies, which occurs on all continents except Australia and some small groups of islands, exists also in otters. (*Lutra lutra*: Rübel et al., 1987; Dathe, 1976; Butzeck, 1984; Pitzschke, 1953 and 1963; *Aonyx cinerea*: Keymer et al., 1981). The incubation period ranges from one week to several months, and the virus is contagious to human beings. Vaccination every year against rabies with inactivated vaccine is recommended.

2.
Canine distemper has been discovered among Eurasian Otters as well as among North American River Otters (*Lutra lutra*: Geisel, 1979; Steinhagen and Nebel, 1985; *Lutra canadensis*: Eveland, 1980). A yearly vaccination with inactivated vaccine was recommended, but since this inactivated vaccine is no longer available, we now use "attenuated" and are waiting for the "ferret" CVD-vaccine (ISCOM – type) to become available.

3.
Infectious canine hepatitis is only known for the skunk, a yearly vaccination with inactivated vaccine has no side effects and thus should be applied.

4.
Parvo-virosis: all otters are prone to this (Garbrisch, 1987). Moreover Hoover 1985 (*Lutra canadensis*) has found antibodies against this virus in otter blood. It is better to give a yearly immunization with inactive dog vaccine.

B: bacterial diseases:
Tuberculosis
Salmonellosis
Proteus bacteria
Klebsiella
Clostrids
Plesiomonas
Leptospirosis
Streptococcus
Staphylococcus
E. coli.,
Bacillus anthrax.

Tuberculosis is the most serious disease for otters because it is contagious and chronic. The causal agent can be *Mycobacteria tuberculosis, Mycobacteria bovis or Mycobacteria avium.* In Middle Europe bovine tuberculosis is supposed to be extinct and the type *M. humanus* is very rare, there is a possibility of an infection by *Mycobateria avium.* The infection occurs by feeding on cuberlous poultry. In this case a therapy cannot be recommended, the animals should be killed as the risk for the keepers and the public is to big (zoonosis). In 2000 one case of *Mycobacteria microti* was diagnosed (personal communication by Alfred Melissen, Otterpark Aqualutra).

Salmonellosis caused by infected food, can be found in the otter. *Salmonella anatum* is said to lead to kidney damage in the otter (rental tubular necrosis) (*Lutra canadensis*: Hoover and Tyler, 1986).

Infections with **proteus bacteria** (*Proteus mirabilis*) lead to infections of the urogential tract, and are regularly found in female North American River Otters. This type of bacteria can appear in connection with Streptococcus and Colibacteria.

A futher type of bacteria is *Klebsiella pneumoniae* that leads to a very heavy pneumonia (*Lutra canadensis*: Hoover and Tyler, 1986).

Even **clostrids** (*Clostridium welchii*), among others the causal agent of gas gangrene, were found in otters and proved lethal (*Lutra canadensis* and *Lutra perspicillata*: Johnstone, 1978).

A first record of harmful infection of **Plesiomonas** *shigelloides* in a wild mammal was described in an Eurasian otter and was the cause of abortion. The bacterium is closely related to fresh water (*Lutra lutra*: Weber and Roberts, 1989).

Leptospirosis (see appendix XI) is a well known zoönosis (a disease that can be transmitted from animals to humans and from humans to animals). Leptospirosis are transfered by food, which is infected by rodents or their urine, or the water a rodent has urinated in. The incubation period ranges from 3 days to 2 months. Up to now, only one otter infection has been recorded (Chanin and Jefferies, 1978). Nevertheless an immunization with inactive vaccine and yearly repetition is recommended.

Staphylococcus have been found in abscesses (*Lutra lutra*: Ziems, 1973; *Lutra canadesis*: Hoover and Tyler, 1986)

C: Mycotic diseases:

These are very rare in otters. The only reported fungus is a *Monilia* species (Laidler, 1982). This is an optional pathogenic fungus which can normally be found as commensals on the skin. This fungus grows in discordered environmental and keeping conditions, and stress factors also play an important part. But if the otter's coat is healthy the fungus cannot spread.

D: Parasites:

The harmful consequences of parasites are the deprevation of nutritive substances of blood, mechanical irritation, or toxic or enzyme effects.
1. ectoparasites: ticks and lice rarely.
2. endoparasites: *Isthmiophora melis, Opisthorchis felineus, Eustrongylus gigas, Eryhelmis spec, Molineus spec., Heterophyidae.*

2.
Isthmiophora melis and Opisthorchis felineus are potential *zoonosis infectors* (*Lutra lutra*: Schuster et al., 1988).
Eustrongylus gigas is a nematode that lives in the renal pelvis or in the abdominal cavity of the host and leads to damage of the kidney tissue, hypertrophy of the ureter and probably to peritonitis (*Lutra lutra*: Krumbiegel, 1955).

For the otter the importance of parasites is not very striking, contrary to other carnivores. The lack of social contact, the low population density and the often large "home range" are ecological barriers for the distribution of parasites. The infrequent visits to particular latrine sites and their close proximity to the water diminishes the danger of infection by faeces. Additionally the water may serve as a dilution factor for eggs and larvae concentrations. Parasite control for newly arrived animals is recommended, but it is also recommended to periodical samples of the faeces of the otters for parasite control.
The Aktion Fischotterschutz at Hankensbüttel (Germany), recommends that in addition to regular vaccination, the animal has to be checked, and, if necessary treated for worms at least once a year, especially females before mating (e.g. with Vitaminthe ® =1 ml per 2 kg bodyweight, 1 ml contains: 240 mg Niclosamide, 30 mg Oxibendazol and Excipiens until 1 ml)

2.7.7 Vaccinations
The otters have at least to be vaccinated against:
-rabies: preferably only inactivated vaccins; yearly booster
-feline parvovirus: preferably only inactivated vaccins; yearly booster
-canine distemper (not yet found in otters): inactivated vaccine, twice; yearly booster
-feline viral rhinotracheitis/ niesziekte (not yet found in otters): inactivated vaccine, twice; yearly booster
-leptospirosis (not yet found but suspected in otters): inactivated vaccine, twice; yearly booster
The Aktion Fischotterschutz at Hankensbüttel (Germany) recommends that in the eight week after birth the basic immunisation against parvovirosis, canine distemper and hepatitis should take place with Candur SHLT + P. In the twelfth week the cub will be vaccinated against rabies with Candivac SHLT and Candur P (all inactivated vaccins).

Otterpark Aqualutra vaccinates at 6-8 weeks and 10-12 weeks with:
- Duramune 7®
  - Infectious canine hepatitis/ Rubarth's disease/ Hepatitis Contagiosa Canis (H.C.C.)
  - Parvovirosis
  - Canine distemper (CD)/ Hundestaupe/ maladie de jeune age/ Carré's disease/ hondeziekte
  - Leptospirosis
  - Kennelcough/ Zwingerhusten/ kennelhoest
- Dohorab ® Solvay Duphar
  - Rabies/ Tollwut/ lavage la rage lyssa/ hondsdolheid
- Fel-o-Vax ®
  - Feline infectious enteritis/ speudomembraneuze enteritis/ panleucopaenia/ katteziekte

See appendix XI for details about these vaccinations. **See appendix XII, article "Diseases of the Eurasian Otter (Lutra lutra): 10 years of deathcauses within the European Studbook "**.

In all cases first vaccination at 8 weeks of age.

2.7.8 Non-infectious diseases
1. traumatic
2. hyperthermia
3. nutritional: management/deficiency
4. intoxication
5. tooth injuries
6. urolithiasis and metabolic disorders
7. stomach impaction

1.
Traumatic diseases include **bone fractures** and injuries of all kinds, due to fighting, escape atttempts or catching injuries.
2.
Hyperthermia as a cause of disease or death may be especially important for captive otters, particular when they are immobilized on hot summer days. The ketamine-hydrochloride contained in the narcotic drug is able to produce hyperthermia. Because the otter's heat compensation only takes place by breathing (panting) and possibly a little by perspiration of the pads and webs there could be an accumulation of heat. At a body temperature of more than 42EC, the exitus is near. Because of this one should always take the animal's temperature during immobilization. Should the temperature rise to more than 41EC the animal has to be cooled with water or ice (REUTHER, 1991) (Ice should always be kept available!!)
3.
Among the nutritional deficiences **rickets** has to be metioned as a disease of the bone tissue caused by a vitamin D deficiency together with an unbalanced feeding of meat. The clinical symptoms are distinct thickenings at the joints and the bones flex due to the lack of minerals. The calcium-phospherus-balance is disturbed (*Aonyx cinerea*: Lancaster, 1975)
Of great importance is **vitamin B1 deficiency**. In fact this metabolic disease is often due to secondary deficiency of thiamine caused by the feeding of fish which contain thiaminase. These can be marine and freshwater species, e.g. carp, mackerel, herring. One gram of **RAW** fish can destroy 44 µg thiamine.
Following a lack of appetite, the symptoms of vitamin-deficiency are uncoordinated movements, ataxia, retarded reflexes and may even lead to partial paralysis of the limbs. The final state is a coma-like spastic with opisthotonus. If a B1-deficiency exists the animal's body uses more and more nitrogen substances (protein) and the animal loses weight.
4.
Intoxication:
E.g. by oil on the watersurface, which infiltrates the skin and leads to kidney failure (*Lutra lutra*: Mason and Reynolds, 1988).
5.
Tooth injuries:
Many authors (*Lutra lutra*: Cocks, 1881,; Piechocki, 1975; Mau, 1985; Rübel et al., 1987) have pointed out the otters' susceptibility to toothfractures, abscesses and fistulae. The early build-up of dental plaque with gingivitis, paradentosis and caries is alarming. Prohylactilly it's recommended not to mince the food, and give whole prey with bones that must be chewed intensively. Some institutions recommend mixing the food with ballast-food (rumen, carrots, snails or crustaceans), so the food has to be chewed intensively.
6.
Otters are especially susceptible to urolithiasis, i.e. the formation of urinary calculi in the kidney, ureter or bladder. There is a striking frequency of references concerning the formation of urinary calculi among otters.
In wild otters urinary calculi have been found as often as in captive otters (*Lutra lutra*: Stubbe, 1973; Chanin, 1985; *Aonyx cinerea*: Foster-Turley, 1983; *Pteronura brasiliensis*: Murman and Hagenbeck, 1984). The calculi can be as big as a bean and they consist of calcium ureate, or ammonium ureate, respectively (*Aonyx cinerea*: Keymer et al., 1981), calcium oxalate or calcium phosphate (*Aonyx cinerea*: Keymer et al., 1981). **Many stones in *Lutra lutra* contain ammonium urate and are therefore barely visible on an X-ray** (Heike Weber, personal communication).
7.
Stomach impaction
If the otter is allowed to eat inside the nestbox, pieces of hay and wood wool might attach to the fish, thus giving the risk of the stomach becomming filled with these long-threaded non-digestive materials. Unfortunaly this can only be seen by a (double) contrast X-ray, so in many cases it will be too late to operate and help the animal.
Straw sticking to fish has on more cases been reported to cause choking.

2.7.9 Prophylaxis against urolithiasis

If urolithiasis has been diagnosed in one of your otters, you should consider the following measurements:
-NACL in the food: ca. 200 mg/kg bodyweight, so the animal will drink more water.
-NaHCO3 in the food: ca. 100 mg/kg bodyweight, the pH of urine has to be controlled.
-reduced purine level in the food
-medication with allopurinol (has not yet been used for the otter); can only be useful with certain types of renal calculi.

2.8 Legislation

This paragraph contains a short summary of some of the conventions, directives and regulations that concern the Eurasian otter and it's habitat. For a more detailed review see the Otter Action Plan 2000.

Washington Convention

As said in paragraph 1.2.1 Zoogeography/Ecology, the Eurasian otter is listed in Appendix I of the "Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES)". Trading with the otter is only allowed under special circumstances and requires special permits.

EU Regulation on Trade in Endangered Species

The European Union has been fully implenting the Washington Convention. It has adopted two Council Regulations; - "Protection of Species of Wild Fauna and Flora by Regulating Trade Therein"
-a regulation containing detailed implementation provisions, particularly on the use of permits and certificates.

The EU Regulation ensures the succesfull realization of the CITES regulations throughout the European Union and as practice shows, the problems of illegal trade of the Eurasian otter could be reduced to a marginal level in the member states of the EU.

Bonn Convention

The "Convention on the Conservation of Migratory Species of Wild Animals (CMS)" concluded in Bonn in the year 1983, has listed the Eurasian otter in Appendix I. Anmimals listed in Appendix I receive the highest level of protection. The Bonn Convention could be a tool for protection of the *Lutra lutra* against persecution as well as against habitat destruction ar for habitat restoration.

EU Habitats Directive (Fauna, Flora, Habitat Directive)

In 1992 the European Union implemented the "Directive on the Conservation of Natural Habitats and of Wold Plants and Animal's. This is an obligatory directive, sanctions are possible by the European court of justice.
Main aims of the directive are:
-to promote the maintenance of biodiversity,
-to take measures at Community level in order to conserve natural habitats which are continuing to deteroirate and the increasing number of wild species seriously threatened.
-to define certain types of natural habitats and certain species as having priority in order to favour the early implementation of measures to conserve them,
-to designate special areas of conservation in order to create a coherent European ecological network to ensure the restoration or maintenance of natural habitats and species of Community interest.

The Eurasian otter is listed in these directives, but not as a "priority species".

Convention on Biological Diversity

Just like the "Bern Convention", this convention is obligatory in the sense of international law, but does not provide sanctions against contractual parties in case of non-performance.
There are no specific species listed, but the general regulations cover many aspects of otter conservation (biological diversity, conservation of species, research, education, etc)

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IV. APPENDICES

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APPENDIX Ia

Size, water-land-ratio and bankside length of the enclosures (encl.) in the Hankensbüttel Otter Centre.

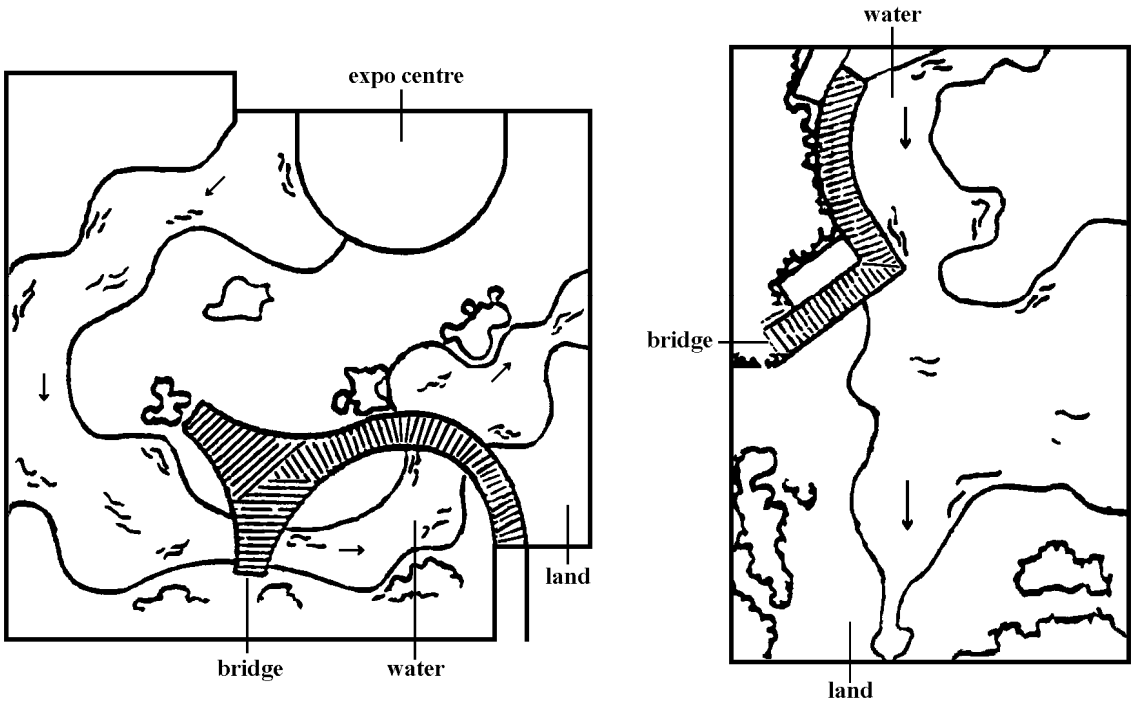
	Total size (m5)	**Total land (m5)**	**Total water (m5)**	**Water-Land-Ratio**	**Bankside Length (m)**
Public encl. "Otter pool"	549	235	314	1:0.75	83
Public encl. "Otter River"	1147	1037	110	1:9.43	170
Public encl. "Otter Waterfall"	474	347	100	1:3.74	97
Research encl. No. 1	451	388	63	1:6.16	42
Research encl. No. 2	453	390	63	1:6.19	37
Reseach encl. No. 3	495	403	92	1:4.38	54
Research encl. No. 4	427	342	85	1:4.02	47
Research encl. No. 5	727	507	220	1:2.30	98
Research encl. No. 6	694	549	145	1:3.79	65
Research encl. No. 7	400	336	64	1:5.25	42

APPENDIX Ib

Size, water-land-ratio and bankside length of the enclosures (encl.) in Otterpark AquaLutra.

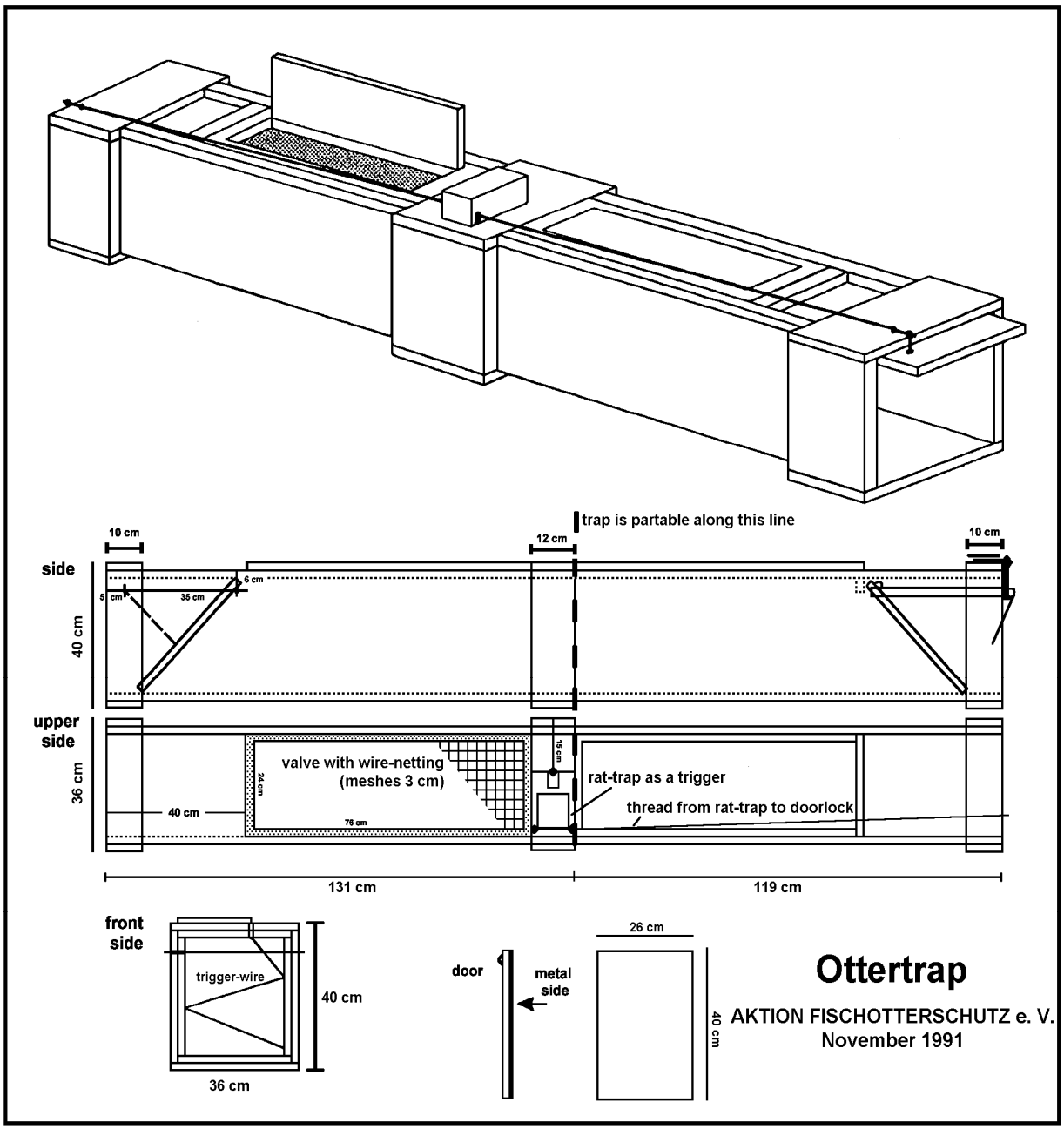
	Total size (m5)	Total land (m5)	Total water (m5)	Water-Land-Ratio	Bankside length (m)
Public encl. number 1	1000	639.25	360.75	1:1.77	80
Public encl. number 2	706	389.5	316.5	1:1.23	82.5

Map of enclosures at Otterpark Aqualutra.



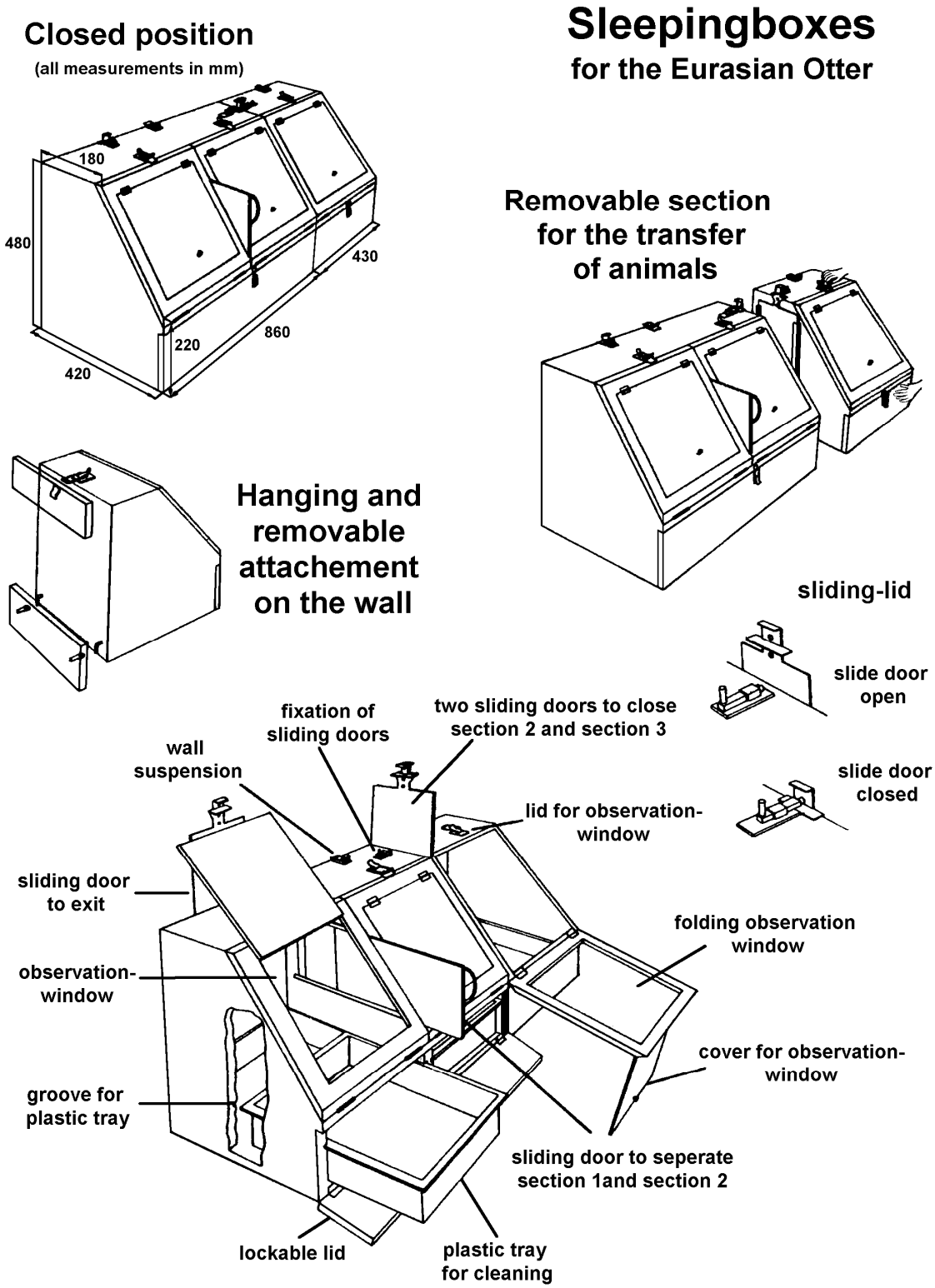
APPENDIX II

Ottertrap
Source: Reuther, C.; Röchert, R. (1989); Habitat, Proceedings der Aktion Fischotterschutz



APPENDIX III

Sleeping and breeding boxes (compartment: ca. 450 x 420 x 430 mm)
Source: Reuther, C.; Röchert, R. (1989); Habitat, Proceedings der Aktion Fischotterschutz



APPENDIX IVa

Feeding-schedule of *Lutra lutra* in Aqua*Lutra* (August 1996)

NAME	FIRST FEEDING (in grams)	SECOND FEEDING (in grams)	THIRD FEEDING (in grams)	TOTAL (in grams)	DETAIL
Paul	40 day-old chicken, 100 mackerel	125 day-old chicken	175 mackerel	440	Public enclosure
Franziska	40 day-old chicken, 100 mackerel	125 day-old chicken	175 mackerel	440	Public enclosure
Liza	40 day-old chicken, 150 mackerel	165 day-old chicken	190 mackerel	545	Public enclosure
Dieko	40 day-old chicken, 150 mackerel	165 day-old chicken	190 mackerel	545	Public enclosure
Dodde	155 day-old chicken, 255 mackerel			410	Breeding Centre
Ursula	155 day-old chicken, 255 mackerel			410	Breeding Centre
Sara and 3 young	750 day-old chicken, 1250g mackerel			2000	Breeding Centre
Idour	310 day-old chicken, 510 mackerel			820	once a week 300gr rat instead of chicken. Breeding Centre
Otje	215 day-old chicken, 360 mackerel			575	Breeding Centre

Feeding-schedule of *Lutra lutra* in Aqua*Lutra* (Januari 1997)

NAME	FIRST FEEDING (in grams)	SECOND FEEDING (in grams)	THIRD FEEDING (in grams)	TOTAL (in grams)	DETAIL
Paul	120 day-old chicken, 200 mackerel	240 day-old chicken	340 mackerel	900	First feeding one spoonful SA-37 (about 0.8239 gram). Public enclosure.
Franziska lactating	360 day-old chicken, 250 mackerel	280 day-old chicken	630 mackerel	1520	First and third feeding one spoonful SA-37. Janosh is a young of Franziska. Public enclosure.
Janosh	120 day-old chicken, 160 mackerel	120 day-old chicken	200 mackerel	600	First feeding one spoonful SA-37. Public enclosure.
Liza	120 day-old chicken, 160 mackerel	200 day-old chicken	320 mackerel	800	First feeding one spoonful SA-37. Public enclosure.
Dieko	120 day-old chicken, 250 mackerel	280 day-old chicken	400 mackerel	1050	First feeding one spoonful SA-37. Public enclosure.
Dodde	300 day-old chicken, 500 mackerel			800	One spoonful SA-37. Breeding centre.
Ursula	745 day-old chicken, 930 mackerel				745 on monday until wednesday, 930 on thursday until sunday. One spoonful SA-37. Breeding centre.
Idour	430 day-old chicken, 720 mackerel				
Otje	395 day-old chicken, 655 mackerel				
Sara	300 day-old chicken, 500 mackerel			800	One spoonful SA-37. Breeding centre.

Nutrient composition: of mackerel in appendix VIa on page 48,
of day-old chicken in appendix VIb on page 49
of SA-37 in appendix VIb on page 50.

APPENDIX IVb

Feeding-schedule for *Lutra lutra* at the Hankensbüttel Otter Centre.

	Quantity in 1-3 ratios	**food**
Monday	1000 gr	fish and vitamins*, 3. stomach from the cow[1], liver**
Tuesday	1000 gr	fish and vitamins, heart from the cow
Wednesday	1000 gr	1. stomach from the cow, day-old chicken, liver
Thursday	1000 gr	3. stomach from the cow, fish and vitamins
Friday	1000 gr	day-old chicken, 1. stomach from the cow
Saturday	1000 gr	3. stomach from the cow, liver
Sunday	1000 gr	fish and vitamins, heart from the cow.

*The vitamins VITACOMBEX are given to the otters
Nutrient composition of VITACOMPEX
source: Parke, Davis & Company, Berlin
2 ml VITACOMBEX per otter per day, four times a week.

Vitamin A	5000 I.E.
Vitamin D3	400 I.E.
Vitamin B1	3,0 mg
Vitamin B2	4,3 mg
Vitamin B6	1,0 mg
Vitamin B12	5,0 µm
Viamin C	50,0 mg
Nicotinamide	20,0 mg
Natrium-D-panthothenate	5,5 mg

**liver not more than 150 gr per otter
-mother with cubs can have so much food they want.
[1]: 3.= A cow has four stomachs and Hankensbüttel feeds the first and the third stomach.
-The quantities of the food are different. Each otter has his own quantity, but the amount is different throughout the year. In the winter the otters eat more than in the summer and old animals need more food than otters between 2 to 8 years. For example Bulgare eat in 1982 about 250 grams and in 1991 he eat about 800 grams.

APPENDIX IVc

Feeding-schedule of *Lutra lutra* at Blijdorp Zoo

Food	**Grams**	**Unit/pieces**
Rovo ® worst RODI	45	slice of 4 cm diameter
cow meat	35	
chicken	360	3
day-old chicken	70	2
Carmix ® HOPEFARMS	10	2 tea-spoons of 10 ml

The otters are fed twice a day, seven days a week. Some days, variation is given in the diet.
Wednesday: 200 g mackerel instead of 3 pieces chicken and
150 g chicken.
Thursday: 300 g rat and no chicken.
Sunday: whole chicken with feathers and intestines.

APPENDIX IVd

Feeding-schedule of *Lutra lutra* at Planckendael Zoo

Seven days a week the same diet:
25 grams oats
35 grams bran
40 grams day-old chicken
12 mackerel (100-150 grams)
mice and/or small rats
330 grams meat
Z01 supplement:

crude protein:	12.0%
crude fat:	5.0%
crude fiber:	2.0%
ASH:	50.0%
calcium:	14.0%
natrium:	2.4%
Phosphor:	2.6%
Vitamin A:	360.000 I.E./kg
Vitamin D3:	60.000 I.E./kg
Vitamin E:	1.200 mg/kg

APPENDIX V

Variation in energy intake in Eurasian otters (*Lutra lutra*):
Effects of lactation and seasonal changes

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KEYWORDS: Nutrition; Lutrinae; Diet; Food intake;

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Summary
Otters are large consumers, daily food intake can mount up to 15% bodyweight in wintertime, or up to 28% bodyweight during lactation.
In order to investigate variation in energy intake related to changing seasons and lactation, the food intake of 4 Eurasian otters kept at the Otterpark AQUALUTRA was monitored over a period of one year (including a hot summer and a severe winter) and of six months respectively.
As Eurasian otters are kept in many countries in Europe, with very different climatological circumstances during the year, data on average temperature during the test period were collected, in order to be able to give more specific advise on gross energy intake related to average environmental temperature.
Also indications on how to increase the amount of food offered to a lactating female otter are given.

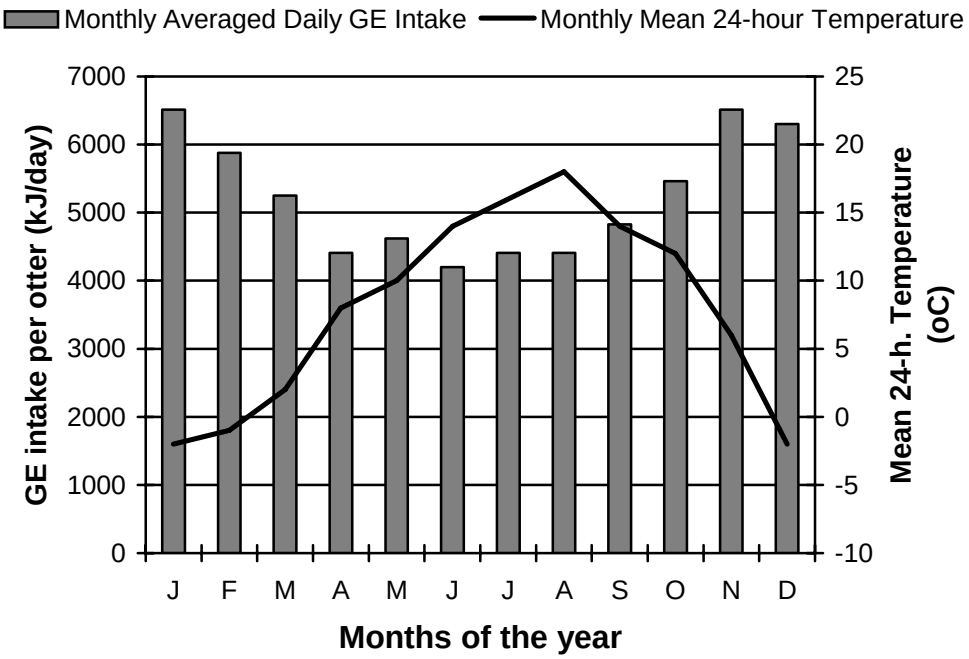
Effects of seasonal changes on energy intake
Otters are large consumers, daily food intake is reported to mount up to 12% bodyweight in wintertime, or up to 28% bodyweight during lactation (Duplaix-Hall 1975; Kruuk 1995; Wayre 1979). Most studies into quantity of food eaten do not take into account the energy content of the food eaten, and only have taken place over a short period of time, thus not looking at seasonal changes. As Eurasian otters are kept in many countries in Europe, with very different climatological circumstances during the year, data to enable more specific advise on gross energy intake related to average environmental temperature are needed to be incorporated in the husbandry guidelines for the Eurasian otter.

A study was designed to measure these seasonal changes in food quantity intake, thus giving indication for changes in energy intake. Two adult, non pregnant or lactating animals (1.1) of average bodyweight (male ±8kg, female ±7kg) were housed together in the publicly accessible enclosures of 400 square meters, with 1/3 surface area of streaming water of the Otterpark AQUA*LUTRA* at Leeuwarden, the Netherlands. Their food intake was registered during one year. The animals were fed three times daily a fixed amount of food with a two to three hour interval. The quantity was determined once a week by the behaviour of the animals in the previous week, as the amount of food would be increased to the point the animal would not appear on three consecutive days from their nestboxes for their last feeding time (indicating the food intake for that day had been enough), then the daily quantity of food given was reduced. When the animals became too aggressive to the keepers for several consecutive times because of hunger, the quantity of food offered was increased to the level they would still appear on all three feeding times without showing aggression caused by hunger. In general this resulted in stable food quantity levels for several weeks to months before a change had to be made again.

The animals were fed a fixed composition diet during this testing period, consisting on 2/3 of gross energy intake on freshly thawed mackerel (840 kJ GE/100g as fed, 68% water) and 1/3 of gross energy intake on freshly thawed one day old chickens (630 kJ GE/100g as fed, 73% water) making up ±40% chicken / ±60% mackerel with a ±750kJ GE/100g as fed diet mixture. Nutritional values are mean values obtained from several sources (Clum et al. 1997; Dierenfeld, 1997), including own analyses on crude fat, crude protein and dry matter on samples of the food offered throughout the year. During the test period the animals kept their bodyweight at an estimated 8kg, appeared healthy and were behaving normally. Shortly after the testing period the female became pregnant and raised a healthy cub. The data were related to the other 8 otters housed in other enclosures at the Otterpark, who functioned as a control group to eliminate the temporary changes in character (periodically increased aggressiveness not caused by hunger) which regularly occur in otters. For a short period of time (2-6 days) otters, males and females, can become more aggressive, maybe due to hormonal changes. By crosschecking the behaviour of the two otters in this test, this influence could be excluded and food amounts would not be increased.

In Figure 1, the monthly averaged daily energy intake during a one year period related to the averaged 24-hour day-night monthly air temperature (KNMI 1995,1996) are shown. As can be seen, food intake decreases as average 24-hour temperatures increase. Energy intake was calculated based on the fixed food composition ratio, and calculated by addition of the daily intake of the two otters per month, divided by the number of days. The food amount was then divided by two, in order to get the foodintake for an average otter (±7.5kg bodyweight). In this way small fluctuations, caused by a nice sunny weekend in springtime for example, were eliminated.

During this period the highest daily average 24-hour temperature was +25 °C (max. day temp. +32 °C, min. night temp. +18 °C), corresponding to a minimum daily intake of 450g of food (6% of bodyweight, 3375 kJ GE/day) that week, whereas the lowest daily average 24-hour temperature was -13 C (max. day temp. -6 °C, min. night temp. -20 °C), corresponding to a maximum daily intake of 1050g of food (13% of bodyweight, 7875 kJ GE/day) that week.



Monthly averaged food intakes varied between 600g in summer and 950g in wintertime, whereas the average 24-hour temperature varied between -3 °C in winter months and +18 °C in summer months.

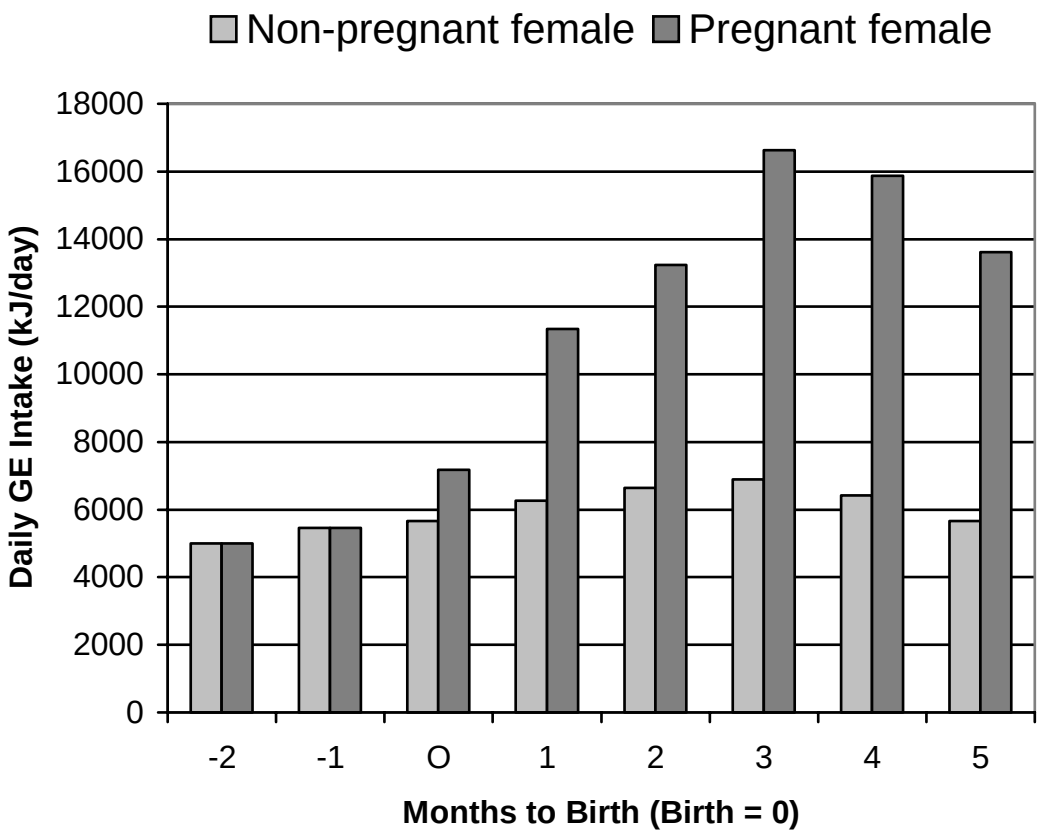
Figure 1: Monthly averaged daily gross energy intake per otter during a one year period related to the monthly mean 24-hour temperature

Effects of lactation on energy intake

The effects of lactation on energy intake were studied in two female otters of 7kg estimated bodyweight. They were housed individually in the breeding center in enclosures of 200 square meters each, with 1/3 surface area of streaming water. Both females were fed the same basic mixture diet as described above, the quantities of food offered being determined by the animals in the public enclosures as described above. The animals were fed once daily at the end of the day. Both females were housed under comparable conditions in adjacent enclosures, and were monitored over a period of six months. During this period one of the females was mated, became pregnant and raised three cubs successfully. The other female, of approximately the same bodyweight, remained unmated and was used as reference animal to eliminate climatological effects.

In Figure 2, the differences in daily gross energy intake between a pregnant/lactating female and a non-pregnant/non-lactating female are shown. As can be seen, lactation may cause a rise in mean monthly gross energy intake to 240% of the control animal level. Peak weekly food intake was up to 1800 grams (26% bodyweight, 300% of control animal food intake, as the control animals intake was only 600g of food per day that specific week in month 2 after birth), or 2200grams (31% bodyweight, 240% of the control animal intake in month 3 after birth). As from the third month after birth the cubs started feeding of their own, mother's food intake slowly decreased.

Figure 2: Differences in daily gross energy intake between a pregnant/lactating female and a non-pregnant/non-lactating female



Conclusions

There seems to be a clear relation between the mean 24-hour day-night air temperature and the energy intake in otters. As otter have a very dense fur, that gradually loses its protective isolation air layer under water (the bubbles you can see escaping from the fur if an otter dives), it is likely to presume a closer relation between water temperature and time spent in the water per day. But as water temperature will roughly follow the air temperature, air temperature can be used as a rough indicator. The results indicate that in winter the amount of food offered should be monitored carefully (weighing the amount given and the amount not-eaten daily!) as it increased in our

case up to 200% compared to the lowest summer averaged weekly intake. For lactating females the amount increases even more (up to 300%). This test was done with a high-energy diet, the basic diet of the Otterpark AQUA*LUTRA*. If freshwater fish is used, the amount of food offered daily will be considerably higher, due to their lower energy density. Also the risk of thiaminase should be well considered in some freshwater species of fish (like carp), causing hypovitaminosis B1. This amount of food can not be eaten in one time and regarding the fact that an important component of otter diets in general (fish) is very perishable, husbandry measures are necessary in order to provide the animals a sufficient amount of proper food. In winter this means protection of the food from freezing, and in summer prevention from becoming sour, combined with a two or even better three times daily offering of the food. Preventive measures against stealing of the food must be taken and accurate daily monitoring of amounts given to the animal and eaten by the animal should be performed.

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APPENDIX VIa

Nutrient composition of mackerel
Source: WSC Zootrition 1999, Wildlife Conservation Society

(26,30 % DM/73,70 water)
Dry matter analysis:

Ash	10,50 %
Calcium	2,40 %
Copper	1,00 mg/kg
Crude fat	15,90 %
Crude protein	67,70 %
Iron	158,20 mg/kg
Magnesium	0,10 %
Manganese	3 mg/kg
Vit A	234,89 IU A/g or RE/g
Vit E	166,40 mg/kg
Zinc	44,40 mg/kg

1 STD QTY= 100.0 Gms mackerel, as fed.
Data Source: SOUCI ET AL 81
Category: fish
DM: 32 % PRO: 58 % FAT: 37 % ASH: 4 %

	195 Kc Gross energy (GE)
	68.00 Gm Water (H20)
	32.00 Gm Dry matter
	1.400 Gm ASH
Protein	18.70 Gm CRD Protein
Fat	11.90 Gm FAT
	- Gm Linoleic acid
	- Mg Arachidonic acid
Minerals	12.00 Mg Calcium
	2.44 Mg Phosphorus (P)
	95.00 Mg Sodium (Na)
	396.0 Mg Potassium (K)
	30.00 Mg Magnesium (Mg)
	1.000 Mg Iron (Fe)
	0.160 Mg Copper (Cu)
	0.037 Mg Manganese (Mn)
	- Mg Zinc (Zn)
	0.074 Mg Iodine (I)
	0.035 Mg Selenium (Se)
Vitamins	333.0 IU Vit. A
	- IU Vit. D2
	40.00 IU vit. D3
	1.250 Mg Vit. E
	0.130 Mg Thiamin
	0.360 Mg Riboflavin
	0.460 Mg Pantothenic acid
	7.500 Mg Niacin
	0.630 Mg Pyridoxine
	9.000 Ug Vit. B12
	- Mg Choline
	0.003 Mg Biotin
	- Mg Taurine

APPENDIX VIb

Nutrient composition of day-old chicken
Source: WSC Zootrition 1999, Wildlife Conservation Society

(27,00 % DM/73,00 water)
Dry matter analysis:

Ash	7,25 %
Calcium	1,30 %
Copper	3,30 mg/kg
Crude fat	23,80 %
Crude fiber	0,95 %
Crude protein	62,35 %
Iron	120,95 mg/kg
Manganese	2,70 mg/kg
Phosphorus	0.97 %
Thiamin	13,30 mg/kg
Zinc	121,65 mg/kg

1 STD QTY= 100.0 Gms day-old chicken, as fed.
Data Source: UNKNOWN
Dm: 27 % PRO: 62 % FAT: 24 % ASH: 7 %
CF: 1 % NDF: - % ADF: - % NFE: 6 %

	162.0 Kc Gross Energy
	73.00 Gm Water
	27.00 Gm Dry matter
	0.257 Gm Crude Fiber
	1.960 Gm ASH
Protein	16.80 Gm CRD Protein
Fat	6.430 Gm FAT
	- Gm Linoleic acid
	- Mg Arachidonic acid
Minerals	355.0 Mg Calcium
	265.0 Mg Phosphorus (P)
	- Mg Sodium (Na)
	- Mg Potassium (K)
	- Mg Magnesium (Mg)
	3.300 Mg Iron (Fe)
	0.090 Mg Copper (Cu)
	0.070 Mg Manganese (Mn)
	3.310 Mg Zinc (Zn)
	- Mg Iodine (I)
	- Mg Selenium (Se)
Vitamins	- IU Vit. A
	- IU Vit. D2
	- IU vit. D3
	- Mg Vit. E
	0.359 Mg Thiamin
	- Mg Riboflavin
	- Mg Pantothenic acid
	- Mg Niacin
	- Mg Pyridoxine
	- Ug Vit. B12
	- Mg Choline
	- Mg Biotin
	- Mg Taurine

APPENDIX VIc

Nutrient composition of SA-37 as fed per 100 GRAM
source: MYCOFARM

NUTRIËNT	COMPOSITION	NUTRIËNT	COMPOSITION
Vitamin A	800000 IU	Cholin	2400 Mg
Vitamin D3	8000 IU	Biotin	0,200 Mg
Vitamin E	55,0 Mg	Vitamin C	600 Mg
Vitamin K	280 Mg	Iron	210 Mg
Riboflavin	25 Mg	Zinc	24.0 Mg
Niacin	100 Mg	Copper	30,0 Mg
Foliumacid	2000 Mg	Manganese	20,0 Mg
Vitamin B12	360 µg	Iodine	9,00 Mg
Panthothenic acid	20,0 Mg	Cobalt	36,0 Mg

APPENDIX VII

Development of Eurasian otter cubs.
The data that has been used to compile this table, is derived from the graphs in the article "Development of weight and length of Eurasian Otter (Lutra lutra) cubs" by Claus Reuther, IUCN Otters Specialist Group Bulletin, Volume 16 (1) April 1999.

	1 day	**7 days**	**14 days**	**21 days**	**28 days**	**35 days**	**42 days**	**49 days**	**56 days**	**63 days**
Mean value for body weight (g) of all cubs measured	95	160	300	450	600	800	1000	1200	1420	1645
Mean value for sex specific body weight (g)	♂ 95 ♀ 95	♂ 160 ♀ 160	♂ 300 ♀ 300	♂ 450 ♀ 450	♂ 600 ♀ 600	♂ 800 ♀ 800	♂ 1010 ♀ 990	♂ 1230 ♀ 1170	♂ 1450 ♀ 1390	♂ 1700 ♀ 1590
Mean value for total lenght* (cm) of all cubs	18	24	28	34	38	44	47,5	51	55	57,5
Mean value for sex specific total lenght* (cm)	♂ 18 ♀ 18	♂ 24 ♀ 24	♂ 29 ♀ 27	♂ 35 ♀ 33	♂ 39 ♀ 37	♂ 45 ♀ 43	♂ 48 ♀ 47	♂ 51,5 ♀ 50,5	♂ 55 ♀ 55	♂ 57,5 ♀ 57,5
Mean value for body lenght** (cm) of all cubs	14	17	20	23	26	29	32	34	36	38
Mean value for sex specific body lenght** (cm)	♂ 14 ♀ 14	♂ 16 ♀ 18	♂ 21 ♀ 19	♂ 23 ♀ 23	♂ 26 ♀ 26	♂ 29 ♀ 29	♂ 32 ♀ 32	♂ 33,5 ♀ 34,5	♂ 35 ♀ 37	♂ 37 ♀ 39

* Total length: from nose to tip of the tail
** Body length: from nose to base of the tail.

APPENDIX VIIIa

Nutrient composition of KMR (Milk Replacer for Kittens)

Source: Pet-Ag Inc.
30W432 Rt.
20 Elgin,
IL 60120
Great Britain

Analysis: (as fed.)

Crude protein, min.	7.5%
Crude fat, min.	4.5%
Crude fiber	none
Moisture, max.	82.0%
ASH, max.	1.5%

*Fortified with vitamins, minerals and taurine.

Ingredients:
Skimmed milk,
Water,
Soy oil,
Sodium caseinate,
Calcium caseinate,
Butter,
Egg yolk,
Lecithin,
Calcium carbonate precipitated,
L-arginine,
Potassium chloride,
Potassium Phosphate monobasic,
Choline chloride,
Magnesium sulfate,
Carrageenan,
Potassium phosphate dibasic,
Ascorbic acid,
Taurine,
Iron sulfate,
Zinc sulfate,
Vitamin E supplement,
Vitamin A supplement,
Copper sulfate,
Niacin supplement,
Calcium pantothenate,
Vitamin B12 supplement,
Manganese sulfate,
Thiamin hydrochloride,
Riboflavin,
Vitamin D3 supplement,
Folic acid,
Potassium iodide,
Pyridoxine hydrochloride.

APPENDIX VIIIb

Nutrient composition of ESBILAC (Milk Replacer for Puppies)

Source: Pet-Ag Inc.
30W432 Rt.
20 Elgin,
IL 60120
Great Britain

Analysis: (as fed.)

Crude protein, min.	4.5%
Crude fat, min.	6.0%
Crude fiber,	none
Moisture, max.	85.0%
ASH, max.	1.0%

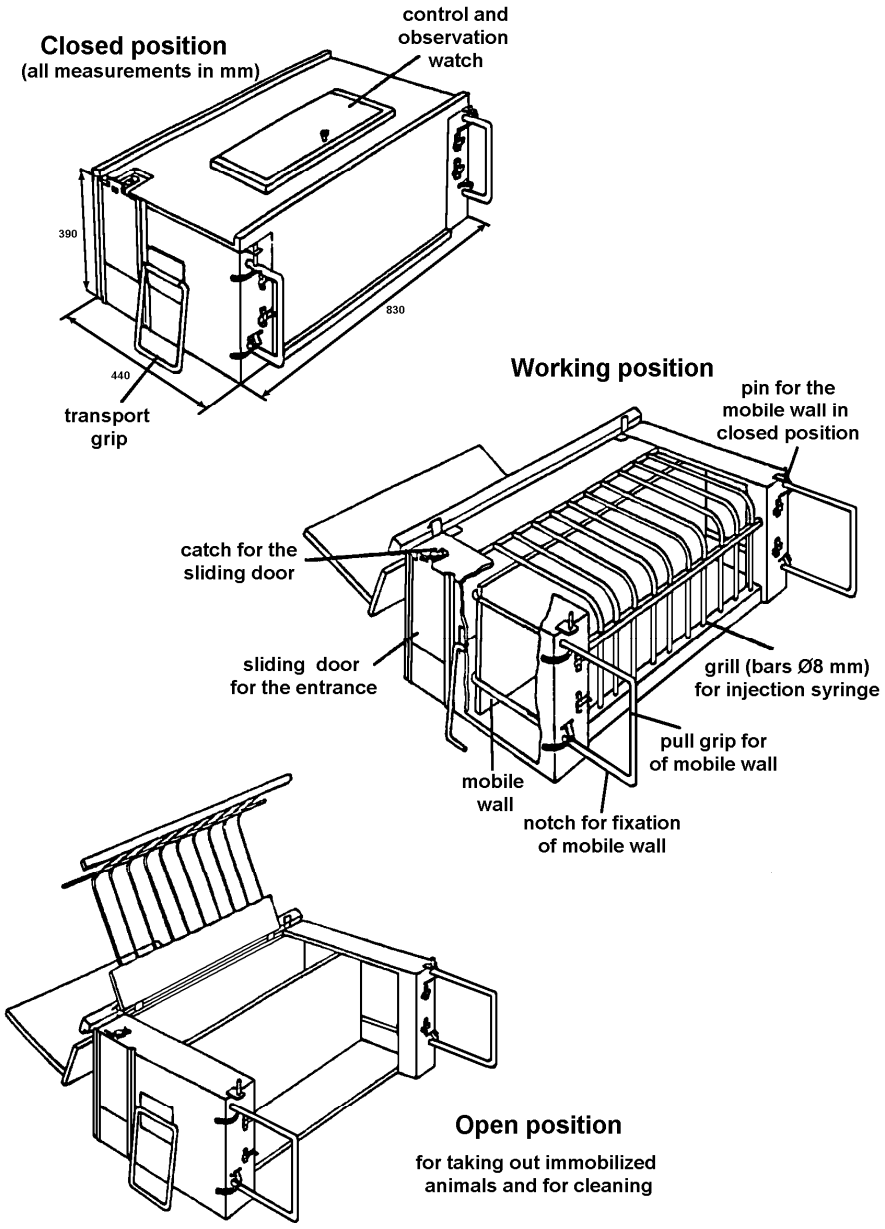
*Fortified with minerals and vitamins.

Ingredients:
Water,
Skimmer milk,
Soy oil,
Sodium caseinate,
Butter,
Egg yolk,
Calcium caseinate,
L-arginine,
DL- methionine,
Calcium carbonate,
Potassium chloride,
Potassium phosphate monobasic,
Lecithin,
Magnesium sulfate,
Choline chloride,
Sodium chloride,
Carrageenan,
Potassium phosphate dibasic,
Ascorbic acid,
Vitamin A supplement,
Zinc sulfate,
Iron sulfate,
Vitamin E supplement,
Copper sulfate,
Niacin supplement,
Calcium pantothenate,
Vitamin B12 supplement,
Vitamin D3 supplement,
Manganese sulfate,
Riboflavin,
Thiamine hydrochloride,
Pyridoxine hydrochloride,
Potassium iodide,
Folic acid.

APPENDIX IX

Fixation-box
Source: Reuther, C.; Röchert, R. (1989), Habitat, Proceedings der Aktion Fischotterschutz.

Note: This is the "pull" type of "crush-cage". A push type may prove to be easier for the veterinarian to provide him more workspace.



APPENDIX X

Summary from IATA, Live Animals Regulation (1994), applicable to otter species.

Design and construction of container:

Containers must be constructed with a strong framework, with joints so that the animal cannot claw or bite through the joints or escape due to continual biting and scratching at the corners of the container.
Transportation may increase defecation. The floor of containers must be leak-proof with sufficient absorbent material contained therein.

Feeding and watering:
Animals normally do not require feeding or watering during 24 hours following the time of transport. If feeding is required due to an unforseen delay, canned dog or cat food must be provided but care must be taken not to overfeed. Watering is more important than feeding, and if this cannot be performed during transport, the animal must, at least, be watered before dispatch and upon arrival.
Any feed or water given must be recorded on the container instructions with the date and time of supply.

Behaviour and stress:
Stressful situations for animals:
-yarding and handling,
-deprivation of food and water during extended periods,
-inadequate ventilation- overcrowding or isolation,
-large fluctuation in temperature,
-unfamiliar surroundings in combination with noises,
-insufficient care during all phases of transportation,
-mixing different species,
-mixing mature male with female in heat,
-improper pre-shipment acclimatization, such as getting used to container and/or companions

Wild animals generaly prefer to travel in darkness or semi-darkness, as this encourages them to rest.
In general the carriage of mammals with suckling young is not recommended because some females sensing danger may cause harm to their young.

Animals that are natural enemies must not be crated together. Animals in quarantine must be segregated from those that are not. Animals known to be for laboratory use must not be stored adjacent to other animals in order to reduce any risk of cross-infection or contamination, e.g. specific pathogen free (SPF) consignments.

Sedation:
Experience has shown that there is considerable risk in sedating animals transported by air. Tranquilizers reduce the ability of the animals to respond to stress during transportation. In addition, the reaction of various species to tranquilizers cannot always be foreseen. For these reasons routine tranquilization is not recommended.
Tranquilizers must only be used when a specific problem exists and must be administrated by a veterinarian or by person who has been instructed in its use. The drugs must only be administrated during the flight with the knowledge and consent of the captain. A note must always be attached to the container, stating the animal(s) individual weight, generic name of the drug used, the dose, method of administration and the time given.

General loading procedures:
Avoid unnecessary tilting and jolting of containers. Handle and stow the containers in the upright and level position.
Animals must be loaded as near to the time of the aircraft's departure as possible.
Live animal shipments should be located in such ways that local temperatures will not immediately affect them when the cargo compartiment doors are opened.
Containers with live animals must be placed on spreader boards, instead of directly on the floor, to stop the transfer of cold air from the airframe to the containers. Also do not load directly in front of or below air ventilation outlets.
Avoid draft but stimulate healthy ventilation.

Prevent other loads from shifting and falling or leaning onto the animal container. To avoid movement of the animal container it may be necessary to tie it down.
Treat most live animal transports as wet cargo. Place plastic sheeting or tarpaulin under the containers in order to avoid soilage of aircraft.

Health and hygiene:
Animals:
Do not place animal container in close proximity to foodstuffs, because of serious risk of contamination.
When feasible, arrange for animals injured or having become apparently ill during carriage to receive veterinary treatment.
Personnel:
All animals are capable of transmitting a variety of diseases to humans, consequently, physical contact with the animal must be avoided and strict personal hygiene must be observed.
Wear washable or disposable, impervious gauntlets. Wash both gauntlets and hands in germicidal soap after handling animal consignements. Report to a doctor as soon as possible after being bitten or scratched by an animal providing information on the species and origin of the animal.
Staff who handle animal (transports) regulary must be immunised against diseases.

Note: the text above is a summary, for a more extensive version see IATA, Live Animal Regulation.

APPENDIX XI

Details about the vaccinations
Source: Poppema drs. D. J. (1994)

Infectious canine hepatitis / hepatitis Contagiosa Canis (H.C.C.)/ Rubarth's disease:

A virus causes this highly contagious disease. The main sufferers are young animals (e.g. dogs), under one year of age. For this reason all young puppies should be vaccinated at around eight to ten weeks. The incubation period is five to seven days.
What are the signs? Initially the signs are vague. Only mild cases may go of their food and show a raised temperature for a few days. More severe cases become very dull, refuse to eat and are thirsty but occasionally, an animal will die without warning.
Common signs are:
-coughing
-vomiting, with blood seen in the vomit in the later stages.
-diarrhoea, which may also contain blood.
-abdominal pain and restlessness.
-excitability
-lack of coordination of the hind legs
-convulsions
-jaundice (occasionally)
-pale gums, with minute haemorrhages

Other associated problems include kidney damage (this is the last part of the body to become clear of the virus). Recovered animals shed live virus in their urine for months after infection, which makes them a serious risk to unvaccinated animals.

Rabies/ Tollwut/ la rage lyssa:

This killer viral disease is transmitted by infected saliva (from an infected animal e.g. a dog), being left in a bite wound. Signs include:-inability to swallow
-furious running, biting
-drowsiness
-paralysis. The virus moves back down the nerves to the salivary glands where it multiplies.

Affected animals will die; humans in contact with them are in danger and must be vaccinated immediately.

Parvovirosis:

A relatively new disease, parvovirus has been prevalent only once since 1978 when swept simultaneously across Britain, North America and Australia. This major viral disease is similar to panleucopaenia in cats.
The major signs are:
-severe enteritis with haemorrhagic diarrhoea
-acute vomiting, even of fluids
-severe depression
-high temperature

Unless treated promptly the disease can be fatal.

Canine distemper (CD)/ Hundestaupe/ maldie de jeune age/ Carré's disease:

This condition occurs more often in young animals (e.g. dogs), but can attack at any age. Infection occurs through inhalation of the virus and is spread around the body by defensive cells trying to capture and kill it. If they fail, the virus attacks the immune and nervous systems and the cells lining the lungs and gut.
The signs include: As the second phase symptoms are improving, about four weeks after initial infection, the nervous system may start to show damage. This can range from slight tremors to full epileptic fits.

Leptospirosis:

Leptospira icterohaemorrhagiae is one of the two types of leptospirosis. The bacterium attacks the liver and is also the cause of Weil's disease in humans. The second form attacks the kidney. Both are spread through infected urine and the incubation period is about a week.
Signs are: -sudden dullness
-high temperature
-vomiting with thirst
-bloody diarrhoea
-jaundice (yellowness in gums and whites of eyes)
-small haemorrhages on the gums.
The disease can be fatal for young animals.

Kennelcough/ Zwingerhusten/ kennelhoest:

Normally caused by a bacterium called *Bordetella brochiseptica and Pasteurella*, this disease may also be contracted from viruses and other bacteria. Kennelcough is most prevalent during summer; it spreads when animals are brought together.
Signs (among other things): -continental harsh, dry cough
-lack of appetite, nasal or eye discharge
-depression (general lack of interest, lying around)

Feline infectious enteritis/ panleucopaenia/ pseudomembraneuze enteritis/ katteziekte:

This higly contageous viral disease is resistant to many antiseptics, and can be transmitted by direct or indirect contact, even via fleas. With a 2-9 day incubation period, it ivades the cells of the small intestine wall, the liver, spleen, bone marrow, some lymph nodes and, unborn or newly born animals (e.g. kittens), the brain. Animals may die within minutes of first show.
Signs include: -depression
-persistent vomiting
-diarrhoea
-rapid dehydration
-sitting in a typical "hunched-up" posture
-wailing pityfully when touching

APPENDIX XII

Article: "Diseases of the Eurasian otter (*Lutra lutra*): a survey of 10 years of deathcauses within the European Studbook."

Authors: Drs Alfred Melissen (Otterpark Aqaulutra, Leeuwarden: EEP-coordinator and studbook-keeper of *Lutra lutra*) and Geoffrey Huizinga (Van Hall Instituut)

Summary:
According to information/data from literature about European otters they can have many diseases. This article gives a short survey of these diseases and then it will count and discuss the deathcauses of otters that were part of the studbook from 1988 to 1998.

Diseases in otters:
Diseases in otters are described in several aritcles. Assumptions about the frequency in which these diseases occur are made rarely. Usually only a few cases are described. In the next overview (table 1) the described diseases in otters untill now are listed.

Table 1: Diseases in otters/martens/mustelidae (* = described in *L.lutra*, otherwise diseases reported in other otterspecies/ martens/mustelidae in general; [*] = Literature reference)

1. Infectious diseases:

1.1 Virus infections

- *rabies [*1,*3]
- pseudorabies/ "Aujesky disease" (Herpes I) [1]
-*canine distemper [*1,*2,*3]
- Infectious canine heptitis [1,3]
- Herpes virusinfection (Seeotter Alaska) [1]
- *Parvo-virosis [*1,3]
- Mink enteritis [1]
- Feline infectious enteritis [1,2,3]
- *Aleutian Disease: Parvo [1,*2,*3]
-Rotavirus, Coronavirus [1]
- Influenza[1]
- Rhinotracheitis Virus [1,3]

1.2 Bacterial diseases

- *Leptospirosis [1,*2]
- *Brucellosis [*1]
- *Salmonellosis [1,*2,*3]
- *Tuberculosis [*1,*2,*3]
- *Pseudotuberculosis [1,*2]
- Yersiniose [1]
- Pseudomonas Pneumonia [1]
- Campylobacterinfection [1]
- Botulism [1]
- *Shigellosis (*cause of abortion in Scotland)[1]
- Proteus bacteria[3: urogenital]
- Klebsiella pneumoniae [3]
- *Clostrids [*2,3]
- Plesiomonas *shigilloides* [3]

1.3 Parasites

Ectoparasites:
- *Ticks (I. ricinus) [*1,*3: rare in L.lutra]
- *Lice (Lutridia exilis) [*1: rare in L.lutra]

Endoparasites:
- Toxoplasmose [1]
- Tapeworm: Taenien / Diphylobothrium med. [1]
-*Roundworm: Anisakis simplex, Skrjabingylus [1]
- Heartworm: Dirofilarien (Amerika) [1]
- Kidneyworm: Dictphyma renale (Amerika) [1]
- *Isthmiophora melis [*3]
- *Opistorchis felineus [*3]
- *Eustrongylus gigas [*3]

1.4 Mycotic diseases [*1,*3: rare]

- Microsporus and Trichophyton [1]
- Histoplasmosis [1]
- Cryptococcosis [1]
- Blastomycosis [1]
- Actinomycosis [1]
- Monilia [3]

1.5 General diseases

- *Pulmonary affection [*2]
- *Injury of the eye [*2]

2. Non infectious diseases:

*Urolithiasis [*1: frequently; *2,*3]
*Tooth injuries [*1,*3: frequently]
*Metabolic disorders [1]
*Hyperthermia [*3: immobilization / transport]
*Vitamin deficiency [*1,*3: vit. B1; 3: vit. D & Ca:P]
*Tumors [*1,*2: rare]
Intoxication [1;3: PCB / PAC]
*Strange object in stomach [*4;*5]
*Traumatic [*1: frequently]
- *Cavity of the mouth (bones / fish-bones) [*1]
- *Bitemarks / abscess [*1: frequently]

Studbook dates:

Between 1988 and 1998, 378 otters were reported dead in the studbook. 98 animals died aged between 0 and 7 days old, 42 between 7 days and 6 months and 238 animals were older then 6 months.
Further inquiry then requests the studbook participants to trace the cause of death. Of 290 otters data was available, but most of the time this data was incomplete, or the post mortem on the animal was not complete.

In table 2 the existant data are listed. Table 3 and 4 enlist more specified data, as they are reported.

Table 2: deathcauses: general overview (n = number of animals, n* = number of animals that had disease in combination with other symptoms)

Internal deathcauses

Disease:		n (n*)	Disease:		n (n*)
- I -	Digestive system	20 (12*)	- VIII -	Kidney and urinary system	23 (12*)
- II -	Nervous system	3 (0*)	- IX -	Infection: specific	24 (12*)
- III -	Muscle of skeleton	1 (1*)	- X -	Infection: non specific	11 (3*)
- IV -	Respiratory system	23 (14*)	- XI -	Reproductive system	4 (0*)
- V -	Cardiovascular system	17 (9*)	- XII -	Perinatal problems	36 (1*)
- VI -	Blood / lymphatic system	8 (3*)	- XIII -	Tumor	4 (0*)
- VII -	Liver and biliary system	15 (12*)	- XIV -	Other internal causes	16 (8*)

External deathcauses

Died because of:		n (n*)	Died because of:		n (n*)
- I -	Intra-specific	12 (0*)	- V -	Drowning	5 (2*)
- II -	Inter-specific	13 (1*)	- VI -	Other external causes	4 (0*)
- III -	Object	13 (0*)	- VII -	Unknown causes	67 (0*)
- IV -	Trauma / stress	15 (1*)			

Table 3: Internal deathcauses: a specified overview (n = number of animals, n* = number of animals that had disease in combination with other symptoms)

-I- Digestive system	n (n*)
Gastro-enteritis	2 (0*)
Gastritis	6 (5*)
Enteritis	3 (2*)
Hemorrhagic colitis	4 (3*)
Intestinal invagination	4 (1*)
Peritonitis	1 (1*)

-II- Nervous system	n (n*)
Paralyzed	1 (0*)
Meningitis	2 (0*)

-III- Muscle of skeleton	n (n*)
Muscle necrose	0 (1*)

-IV- Respiratory system	n (n*)
Öedema (lung-)	10 (8*)
Pneumonia	9 (4*)
Pleuritis	4 (2*)

-V- Cardiovascular system	n (n*)
Infarct	2 (1*)
Failure	4 (1*)
Incompetence	1 (0*)
Fibrose	1 (1*)
No specification	3 (2*)
Fatty degeneration of the heart	1 (1*)
Degeneration of the heartmuscle	1 (1*)
Heartmuscle	2 (1*)
Abcess	2 (1*)

-VI- Blood /lymphatic system	n (n*)
Sepsis	6 (1*)
Heamolytic anamy	1 (1*)
Depletion of blood-agglutination factors	1 (1*)

-VII- Liver and biliary system	n (n*)
Icterus	2 (2*)
Cirrhose	1 (0*)
Distrofy	3 (3*)
Hepatitis	5 (4*)
Necrose	1 (1*)
Bile-stones	1 (0*)
Cholangitis	1 (1*)
Fatty degeneration of the liver	1 (1*)

-VIII- Kidney and urinary system	n (n*)
Calculi	7 (4*)
Urolithiasis	2 (1*)
Nephritis	5 (2*)
Failure	1 (0*)
Colic	1 (0*)
Chron. nephrosis	2 (2*)
Uremie	6 (3*)

-IX- Infection: specific	n (n*)
Tuberculosis	1 (0*)
Parvo-virosis	2 (1*)
Leptospirosis	1 (1*)
Pasteurella	4 (3*)
Salmonella	2 (2*)
Streptococus	1 (1*)
Coli	2 (0*)
Proteus	5 (4*)
Staphylokokken	3 (0*)
Bacillus anthracys	3 (0*)

-X- Infection: non specific	n (n*)
Infection (non specific)	7 (1*)
Phlegmon of soft tissues	1 (0*)
Jaw necrosis	1 (0*)
Skin necrosis	1 (1*)
Spleen enlargement / problems	1 (1*)

-XI- Reproductive system	n (n*)
Endometritis	1 (0*)
Pathological labour	3 (0*)

-XII- Perinatal problems	n (n*)
Stillborn	20 (0*)
No milk	5 (0*)
Postnatal	4 (0*)
No parental care	4 (1*)
Aspiration of amniotic fluïd	3 (0*)

-XIII- Tumors	n (n*)
Tumor	4 (0*)

-XIV- Other	n (n*)
Old age	8 (4*)
Ascites	1 (1*)
Emaciated	1 (1*)
Trauma	3 (1*)
Öedema (not lung-oedema)	3 (1*)

Table 4: External deathcauses: a specified overview: (n = number of animals, n* = number of animals that were killed in combination with other deathcauses)

- I - Killed: intra-specific	n (n*)
By male	1 (0*)
By female: juvenile victim	5 (0*)
By female: adult victim	3 (0*)
By unknown sex	3 (0*)

- II - Killed: inter-specific	n (n*)
By dog	2 (0*)
By man: shot	1 (0*)
By man: poisoned	6 (0*)
By man: euthanised	1 (0*)
By man: nutritional imbalance	1 (1*)
By man: wrong feeding	1 (0*)
By man: unknown	1 (0*)

- III - Killed by an object	n (n*)
By a trap	1 (0*)
By a car	7 (0*)
By a fishbone	2 (0*)
Ice	1 (0*)
Suffocated	1 (0*)
Accident	2 (0*)

- IV- Trauma and stress	n (n*)
By trauma and stress	15 (1*)

- V - Drowning	n (n*)
Drowned: under ice	3 (1*)
Drowned: cramp	1 (0*)
Drowned: could not swim	2 (1*)

- VI - Other external causes	n (n*)
During release	1 (0*)
During transport	2 (0*)
Mother died	1 (0*)

- VII - Unknown causes	n (n*)
Unknown	67 (0*)

Discussion:

Many of the post mortem results were not sufficient, because no clear cause of the animal's death could be found, or because the veterinarian only executed one part of the post mortem, just like often happens with other exotic species. Summarized, there were 53 cases with inflammation symptoms, but a cause was only found in 9 cases (3 x Proteus bacteria + Haemorraghic Colitis**;** 1 x Parvo-virosis + Enteritis; 1 x Pasteurella + Lung-oedema; 1 x Pasteurella + Pneumonia; 1 x Salmonellosis + Pneumonia; 1 x Salmonellosis + Nephritis; Streptococus + Hepatitis).
In most cases it was impossible to find evidence. Not all of the animals were disected. Only few zoos vaccinate their otters against virusses, and it is uncertain if any anti-bodies are made at all.

Recomendations:

*Standarised post mortem-protocol, that will be used for every dead animal
*Tests with zero-conversion for vaccinations
*Data/record keeping with standarised programs (ARKS & MEDARKS)
*Better directives voor keeping otters in the Husbandry Guidelines

References:

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[4] Vogt, P: Persönliche Mitteilung

[5] Walzer, C: Persnöliche Mitteilung

APPENDIX XIII

How otters find their way through maze wire.

APPENDIX XIV

How otters climb trees.

APPENDIX XIV

How to take blood from an otter.