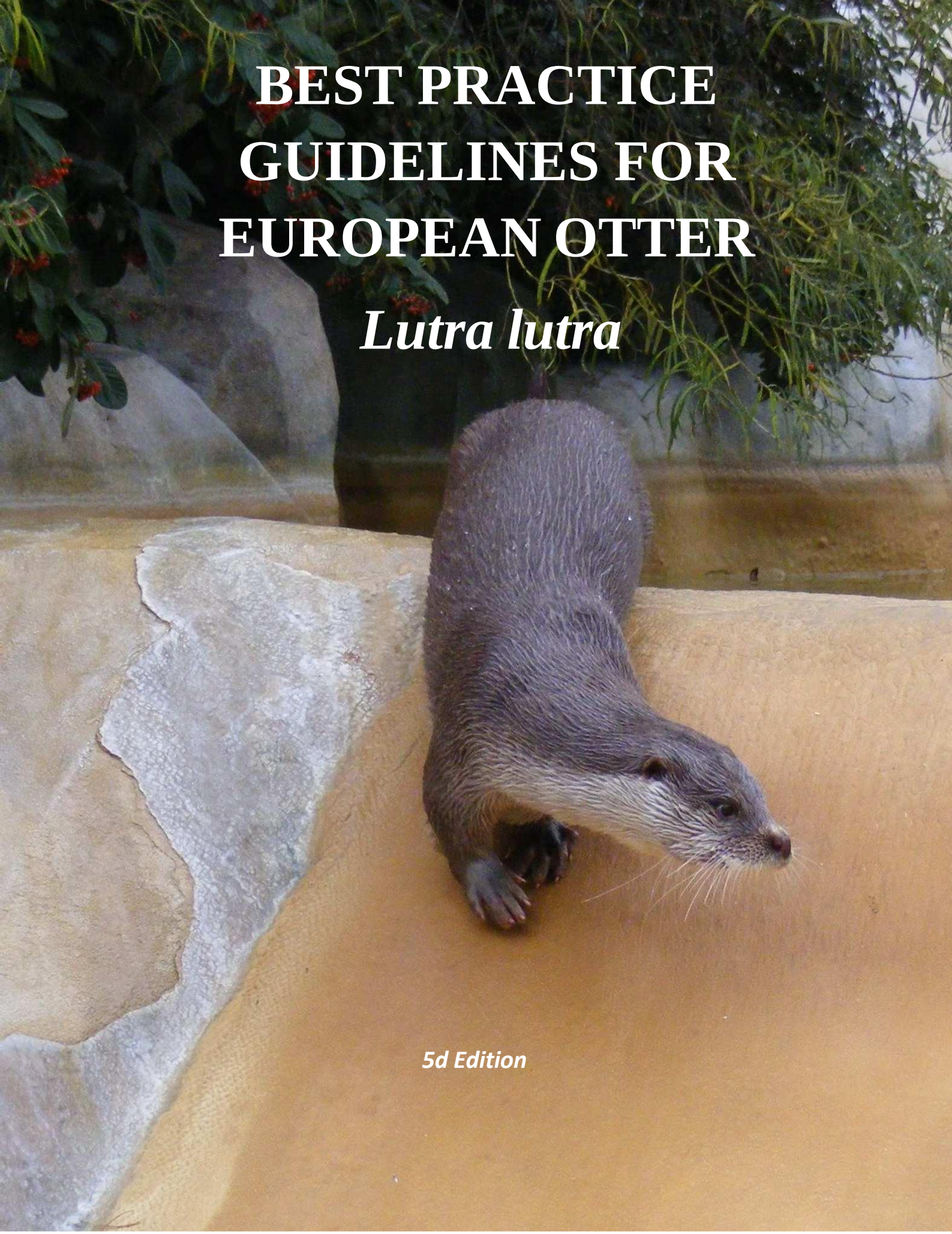
BEST PRACTICE GUIDELINES FOR EUROPEAN OTTER

Lutra lutra



5d Edition

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PREAMBLE

Right from the very beginning it has been the concern of EAZA and the EEPs to encourage and promote the highest possible standards for husbandry of zoo and aquarium animals. For this reason, quite early on, EAZA developed the "Minimum Standards for the Accommodation and Care of Animals in Zoos and Aquaria". These standards lay down general principles of animal keeping, to which the members of EAZA feel themselves committed. Above and beyond this, some countries have defined regulatory minimum standards for the keeping of individual species regarding the size and furnishings of enclosures etc., which, according to the opinion of authors, should definitely be fulfilled before allowing such animals to be kept within the area of the jurisdiction of those countries. These minimum standards are intended to determine the borderline of acceptable animal welfare. It is not permitted to fall short of these standards. How difficult it is to determine the standards, however, can be seen in the fact that minimum standards vary from country to country.

Above and beyond this, specialists of the EEPs and TAGs have undertaken the considerable task of laying down guidelines for keeping individual animal species. Whilst some aspects of husbandry reported in the guidelines will define minimum standards, in general, these guidelines are not to be understood as minimum requirements; they represent best practice. As such the EAZA Best Practice Guidelines for keeping animals intend rather to describe the desirable design of enclosures and prerequisites for animal keeping that are, according to the present state of knowledge, considered as being optimal for each species. They intend above all to indicate how enclosures should be designed and what conditions should be fulfilled for the optimal care of individual species.

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SUMMARY

The European otter (*Lutra lutra*) is a Carnivore from the family of Mustelidae. It is one of the 13 species of otters living in the world.

The species is considered “Near Threatened” by the IUCN Red List due to population decline. This Near Threatened assessment is more of a precautionary listing, because the European otter seems to recover its home range in Western Europe but the conservation actions for this species need to be sustained because of the lack of information from many parts of its range and the sensitivity of this species to changes.

In order to have a good exhibit for this otter in captivity, some points need to be taken into consideration.

Concerning the enclosure, it should be natural and has a water source like a pool or a river. Besides, in most parts of its range, its occurrence is correlated with bank side vegetation showing importance of vegetation to otters (Mason and Macdonald 1986). So in captivity, a land part with vegetation is also necessary.

Facilities of the enclosure are important but also the boundaries. Indeed, the fence of enclosure should be enough high and strong. Some cases of escapes are reported as the otter climbs, jumps and digs well.

This species is a robust animal which can support low temperatures even if it needs an area protected against frost during winter. But it is sensitive to heat. This point should be taken into consideration especially during transport.

In the wild, European otters are solitary whereas in captivity, they can live in pairs or unisex groups. But it depends on the character of each individual. Concerning unisex groups, only related animals can live together. But, a monitoring is important to prevent conflicts.

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PREFACE

These Best Practice Guidelines for the European Otter (*Lutra lutra*) are a recording of their needs and demands. Experts on otters have contributed to these guidelines through writing about their experiences with the animals, so occasionally, several solutions are offered or examples are given. This version of the husbandry guidelines is based upon previous guidelines written by Alfred Melissen in 2000 and questionnaires filled by EEP members.

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1-BIOLOGY AND FIELD DATA

1.1 Biology

1.1.1 Taxonomy

The European otter *Lutra lutra* (Linnaeus, 1758) is a mammal from the Order of Carnivora. It belongs to the Lutrinae that includes 13 species spread in 7 genus: *Lutra, Lontra, Aonyx, Hydrictis, Lutrogale, Enhydra* and *Pteronura*.
Lutrinae belongs to the family of the Mustelidae which has 63 species around the world.

The exact number of subspecies is controversial but some subspecies were reported (Conroy, 1998):

- *Lutra lutra lutra* : Europe and Northern Africa
- *Lutra lutra nair :* Sri Lanka, Southern India
- *Lutra lutra monticola :* North of India (Himashal Pradesh, Sikkim, Assam), Nepal, Bhutan
- *Lutra lutra kutab :* North India (Kashmir)
- *Lutra lutra aurobrunnea :* Nepal, Garhwal Himalayas
- *Lutra lutra barang :* Thailand, Vietnam, Malaysia, Sumatra, Java
- *Lutra lutra chinensis :* China, Taiwan
- *Lutra lutra meridionalis :* Iran, Southern Russia
- *Lutra lutra seistanica :* Kazakhstan, Uzbekistan

The common name for this species is European Otter, Eurasian Otter or Common Otter.

1.1.2 Morphology

Like most otters, the European otters are well adapted to a life near the water. They have an elongated and sinuous body. The tapering tail is muscular, thick at the base. The feet are well webbed with strong claws.

Figure 1: webbed feet of Eurasian otter

The nostrils, eyes and ears are placed in one line to allow otters to swim in surface whilst using these senses.

Figure 2: the head of a European otter

The fur is medium to dark brown but clear in the ventral surface. The pelt consists of roughly 70 000 hairs/cm² (Kruuk 2006, Kuhn 2010). It has 2 types of hairs: a dense underfur of fine hairs (10-15 mm long) which traps air insulating the body and keeps the body warm. The second one is longer (25 mm long) and waterproof.

Their vibrissae are used underwater to locate their prey, even in murky water. They have carnassial molars and premolars for shearing the soft flesh of fish.

The table below shows morphologic parameters of the European otter.

	Males	**Females**
Weight	7-12 kg	4-8 kg
Total length	100-135 cm	90-125 cm
Body length	57-85 cm	55-80 cm
Tail length	40-52 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

Figure 3: Morphologic parameters

1.1.3 Physiology

The body temperature of a relaxed otter is between 38 and 38,5°C (average: 38.1°C) but an active otter can have a temperature between 39 and 40°C (Krüger, 2008).
An otter which get more than 41°C during anesthesia might be in trouble (Weber, pers. comm).

Heart rate and respiratory rate have been recorded on 82 anesthetized otters (Fernandez-Moran & al, 2001):

- Heart rate : between 56 and 173 beats per minute (average : 95 beats)
- Respiratory rate: between 20 and 44 respirations per minute (average: 32 respirations).
  Besides at Otter Zentrüm, it was recorded 20-24 respirations per minute (Krüger, pers. comm)

1.1.4 Longevity

Captive European otters have on average a life span of 12 to 14 years but the life expectancy can be up to 18 years.
In the wild, otters live on average 5 years with a maximum of 12 year-old. In some regions, mortality is seasonal, with a maximum in autumn-winter.

1.2 Field data

1.2.1 Conservation status/Zoogeography/Ecology

- *Zoogeography and ecology*

The range of the European otter covers parts of 3 continents: Europe, Asia and Africa. Its current distribution in Europe is marked by a large corridor, reaching from Central Denmark, via the Western parts of Germany, the Netherlands, Belgium, Luxembourg, some parts of France, Switzerland, Austria to Central Italy where the otter is reduced to small and sometimes isolated populations. The distribution of the population in Russia is fragmented (IUCN).

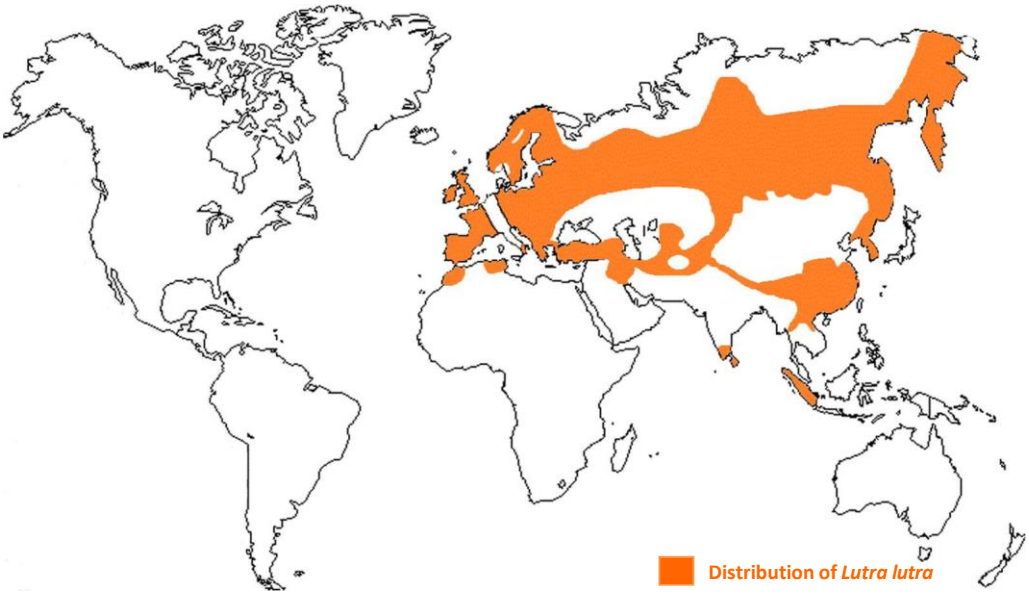


Figure 4: Distribution range of the European otter

The European otter lives in a diversity of countries so in a variety of habitats like highlands and lowland lakes, rivers, streams, ponds, swamp forests and coastal areas. But to breed, they need holes or cavities in tree roots or rocks.

In Europe, it is found in the brackish waters from the sea level up to 1000m in the Alps and above 3500 m in the Himalayas or 4120 m in Tibet.
With the advent of winter, the otter comes down to lower altitudes.
The availability of food is a limiting factor of their habitat.

European otter needs an area with freshwater and land.
Indeed, this species seems to prefer a linear living space, on the border of land and water. Moreover, in most parts of its range, its occurrence is correlated with bank side vegetation showing importance of vegetation to otters (Mason and Macdonald, 1986).
Besides, otter distribution in coastal areas is strongly correlated with the presence of freshwater.

- *Population*

In spite of several studies, the status of the population is not known from many parts of its range.
In 1900, the distribution of the European otter was widespread throughout Europe. In 2004, the otter population has decreased, though there are still large populations in Southwest Europe.

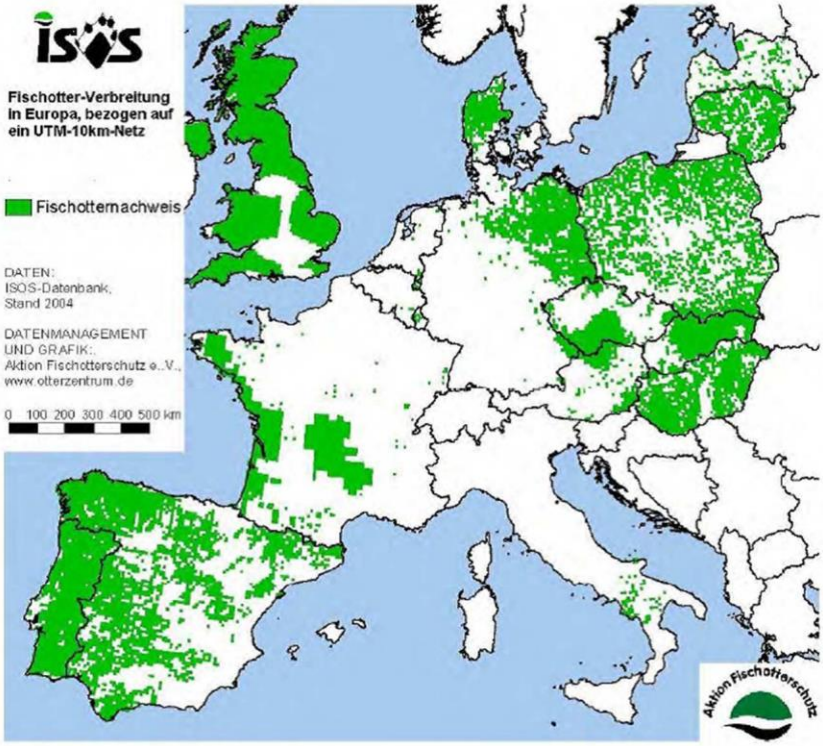


Figure 5: Distribution of the *Lutra.lutra* in Europe (Aktion Fischotterschutz, 2004)

- *Conservation Status*

The European otter is strictly protected under international legislation and convention. It is listed in Appendix I of the CITES (Convention on International Trade in Endangered Species), Appendix II of the Bern Convention, Annex II and IV of the EU Habitats and Species Directives and Appendix I of the Bonn Convention which recommends highest degree of protection to it.
It is classified as a Near Threatened species in the IUCN red list of threatened species.

The species is recovering in Western Europe (although conservation measures need to be maintained). However, past declines and local extinctions in the past, the sensitivity of the species to sudden changes in threat level, the lack of information about huge parts of the range and possible over-exploitation in China and Indo-China justify a precautionary Near Threatened listing.
Besides being protected by international laws, the European otter is also protected by several national laws.
The table below shows the status of protection, the threats and the distribution of the species in European countries (according the International Otter Survival Fund website and personal communications).

Countries	Distribution	Threats	Protection
Albania	Widespread throughout the country	Habitat destruction, water pollution, legal hunting	None
Andorra	Extinct	Extinct	None
Austria	Population is increasing	Habitat loss, hunting	Fully protected since 1947
Belarus	Widespread throughout the country with decreases in the south-west of the country	Poaching (from 1984 to 1991), illness, illegal killing and habitat destruction	Protected. But trapped with licences
Belgium	Since 1980 it is regarded as extinct, but few sightings in the south (2006)	Water pollution	Protected
Bosnia and Herzegovina	Widespread throughout the country	Pollution, illegal killing, habitat destruction	Not known
Bulgaria	Sporadic population. The species becomes Endangered	Pollution, illegal killing, habitat destruction	Fully protected
Croatia	Common in northern part of the country but lower density along the coast. Population appears to be stable	Pollution, illegal killing, habitat destruction	Protected
Czech Republic	3 isolated populations : one in the North, one in the East bordering with Slovakia, one in the Central part	Pollution with fertilisers and pesticides, illegal hunting	Fully protected
Denmark	Sporadic population and classed as endangered in the country	Fyke nets and road traffic	Fully protected
Estonia	Sparsely distributed throughout the country	Destruction of waterways, water pollution	Protected
Finland	Widespread with a patchy distribution and classed as declining	Fish traps, road mortality and some are shot by mistaking them for beavers which are hunted (Skaren, 2003)	Fully protected under a hunting law which may be temporary
France	The otter is common in the west of the country and in the south but rare or absent from the North and East	Destruction of habitat, water pollution and road deaths	Fully protected since 1976
Germany	The otter is spreading from the North-East to the South-East but extinct in the South West	Fish traps, road mortality, canalization of rivers, pollution, illegal hunting	Fully protected since 1968.
Greece	Widespread throughout the country with the densest population in the north east	Habitat destruction, intensive fish farming, pollution, road mortality, hunting, fish traps, canalization of rivers	Fully protected
Hungary	Stable population but a decline in areas east of the Danube	Pesticides pollution, killing at fish farms	Protected since 1978
Ireland	Widespread in the country	Fish traps, road mortality, canalization of rivers, pollution, illegal hunting	Fully protected
Italy	The otter is the most endangered animal in Italy with populations only in the South	Habitat destruction and organochlorine pollution	Fully protected
Latvia	Sporadically distributed. Dense populations are found in the Western and Eastern parts	Agriculture, persecution by crayfish and fish farmers, habitat destruction, organochlorine pollution	Not known
Lithuania	Widespread throughout the country	Habitat destruction and loss of food supply due to water pollution	Fully protected since 1975

Countries	Distribution	Threats	Protection
Luxembourg	Widespread until the end of the 19th century. Trapping and pollution has since caused its extinction	Extinct	None
Norway	The north of the country has healthy populations but fragmented in the South. Recently the population is in decline	Pollution, mortality in fish traps and poisonous marine algae	Protected but killed with licenses (fish farms)
Macedonia	Widespread and numerous along the Albanian border	Not known	Not known
Montenegro	Present except the central part of the country and west central Montenegro	Not known.	Protected as a natural rarity but law outdated
Poland	Widely distributed. (Romanowski,2006)	Pollution, drowning in fish traps and poaching.	Protected since 1974
Portugal	Widespread and thriving throughout the country in all aquatic habitats	Damming of rivers, drought, illegal killing and coastal oil spills	Protected but killed with licenses (fish farms)
Romania	Decline of the population over the last 40 years. Considered Endangered	Habitat destruction, pollution and poaching	Protected but legal trap from 01/10 to 01/03
Russia	Widespread throughout the country (except tundra areas). A decrease in density occurs from West to East	Habitat destruction and pollution	Not known
Serbia	Present in the river Gradac's gorge.	Not known	Protected as a natural rarity but this law is outdated
Slovenia	Widespread throughout the country but is common in the north east	Road mortality and habitat loss	Not known
Slovakia	Decline from the south east and western	Road mortality and pollution	Not known
Spain	Widely distributed in the west but threatened in the central and eastern regions	Habitat destruction, tourist expansion, illegal hunting, drainage of wetland, pollution	Protected
Sweden	Decline from 1950 to 1980 but increase of the population due to re-introduction programmes in the Center of the country	Habitat destruction and pollution	Protected since 1968
Switzerland	Declared extinct in 1989 but some otters were observed or spraints have been found after	Hunting (1888-1920), organochlorine pollution and availability of fish insufficient	Protected since 1952
The Netherlands	In 2002 a re-introduction programme began as the species declared extinct but it has been controversial as many animals have been killed	Water pollution, road mortality and fyke nets	Protected
United kingdom	Population healthy in Northern and western Scotland and the UK population is starting to increase. Numbers in Wales are leaping ahead of targets	Habitat destruction, pollution and road mortality	Protected since 1979 (England, Wales and N Ireland) and 1983 (Scotland)

Figure 6: Distribution, threats and Protection of *Lutra lutra* in European countries

- *Threats*

The habitat of European otter is vulnerable to man-made changes. Canalisation of rivers, construction, draining of wetlands, aquaculture activities are not favorable to otter population.

The major threats in Europe are the pollution and road mortality. Coastal population is particularly vulnerable to oil spills. The decline of fish in rivers and lakes, due to their acidification reduces food resources for otters.

Besides, they are killed by drowning, trapped in creels and net set for fishes. Illegal hunting is still a problem in many parts of the distribution range.

1.2.2 Diet and feeding behaviour

Otters feed on a whole range of prey (reptiles, amphibians, birds, small mammals, aquatic insects, crustaceans) but fish tends to be the dominant prey, often making up over 70% of the diet.
They adapt feeding with the available resources so their diet can change with seasons and areas.
In the wild, the daily intake of an otter is probably between 10 and 15 % of the body mass per day (Kuhn, 2009).

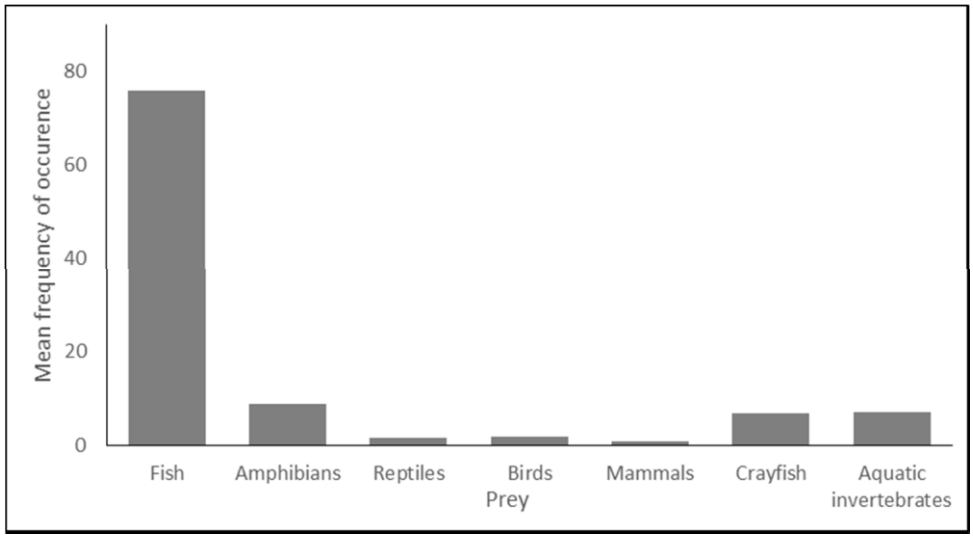


Figure 7: Mean frequency of occurrence of prey items in the diet of Eurasian otters (Clavero & al, 2003)

The European otters vary their searching prey methods according to conditions, particularly the depth of the water. When they can't conveniently swim, they walk along the bottom with the head under water looking for fish and turning over stones with the nose to search for crayfish and bullheads. When the water is a little deeper, the otters swim on the surface with the head submerged.

Under favorable conditions, otters seem to depend mainly on sight for detecting prey. In murky water or during the night, they use their facial whiskers, sensitive to vibration, to find prey.
While chasing fish, otters swim at their maximum speed using the hind end of the body for propulsion and the fore limbs for steering.
Otters have well developed carnassial teeth. Live fish are often eaten head first. They catch their prey with their jaws, but sometimes in their paws and then pass it to the mouth to be eaten.
Small prey is eaten on the water but larger prey is taken ashore for consumption.

1.2.3 Reproduction

Breeding is non-seasonal and can take place throughout the year, even if there are some regional variations.
European otters are polyestrous with estrus occurring every 4 to 6 weeks lasting roughly 2 weeks. Sexual maturity is reached between 2 to 3 years although some males are mature at 18 months. Adults may spend several days or months together although the male takes no part in the rearing of young. Copulation takes place most frequently in the water but can take place on land. Gestation lasts approximately 63 days. The litter size is usually 1 to 4 cubs, blind and with a very thin coat of hair. They are born in a nest site under the roots of a tree or in a hollow log next to a water source.
The young swim at 3 month-old and are weaned at 4 months. The female looks after the young until one year-old.

Figure 8: young otters at Aquamarine Fukushima

1.2.4 Behaviour

- *Activity*

The European otters are principally crepuscular or nocturnal, due to human disturbance.
They have a cycle of activity interspersed by periods of rest. A study showed that a male otter spends only 30% of its time active (Rosoux, 1995).

- *Locomotion*

The European otters are adapted to live near water. They are good swimmers but travel equally on land and water. But like many Otter species, European otters spend a lot of time foraging for food in the water.
When swimming slowly or at the surface, the otters use their four legs. The limb movements are not fixed sequences: sometimes, the animals kick with their hind feet together, sometimes both left feet and sometimes four in all the same time.
For fast swimming, the feet, tail and hind end of the body are used together, undulating up and down.
They can travel large distance but most otters stay in their home range.

- *Grooming*

Grooming and maintenance of the pelt is a vital part of their behaviour. Grooming in otters does not only consist of licking and nibbling at the fur but also they take care of their pelt by rolling and squirming on the ground and rubbing against logs and vegetation.

- *Predation*

In a large part of their distribution in Europe, adult otters don't have natural predators and are on the top of the food chain. The only threats they face are the impacts of human behaviours.

- *Sprainting*

European otters mark their range with their feces, the spraints. Fresh spraints are often dark, but the colour and the appearance of them depend on the type of food eaten.
They put their spraints within their home range and in this way, communicate with other otters. Spraints are used to prevent competition and advertising the use of resource. For this reason, sprainting occurs particularly when resources are scarce.

Besides, spraints can signal presence of an otter and breeding state.
Females seem to cease to mark during the perinatal period and both females and cubs avoid sprainting in the first week after birth, a tendency which is reversed when the cubs begin to move.

Figure 9 : spraints in captivity (left) and in the wild (right)

- *Social behaviour*

The European otters are principally solitary animals. Pairs are formed only when the female is sexually receptive. The most important unit of group of otters is a mother and her offspring.
Playing is not a behaviour which is often seen between 2 adults. In most cases, immature animals are involved. Usually, play consists of wrestling or chasing but occasionally cubs play with prey.

- *Sexual behaviour*

Otters that are intending to mate stay together for 2 or 3 days.
The male crosses the territory of the female. Firstly, he explores and deposits spraints. At the beginning, the female can be aggressive towards the male. Chases and vocalizations appear. They can play together and then, the playing behaviour becomes breeding posture. Mating can occur in water or on land and lasts between 20 and 50 minutes.
During mating, the male holds the female by the neck and squeezes the abdomen with fore feet.
At the end, the female vocalizes and tries to push the male away.

2. MANAGEMENT IN ZOOS AND AQUARIUMS

2.1 Enclosure

2.1.1 Boundary

- *Kind of fences*

Concrete, artificial or natural stones and wire mesh are suitable to build a good fence for an otter enclosure. But the material needs to be strong in order to avoid an escape of otter by destroying the fence.

If wire mesh is used, the mesh should be no larger than 40x40 mm and the minimum diameter of the wire should be 3 mm. An otter can break a mesh of 2 mm with the teeth.

If the wire mesh separates 2 neighboring enclosures, the mesh should be 10x10 mm to prevent biting trough the fence. Another option is to add electric wires on both sides.

If concrete or artificial or natural stone is used, it should be smooth to prevent an escape.

- *Height of fences*

A height of 2 meters (fence or smooth wall) is recommended.
Indeed, European otters are good climbers. If the fence is in wire mesh, it must be taken in consideration that they can climb it.
To prevent an escape, some methods are used:

- A vertical wall in plastic or sheet metal at the top of the fence (minimum height : 100 cm)
- Electric fences. At least, 3 wires
- An overhang made of plastic or galvanized metal or made of wire netting

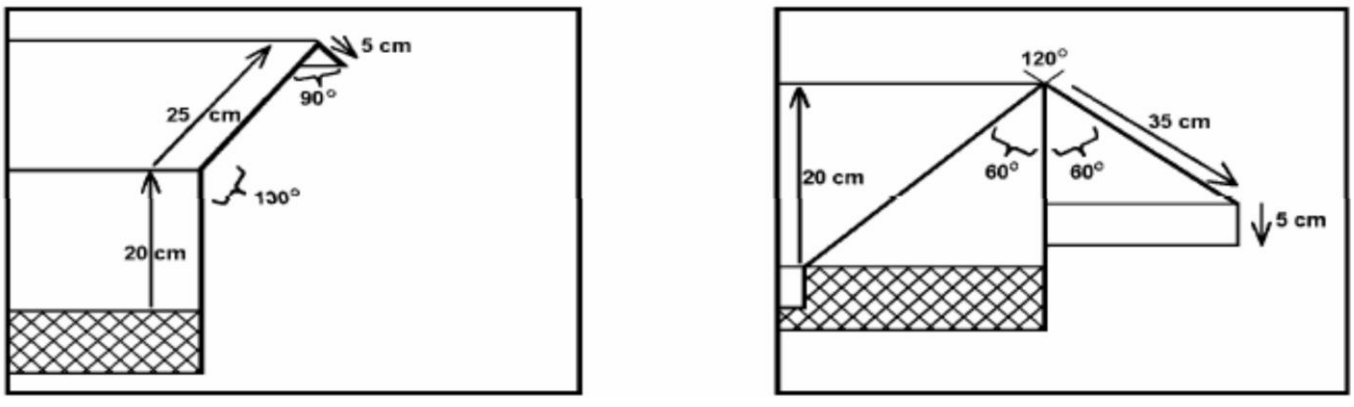


Figure 10: sloping overhangs for outside (on the left) and inner (on the right) fences (Reuther, 1991)

European otters are also good jumpers. They can jump a distance of:

- 130 cm in height when jumping from the ground to a platform
- 160 cm in width when jumping from one platform to another
- 90 cm in height when jumping out of the water to a platform if there is a possibility to push off from the bottom (see figure 11)

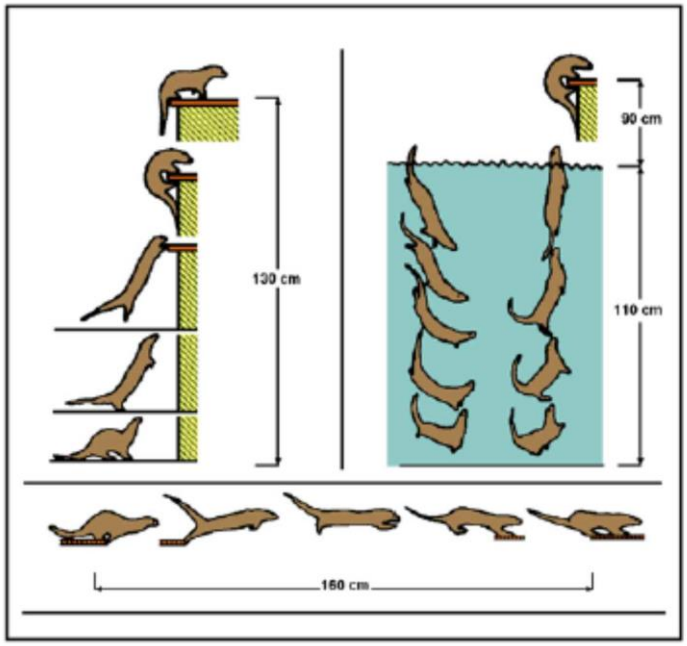


Figure 11: jump-distances for *Lutra lutra* (Reuther, 1991)

Otters are not only good jumpers and good climbers but are also good diggers. So, it is necessary to insert a wire mesh into the ground (depth of 80 cm, but depending on the substrate) or a concrete foundation. An additional mesh laid horizontally also in the ground should not permit an escape by digging (Heap & al, 2010).
Some experiences show that one or two rows of paving stones or tiles (50x50 cm) can avoid the digging of fence.

- *Additional safety*

European otters can also climb on trees. To avoid an escape by a tree, all trees, branches and any structure where an otter can climb should be at least at 2 meters of the fence. If it's not possible, trees and structures close to the fence should be fitted with a smooth collar (aluminum or galvanized metal) of 1 meter and located at a height of 1 or 1.5 m from the ground.
Besides, the height and the design of the enclosure containment have to take into consideration the likelihood of snow in winter in some countries.

Besides, corners where the otters can climb easily have to be avoided.

2.1.2 Substrate

The European otter is a semiaquatic animal and needs aquatic areas like rivers, ponds, lakes, etc. In captivity, an enclosure should be enough large to provide an aquatic area but also a terrestrial part to run, dig, forage etc. Naturalistic enclosures can allow natural behaviours so it is recommended.
A substrate of soil with vegetation, trees and bushes would be a basis of the enclosure. Areas of sand, rocks, etc. can be added to enrich the environment.

An indoor enclosure is not always planned for this species as they are robust. The minimum is to offer them a box per animal. Several bedding materials are tested and the most used by otter is wood wool. Some otters bring fresh grass or leaves in their box. In wintertime and before parturition, wood wool should be provided ad libitum.
But hay and dry leaves can also be used.
Otters should not eat in their box to avoid risk of choking with the substrate. It was the reason why the straw was not recommended for a long time.

2.1.3 Furnishing and maintenance

- *Furnishing*

Natural materials should be included in the enclosure to stimulate natural behaviours and activities and to provide a variety of substrates for locomotion exploration, etc.
For example, stones, sand mounds or branches should be offered for spraint marking behaviour. Otters need hiding places so hollow tree trunks, bushes or stone caves are appreciated by animals to hide or rest.

In some institutions, otters can dig their own nest under the ground. But monitoring animals can be difficult as they can dig a long tunnel so it can be hard to see if there are animals inside and if they are healthy.

For example, it was reported by an institution that an otter was disappeared but the staff didn't know if the animal escaped or died in one of natural burrows created by otters because some of them are too deep to see inside.

So, in addition to hiding places, "artificial" nest boxes should be provided. They can have the form of tree trunk or something more natural but they should be easy to clean, easy to reach by the staff and give safety and physical comfort for the otters.

Figure 12. “Natural” nestbox at Otter Zentrum, Hankesbüttel

If an inside enclosure is provided, otters should have nest boxes inside too. Each box must not be less than 45x45x40 cm. At least one of the boxes should be removable for trapping or transport. So they need to have sliding doors. They have to be built of wood or other non-heating material. Plywood should be at least 18 mm thick. An adult otter is able to demolish a nest box that’s why it is important to be sure the otter can’t escape after ruining the nest box.

The floor must be equipped with drainage like a wooden grating that prevents the bedding from getting wet. The bottom should have a way to get rid of water.

Each individual should have a box, where it could turn and curl up comfortably. But a set of 3 nesting boxes side by side should be provided, for mother and cubs for example.

Figure 13 : nest and transport box at Paris Zoo

If there is tunnel to access to the box, it should be easily checked.

Bedding of hay, wood wool, leaves should be offered and replaced when it is wet or soiled.

- *Hygiene*

European otters are usually clean animals and tend to spraint in one or two places around the enclosure.
Enclosures, pools, sleeping boxes should be cleaned daily removing feces and uneaten food (except during parturition for the female where the cleaning should be less important to avoid stress).
The bedding should be replaced when it gets wet. Besides, it should be checked daily.

Scent is important for otters so sprainting location and marking spots should not be disinfected regularly.

2.1.4 Environment

European otters can withstand low temperatures but the temperature of their inside enclosures or their nest box should be protected from frost.

In case of illness, it is possible to heat around the nest box, but not the nest box itself in order to avoid the decreasing of heat keeping capacity of the fur.

In the winter, the water should not freeze in order to avoid an otter becomes trapped underneath. A pump or air bubbler can be used to keep the water moving and prevent icing over.

2.1.5 Dimensions

Wild European otters use up to 40 km of rivers and cover around 20 km per night so the question concerning the surface has often been asked.
The OCT (Otters in Captivity Task Force) recommends a minimum of 100 m² for an animal and 250 m² for a breeding pair.
Besides, a pair needs two enclosures or to have a big enclosure with the possibility to be divided in two when needed (when the female gives birth for example).
Another enclosure could be useful for offspring which is separated from the mother (at one year-old). A female with cubs should be held in an enclosure of minimum 250 m².

Besides, an appropriate land to water ratio is as important as adequate space. As otters spend around 60 % of the total activity in an area of 1.5 to 2 meters left and right of the water line (Reuther, 1985), an enclosure for European otters should offer an important length of banks, and a land to water ratio of 4:1.

If an inside enclosure is offered, it should be big enough to have nest boxes, one for each individual. In European institutions that have inside enclosures, the average dimension is 5 m².

2.2 Feeding

2.2.1 Basic diet

- *Type of food*

In the wild, European otters eat mainly fish but also a great variety of food (frogs, rodents, birds…). So the main diet in captivity consists of fish but also meat.

- Concerning the fish: freshwater fish (trout, salmon, roach,…), seawater fish (cod, haddock, whiting,…) can be part of the diet. Herring and mackerel should be very fresh to be done. Fishes can be offered alive if it is not prohibited by law according to the country. It's not necessary but it can develop natural foraging activities of the animal. Deep frozen fish that is well thawed in air or under running water can also be accepted.

- Concerning the meat: preferably freshly killed small animals (rats, rabbits, chicken, ducks, guinea pigs, chicks), beef and horse meat and heart.
  Pork is not recommended due to the risk of Aujesky disease.

Fruits and vegetables (carrots, apples, pears …) can be done as enrichment.

- *Quantity of food*

The quantity of food should be adapted to the needs of the animal and depends of its weight, of the season, state of the animal (pregnant, young …). For example, an adult weighing approximately 8 kg requires about 700-800 g of food per day in summer and about 100-150 g more in winter.

Fasting has no biological basis in otters.
It is important to take care of the amount of food given to animals. Over feeding animals can lead to obesity but reduction of food can lead to aggression so it is important when reducing calories to add more bulk and water to the diet.

2.2.2 Special dietary requirements

Otters have a high metabolic rate and a fast digestion and they spend a lot of time to search for food. So, it is preferable to feed otters at least 2-3 times per day. Food given once per day should be avoided because the otter risks letting a part of it as the otter eats 10-20% of its weight but not more than 500 grams each time.

In winter, it's possible to give more food to otters.

- *Vitamin-supplement*

It is important to add supplements when the food was frozen before. Indeed, freezing and thawing can conduct to nutrient loss as vitamin B1 and E in frozen fish. So it is recommended to add supplements especially if the main diet consists of fish:

- Thiamin (= Vitamin B1): 25-30mg/kg fish fed, fresh weight as fed basis (Bernard & Allen 1997). Thawing process will release enzymes which destroy thiamin. Therefore, this supplementation is absolutely necessary.

- Vitamin E: 400 IU/kg dry weight basis (Engelhardt & Geraci 1978)

- Vionate, or a similar product, approximately 2.5 mg per otter daily. Fish-eater tablets also have been used successfully as a supplement and are easy to administrate and specially developed for otters.

To improve coat condition in cold winter, it is possible to add olive oil to their meat meal but no more than 5 ml per day.

Calcium is recommended for lactating females. Nevertheless, it is important to not give a big amount of calcium supplement to avoid the formation of renal calculi.

Some fishes (herring, mackerel,…) have a high level of Thiaminase : it can cause vitamin B1 deficiencies and can conduct to neurological problems. So it is recommended not to give them in large quantity and very fresh.

2.2.3 Method of feeding

Each otter needs to have its own dish to see if all have a balanced diet. It is also possible to scatter food in the enclosure but everywhere in the enclosure to be sure that each otter has access to food.
At Paris Zoo, the food is dispersed during the day in the enclosure and each otter has its own food in the evening in the inside enclosure.
Uneaten food that may mold must be removed.

2.2.4 Water

Water should be given ad libitum outside (and inside if animals have an inside enclosure).

2.2.5 Feeding enrichment

Feeding enrichment can encourage otters to be more active during the day. Nevertheless, any extra food given must be included as parts of its own basic diet to avoid obesity.
Scatter foods include mealworms, snails, crayfish, fruit, and vegetables. Soft boiled eggs can be used for medicating a sick animal. Some food can be frozen into blocks of ice for enrichment purposes.

Figure 14.Example of enrichment (ice with fish) at Nordens Ark

2.3 Social structure

In the wild, European otters are solitary. But, in captivity, they can be kept in pair. This group depends on the characters of each otter and the size and design of the enclosure. Indeed, it is possible that an otter doesn't accept another one. Even if a pair is formed, the male can be removed when there are young. The male stays alone until the young is enough old to leave, and then he can join the female.
However, some institutions reported that they have breeding success without removing the male. But there is a risk of infanticide according to the individual so precautions must be taken.

Generally, young from the same litter can be kept together for a long time. It is also possible for animals from 2 different litters if they always live together.

But non relative animals of the same sex can't be put together. Related adult animals of the same sex should not be put together if they have been separated for a long time.

2.3.1 Group structure

Introduction between 2 animals can be attempted at any age, even if it's easier with young animals.
Firstly, the otters should be housed in adjacent enclosures, separated by a wire mesh (maximum: 2X2 cm) to avoid bites but allows visual, auditory, and olfactory contact. This may only take few days but can also take many weeks.
It is possible to exchange their wood wool from their nest boxes to facilitate the contact by inspecting more closely scents of the other.
It is typically better to introduce the male into the enclosure of the female, as in the wild, where the male enters in the territory of the female.
But it is also possible to just remove the wire-mesh when they seem to accept each other.

The contact is usually carried out outdoors where there are plenty of space and hiding places. Sufficient keepers must be present to separate the otters if fighting occurs.

The first contact can take place immediately as animals can be curious or, on the contrary they can hide.
During this contact, it is possible to have vocal aggression, stand-offs and physical aggression. During initial physical introductions, it may be advisable to separate the animals after they have had some affiliative interactions and gradually lengthen the time they are allowed together. They should not be left alone at any time during this period. Otters should not stay together during the night until any conflicts occur.

2.3.2 Sharing Enclosure with Other Species

As medium size carnivores, European otters are often alone in their enclosure. But some institutions tried to mix them with other species (beaver, raccoon and bears) but it could be complicated to have breeding in these mixed exhibits.
It’s also important that each species has only access to its own food.

2.4 Breeding

2.4.1. Mating

European otters can breed all over the year. However, most births occur between June and September.

Before mating, there are many vocalizations and chasing. The female can be very aggressive with the male.

After several chases that are similar to games, copulation can take place. The male grabs the female by the scruff of her neck and wraps his front feet around her. The copulation can take place on the ground or in the water, between 20 and 50 minutes.

At the end of the copulation, the female chases aggressively the male and can reject him during few hours.

2 or 3 copulations per day can occur.

2.4.2. Pregnancy

The female gives birth to 2-3 young on average after a gestation of 60-63 days. It is not easy to see if a female is pregnant. Sometimes, the belly can appear a little bit rounder and the breasts more visible.
Some publications suggest separating the male few days before the parturition. Indeed, there is a risk of infanticide or much disturbance of the mother by the male.
In some institutions, the male is not separated but it depends on the character of each individual.
In big enclosures, the female can stay away from the male and breeding can succeed.

2.4.3 Contraception

There are different methods of contraception used for the European otter: injection, implant or surgery.

The European Group on Zoo Animal Contraception (EGZAC) compiled these different methods in a table and for each of them gives a lot of data (availability, mechanism of action, effects, latency effectiveness) and if it is recommended to use these methods on the species.
You can see the table below.

For any comments or questions, holders of European otters can contact EGZAC (contraception@chesterzoo.org).

Animal name: European otters

Fact Sheet Compiled by: Veronica Cowl

Last Updated: March 2016

Fact Sheet Reviewed by:

Contraceptive methods	GnRH agonist (implant)	GnRH agonist (injection)	Progestagen (implants)	Progestagen (implant)	Progestagen (injection)	Progestagen (injection)	PZP vaccine	Surgical (Permanent)
Contraceptive Product:	Deslorelin acetate	Luprolide acetate	Etonogestrel 68 mg	Levonorgestrel 2x 75mg	medroxyprogesterone acetate;	proligestrone 100mg/ml	PZP vaccine main components are antigens dervied from porcine zona pellucida glycoproteins and an adjuvant to stimulate the immune response (Freund's modified complete adjuvant for primary vaccination and Freund's incomplete	N/A
Commercial Name:	Suprelorin ®	Lupron *	Implanon® Nexplanon®	Jadelle®	Depo-Provera®, Depo-Progevera®	Delvosteron®	Porcine Zona Pellucida	N/A
Product Availbility:	4.7mg ('Suprelorin 6') and 9.4 mg ('Suprelorin 12') widely available through veterinary drug distributors in the EU.	Luprolide acetate licenced for human use	Manufactired by Bayer Schering Pharma AG. Available through human drug distributors	Manufactired by Organon. Available through human drug distributors	Manufactured by Pfizer. Widely avilable throughout Europe through human drug distributors.	Manufactured by MSD animal Health UK, Intervet Europe. Licensed for use in female dogs, cats, and ferrets; available through veterinary distributors.	Not commercially available in Europe. Can be imported from the USA.	N/A
Restrictions and/or permit required by Importing Country:	EGZAC reccommends: always check with your local licencing authority	Data deficient	EGZAC reccommends: always check with your local licencing authority	EGZAC recommends: always check with your local licencing authority	EGZAC reccommends: always check with your local licencing authority	EGZAC reccommends: always check with your local licencing authority	License required UK and France; all other Countries unknown. EGZAC recommends always checking with local licencing authority	N/A
Mechanism of action:	GnRH agonist suppress the reproductive endocrine system, preventing production of pituitary and gonadal hormones. As an agonist of the GnRH initially stimulates the reporductive system -which can result in oestrus and ovulation in females or temporary enhancement of testosterone and spermatogenesis in males- therefore additional contraception needed during this time. Please see belwo and refer to Deslorelin datasheet for detailed information	GnRH agonist suppress the reproductive endocrine system, preventing production of pituitary and gonadal hormones	Interference with fertilization by thickening cervical mucus, interrupting gamete transport, disruption of implantation, inhibition of LH surge necessary for ovulation	Interference with fertilization by thickening cervical mucus, interrupting gamete transport, disruption of implantation, inhibition of LH surge necessary for ovulation	Anti-estrogenic activity. Interference with fertilization by thickening cervical mucus, interrupting gamete transport, disruption of implantation, inhibition of LH surge necessary for ovulation	Anti-estrogenic activity. Interference with fertilization by thickening cervical mucus, interrupting gamete transport, disruption of implantation, inhibition of LH surge necessary for ovulation	The PZP antibodies interfere with fertilisation by binding to the ZP glycoprotein receptors that suround the egg of the vaccinated female, blocking the binding and subsequent penetration of sperm.	Ovariohysterectomy: removal of one or both ovaries and the uterus; Ovariectomy: removal of the ovaries; Hysterectomy: removal of the uterus; Castration: Permanent contraception by surgical gonadectomy; Vasectomy: Surgical procedure in which the ductus deferens are cut, tied, cauterized, or otherwise interurrupted
Insertion/Placement:	Sub-cutaneous, in a place where it can be easily detected or seen for removal at a later date (I.e.upper inner arm); refer Suprelorin fact sheet for effective method of implant placement (tunnelisation)	Injectable	Intramuscular or subcutaneous. EGZAC recommends sub-cutaneous, upper inner arm for visibility (aid for later removal)	Intramuscular or subcutaneous. EGZAC recommends sub-cutaneous, upper inner arm for visibility (aid for later removal)	Injectable intramuscular	Injectable subcutaneously - do not inject intradermally or into subcutaneous fat or scar tissue	Injectablr intramuscular	Surgical

Females		Data deficient	Not recommended	Not recommended	Not recommended	Not recommended	Not recommended in species which experience copulatory induced ovulation	Ovariohysterectomy; Ovariectomy; Hysterectomy
Dose	1-2 implants depending on species and body weight. 2 x implants would be recommended for individuals >10kgs body weight		**Data deficient.** Please contact EGZAC for dosage recommendations. 1/4 - 1/2 an implant dependent on species weight.	**Data deficient.** Please contact EGZAC for dosage recommendations.	**Data deficient.** Please contact EGZAC for dosage recommendations. 5mg/kg BW in various otter species in 2-3 month intervals.	**Data deficient.** Please contact EGZAC for dosage recommendations.	**Data deficient.** Please contact EGZAC for dosage recommendations.	
Latency to effectiveness:	3 weeks average as GnRH agonist initially stimulate the reporductive system- please refer to the Deslorelin datasheet for detailed information - additional contraception is needed during this time in order to suppress the initial stimulation phase (see product data sheet. ~2mg/kg Megestrol acetate pills /Ovarid® daily 7 days before and 8 days after has been used to suppress inital stimulation phase).		It is advised to use supplementary contraceptive methods for approximately 7-14 days when first inserting the implant due to a latency to effect.					
Oestrus cycles during contraceptive treatment:	Initial oestrus and ovulation (during the 3 weeks of stimulation) may occur and then no oestrus cycle. To supress the initial oestrus and ovulation with the concomitant progesteron production and the associated deletereous effects of this you **MUST** follow the megestrol acetate protocol mentioned above.							
Use during pregnancy:	**Not recommended**			**Not recommended**				
Use during lactation:	**Data deficient**							
Use in prepubertals or juveniles:	**Data deficient**							
Use in seasonal breeders:	**Data deficient.** Should start at least 1 month prior the breeding season.			**Data deficient.** Should start at least prior the breeding season.				
Duration	Duration of efficacy has **not been well established**. As a guide: 4.7 mg implants will suppress for a **minimum** of 6 months; 9.4 mg will be effective for a **minimum** of 12 months.		Duration of efficacy has **not been well established**. As a guide: 2-3 years		Duration of efficacy has **not been well established**. As a guide: 2-3 months in otters.			
Reversibilty	Suprelorin is considered reversible and we do currently hold multiple records of reversals in otter species. Two females contracepted with 4.7mg implants conceived within 11 months - 1.5 years following the estimated 6 month estimated implant expiry. 3 Asian short clawed otter females conceived within 1.3-2 years following the estimated 9.4mg implant expiry. Duration to reversibility is extremely variable. **Removal of the implant is considered to aid reversibility.**		The implants are designed to be fully reversible however, we do not hold any records of reversal in our database.	We have 1 reversal recorded in a yellow mongoose however, the duration for reversal is unknown.	Depo-Provera is considered reversible however, we do not hold any reversal records.			
Effects on Behaviour	Similar to those seen with gonadectomy but reversible.							
Effects on sexual physical characteristics	Individuals may experience an increase in appetite and associated weight gain.		**Long term use is not recommended** Risk of pseudopregancy, endometrial hyperplasia and pyometra increases with exposure to prolonged circulating progestagens/ progesterone	**Long term use is not recommended** Risk of pseudopregancy, endometrial hyperplasia and pyometra increases with exposure to prolonged circulating progestagens/ progesterone	**Long term use is not recommended** Risk of pseudopregancy, endometrial hyperplasia and pyometra increases with exposure to prolonged circulating progestagens/ progesterone	**Long term use is not recommended** Risk of pseudopregancy, endometrial hyperplasia and pyometra increases with exposure to prolonged circulating progestagens/ progesterone		

Males		Data deficient	Not recommended	Not recommended	Not recommended	Not recommended	Not recommended	Castration, Vasectomy
Dose	**Data deficient.** Please contact EGZAC for dosage recommendations. As a general guide 2x implants should be used in otters weighing > 7kgs body weight.	**Data deficient.** Please contact EGZAC for dosage recommendations. 0.12ml/kg bw has been administered in various otter. Injections were given in monthly intervals.				**Data deficient.** Please contact EGZAC for dosage recommendations. We hold a record of a raccoon administered with 3ml/kg BW.		Vasectomising males in which the females of the species experience copulation induced ovulation is not recommended due to the continued risk of pseudopregnancy.
Latency to effectiveness:	Depending on the species there may be fertile sperm present in vas deferens for 6-8 weeks post treatment or even longer. Testosterone decreases after 3-4 weeks but sperm can stay fertile for many weeks after.	Data deficient						
Use in prepubertals or juveniles:	Data deficient	Data deficient						
Use in seasonal breeders:	**Data deficient.** Should start at least 2 months prior the breeding season.	Data deficient						
Duration and Reversibility	Suprelorin is considered reversible and we do have one record of reversal in a spotted necked otter treated with 1x4.7 mg implant. Duration to reversibility is extremely variable. **Removal of the implant is considered to aid reversibility.**	Data deficient						
Effects on Behaviour	Testosterone related aggression is likely to decrease. **Data deficient** in this group, see product information sheet.	Data deficient						
Effects on sexual physical characteristics	One side effect of deslorelin is feminisation of males; it is therefore important to think about the implications that can occur when secondary sexual characteristics are removed. Other possible side effects in males include a decrease in body size and a decrease in testicular size.	Data deficient						
General:								
Side effects	Pseudopregancy, endometrial hyperplasia and pyometra may be associated with the use of GnRH agonist as a result of high progesterone levels during the stimulation phase. A more recently developed Suprelorin®/ deslorelin protocol using Ovarid®/megestrol acetate to prevent the initial stimulation phase, followed by implant removal when reversal is desired, may be a safer contraceptive option.		Risk of pseudopregancy, endometrial hyperplasia and pyometra increases with exposure to prolonged circulating progestagens/ progesterone	Risk of pseudopregancy, endometrial hyperplasia and pyometra increases with exposure to prolonged circulating progestagens/ progesterone	Risk of pseudopregancy, endometrial hyperplasia and pyometra increases with exposure to prolonged circulating progestagens/ progesterone	Risk of pseudopregancy, endometrial hyperplasia and pyometra increases with exposure to prolonged circulating progestagens/ progesterone	Not recommended in species with copulatory-induced ovulation due to the risk of pseudopregnancy.	
Warnings	Causes initial gonadal stimulation that **MUST** be suppressed (see above); correct administration essential - see product information sheet							
Reporting Requirements: In order to increase our knowledge of the efficacy of contraception methods in the small carnivore families it is recommended that all individuals on contraception be reported to EGZAC								

Disclaimer: EGZAC endeavours to provide correct and current information on contraception from various sources. As these are prescription only medicines it is the responsibility of the veterinarian to determine the dosage and best treatment for an individual

Figure 15: Methods of contraception used for European otters (EGZAC)

2.4.4 Birth

The female often gives birth in a nest box.
After the parturition, the female can become aggressive and can move the young if she feels disturbed. At least 2 nest boxes should be available and placed in the enclosure and away from any disturbance.
Hay or wood wool should be given as bedding outside the box. The female can take it if she wants.
Care should be made to limit disturbance to any of these boxes prior birth and 2 weeks after birth. The nest box should not be cleaned during this period.

A quick check is possible after 3 weeks if the female is absent. The cub can be weighed. The second check can be done after about 8 weeks where the young are weighed, sexed, identified by a microchip and vaccinated.

In the exhibition facility of Aquamarine Fukushima, the nest is in a cave in front of visitors. The female gave birth in the cave for three times. She did not care of visitors looking at her and her pups through the glass. It would be able to observe quite many behaviors: breast feeding, grooming to pups, and in an interesting thing is that the mother hides pups when she was out of cave (Chiho Nakamura, personal communication).
But it depends on the character of the animal.

Figure 16: cave in Aquamarine Fukushima

2.4.5. Development and care of young

The young are born blind. The 2 first weeks, they have difficulties to move. The female protects them vigorously. The weigh at birth is around 100 grams. The eyes of the young start to open between 21 and 40 day-old. After 60 days, their fur becomes darker and denser.
The first teeth appear between 13 and 29 days. They grow until 70 to 90 days. They start leaving the nest box between 30 and 90 days of age. Natural behaviours like swimming and foraging can take around 2 months. At 100 days, they begin to mark the territory.

They are weaned at about 9 weeks of age. Typically, the cub weigh between 0.75 to 1 kg.
Care should be taken to provide smaller pieces of meat that are more manageable for the young. Bones (of chicken and rabbit) are dangerous for them.
In the wild, cubs stay with their mother until they are about one year-old. In captivity, the young should not be separated from the mother before the age of at least 7 months. But they can stay longer if there are no conflicts. However, a young male should be separated from his mother before 18 month-old to avoid inbreeding.

2.4.6. Hand rearing

Hand rearing should be avoided because of the risk of imprinted animals on humans and difficulties to be placed with other otters.
If it's unavoidable, a cat milk replacement can be used (Esbalic, Cimicat), Milk substitute from PetAg, which is lactose free (Heap & al, 2010).
Young can be weaned at around 6 weeks old. Cubs should be kept warm but they need to have access to an area less hot.
Firstly, a little fish soup (250g of fresh skinned and boned white fish, 1 tablespoon of milk powder, 1 tablespoon cod liver oil, 2 Mazuri fish eater tablets) can be added to the milk. The whole has to be mixed and liquidized. A portion has to be diluted with enough boiled water to produce a consistency to go through a 10 ml syringe. The remainder can be kept in the fridge or frozen (if the fish is fresh) during up to 24 hours (Heap& al, 2010).
The soup should be warmed at body temperature before giving it to the cub.
It's important to add fish into the diet to avoid the young having stomach upsets. The younger the cub the more consistency of the fish soup has to be smooth in order to avoid overfilling the cub that can enter in the trachea and can cause pneumonia or death.
Food intake should be about 15-20% of bodyweight per day.

Faeces need to be controlled. Spraints should be solid enough to hold their shape, no more than 1 or 2 per feed.

Cubs are weaned at about 8 weeks or 750g body weight, usual when the four canines are through. Then, they can be fed with tiny baby trout and other food (fish soup, minced fish,…) should be used.
But each cub weans at different times and progresses at a different rate. It can take time before they eat solid food.
During all the hand rearing, times of feeding, weight, amount of milk/food taken should be recorded daily.

From 2 month-old, it is possible to provide to the cub a shallow tub of lukewarm water to stimulate swimming. After swimming the cubs must be dried off on clean towels. Increase the depth of the water as the cub grows in confidence. (Heap & al, 2010).

2.4.7 Population Management

The Eurasian otter is categorized as Near Threatened by the IUCN Red list.
In spite of several studies, the status of the population is not known from many parts of its range, particularly in Africa and Asia. The overall estimate of the population in United Kingdom was 10395 individuals in 2004 (JNCC, 2007).
Water pollution and road mortality are the main threats to Eurasian Otters and have caused local extinctions in Western European populations. But they are now recovering as a result of environmental improvements and focused conservation efforts.

Some projects exist in some countries to protect the European Otters. For example, there are "Pro Lutra" in Switzerland and a "National Action Plan" in France. Their 2 main goals are to establish a review of the current situation of otters and to determine measures for the return of otters in these countries.
Concerning Reintroduction or release projects, they should be approved by the National representative of the IUCN/SSC Otter Specialist Group or the chair of the group.

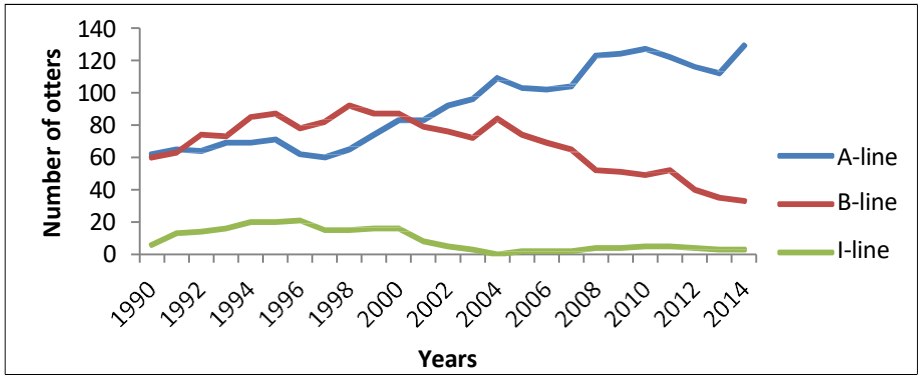
Besides, the IUCN Guidelines for Re-introductions show that releases only make sense when all causes of extinction or decline of the original wild otter population have been sufficiently removed.

The monitoring of the captive population begun in the 1980's by Claus Reuther and the EEP for the European otter was created in 1990 and held in Krefeld Zoo (Paul Vogt). Today, the EEP is managed by La Menagerie du Jardin des Plantes (Elodie Rey).

The captive population is separated in different lines:

- A-line : otters with a pedigree completely known
- B-line : otters with a possible hybridization between 2 subspecies : *Lutra lutra lutra* and *Lutra lutra barang*.
- I-line : Iberian ecotype

The captive population has increased since the beginning of the EEP, mostly the A-line population as the otters from this population was recommended to breed, contrary to B-line otters.



F ig 16. Evolution of the captive population since 1990

2.5 Behavioural enrichment

European otters can be encouraged to be more active and to behave as they can do in the wild by creating different enrichments. The quality of the layout of the enclosure can be used for enrichment. Indeed, the complexity of the enclosure should provide olfactory, foraging or other natural behaviours. For example, different substrates allow the animal to explore different parts of its enclosure. This behaviour can be encouraged by hiding food items for example, throughout the exhibit. Leaf piles, sand pit and large logs can be used for having active otters. But all enrichments items should be examined before use. You can see below enrichments suggested by the Otter Specialist Group:

Appendix B: ENRICHMENT ITEMS – Table (Reed-Smith 2001)

Natural	Exhibit Furniture	Non-edible manmade	Live Food	Edibles
Soil, sand, mulch, etc.	Climbing areas (technically available in all exhibits, i.e. cliffs, ledges, etc.)	Boomer balls – all sizes & various products like the "spoolie" & "ice cube"	Fish (smelt, shiners, gold fish, trout, salmon, mackeral, tilapia)*others listed below	Ice blocks w/ fish, fish-sicles, fish cubes, etc.
				krill cubes, clam cubes, etc.
Grass, sedges, etc.	Logs (on land, submerged, floating; hollow &/or solid)	Ice blocks, cubes, pops, etc.	Crayfish	Frozen or thawed sand eels
Trees	Rocks (not artificial)	Natural snow & ice	Crickets	Fish pieces
Bushes	Waterfall	Dog chews, rawhide treats	Fly-in birds	Scattered carrot pieces
Vines, "vine hoops"	Stream	PVC cricket feeder	Giant mealworms	Chicken necks
Aquatic plants	Sticks	Buckets	Earthworms	Mice
Hay, straw, grass, leaves, wood wool as bedding	Browse (leafy branches on land &/or floating	Blankets, burlap, hammock, non-fraying rags	Freshwater clams	Whole fish – frozen or thawed
Grass piles	Slides	Barrels of water	Mussels	Whole apples/oranges
		Frisbees		
Leaf piles	Tunnels	Tubs of water	Krill	Fruit & berries (incl. grapes, blueberries, strawberries)
		Carpet over board		
Rocks, all sizes for play & manipulation	Stream bed Running water	Rubber-coated heating pad*	Eels – naturally found	Small pumpkins/squash
Knot holes	Holts	Astro turf	Shrimp	Omnivore biscuits
Bark sheets	Jacuzzi-like jets in pool	Floating plastic toys	Aquatic insects – naturally found	Monkey chow
Pine cones		Phone Books		Pigs ears
Mud	Islands in pools	Swim through plastic ring	Mice – naturally found	Frozen blood blocks, cubes, etc.
Sod				
Bank over-hangs	Bridges made from logs, etc.	Kids puzzle balls, Frisbees, billiard balls, hard balls	Frogs – naturally found	Hard-boiled eggs
Floating wood blocks	Stumps	Diff. size pieces of PVC pipe & fittings	Grubs	Day-old chicks
				Crabs
Pine needles	Natural fiber mat	Kong chews	Chub	Melons
Other animal urines	Movable sand box	Metal bowls & pans	Minnows	Coconuts
Powdered scents & herbs	Logs brought from other exhibits	Plastic containers & bottles*	Bluegill	Frozen feline balls
Fresh herbs	Log ladder	Bread tray	Clams	Milk bones
Extracts – i.e. vanilla, etc.	Non-sprayed Xmas trees	Kids plastic slide, house	Mud minnows	Screw pine nuts, unsalted peanuts
Grapevine balls	Moving soil pots	Stock tank		Krill patties
Shells	Hanging logs w/ holes for food	Hanging tub*		Hampster ball w/ treat
Turkey feathers		Warm water hose		
Corn Stalks	Snow Piles	Vari-kennel		Gelatin Jigglers
Blowing bubbles into exhibit	Piles of ice cubes	Tubs w/ different substrates		Corn on the cob
				Chicken necks
Kudzu vines		PVC tube hung for climbing in.		Yogurt w/ fish
Cow Hooves				Unsalted ham

* Any item used from this list should be cleared with zoo management and carefully monitored. The items with asterisks should be closely watched, I do not know if any problems ever arose with these things. **Many people use paper products however caution should be exercised, there have been problems when the paper becomes wet and "glues" itself to an animals mouth. The same holds true for cardboard.**

Figure 17: Enrichment items (Reed Smith, 2001)

2.6 Handling

2.6.1 Individual identification and sexing

Males tend to be larger than females. Even if males and females are morphologically similar, they can be differentiated by their chops (larger in males) and by the shape of the forehead (more prominent in males); females have a smaller and thinner skull, with less apparent sagittal crest (Harris, 1968). This method cannot be used for juvenile because the skulls grows up until 3 or 4 year-old (Yom-tov & al., 2006).
Besides, the male has a much larger distance between the anus and the position of the penis compared to the distance of the anus and vulva of the female. Sexing otter by this method is so easier.

Each animal can be recognized by the face and by the color pattern. Indeed, they have a white spot on the neck which can differ between individuals.

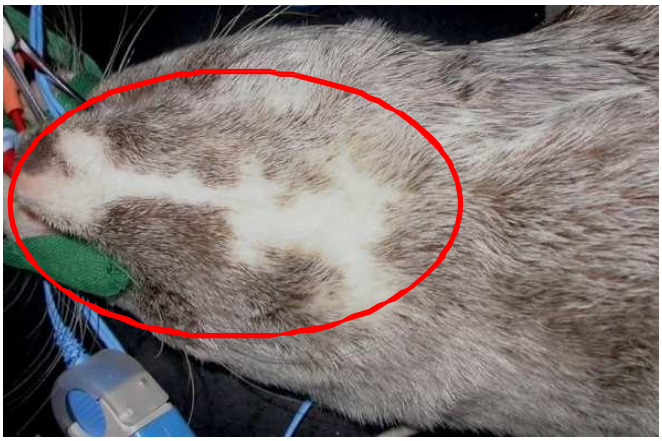


Figure 18. White spot

A transponder chip should be placed subcutaneously in the interscapular area or neck. The location should be recorded in the animal's medical Report.

2.6.2. General handling

Each day, during cleaning or feeding time, observation concerning feeding, general appearance, consistency of faeces and behaviours should be noticed.

Care should be taken with females that can be aggressive when they gave birth or with some animals during the feeding period. It is reported that some animals can try to bite.

2.6.3. Catching/restraining

Otters should not be caught by hand : their fur is very loose and catching the neck or at the base of the tail does not prevent the individual from biting the hand that holds it.

Several methods are used:

- Nest box: Otters use to sleep in nest box. It is possible to close them inside thanks to trap doors. This method limits stress and allows transporting the animal in security.

- Training: Train an otter to enter with food into a crate few days before the capture is possible. The benefit of crate training is to reduce stress and reduce risk of injuries.

- Net: Some institutions use nets to catch otters (sometimes when others methods don't work). It should be soft and well-padded to avoid injuries. Once the otter caught, the net should be twisted to prevent the otter climbing out. Keepers must wear gloves and boots to prevent biting.

- Sedation: used in few cases. The otter should not have access to a pool during this moment and a vet should be present. The otter should not be stressed because it can cause some complications. To do an injection of a drug, a blowpipe can be used.
  It is possible also to block the animal in a "contention crate". A trap can push the animal in the bottom of the crate; the otter is blocked and the injection can be done directly.

To catch an escaped otters, box traps (kind of tunnel) seem to be the most efficient. Box traps should be more than twice the length of the otter and are opened from both sides. The release mechanism is in the middle of the trap-tunnel. The trap-door must not fall on the otter's tail and so not break it.

Fig 19: Example of box trap (Otter Zentrüm)

2.6.4. Transportation

- *Crate*

As a transport in a crate is stressful for an animal, the delay between capture and departure should be as short as possible.

It is important to keep them in a well-ventilated but secure travelling box.
The crate (60x60x40 cm) should be made of solid plywood and without rims to avoid biting. It could be a sleeping box; so the animal is used to be in this box.

The floor should be covered with wood wool or straw.

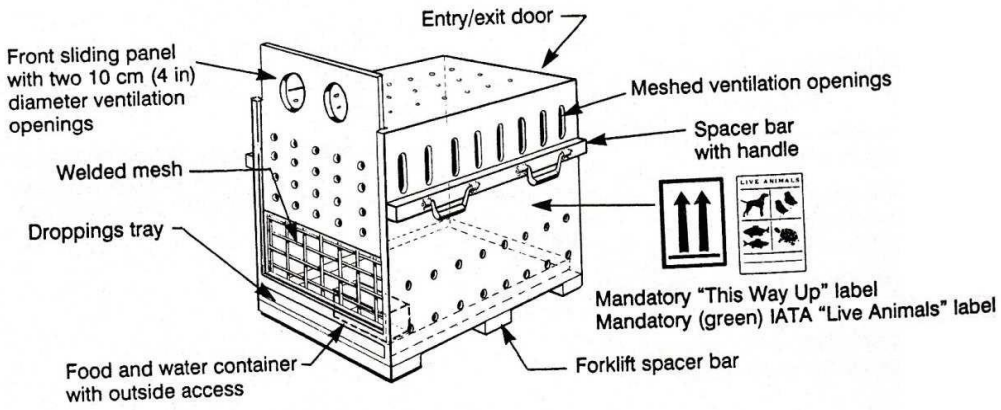


Fig. 20: Crate for otters; extracted from the guidelines for transport containers used for Animal Shipments [Ott Joslin & Collins, 1999].

As otters are sensitive to heat, it is not recommended to transport them during hot days, unless the vehicle is air-conditioned.
Food and water aren't required in the crate if the transport takes less than 24h. If drinking is required, it is possible to offer drinking water in a metal dish fixed in the corner of two walls and at the bottom. On long transport, provisions should be made for feeding in transit.
The animal should be monitored as much as possible, every 30-60 minutes. A high respiration frequency and a trembling can show a high level of stress or a thermoregulation problem.

- *Animals per box*

Adults should always be transported in separate crates.
A mother with a cub under 6 months can travel together. It is also possible for cubs younger than 6 months that have been reared together.
Normally, it's not necessary to transport animal under anesthetic except if it is constantly agitated in the crate.

2.6.5. Safety

Aggressive behaviours toward keepers can be observed when a female has young or if an animal is stressed and feels oppressed.

It was reported that a male otter bites the boot of a keeper during feeding time so it is important to be careful where the otters are in the enclosure and to observe their behaviours.

The enclosure should be enough secure to avoid visitors trying to touch animals. Some biting was recorded.
The enclosure should be checked each day. As the otter is a good climber, digger and jumper, each hole or anomaly of the fence can lead to escapes.

2.7. Veterinary: considerations for health and welfare

2.7.1. Common disease in European otters

European otters are susceptible to renal calculi. In the Eurasian otter, urolithiasis was found in up to 23.4% of the wild population. In the captive population it can be as much as 69.2%. The development of renal calculi seems to be caused by the purine metabolism of the species and affect captive animals as well as wild otters (Weber, 2001).

In captivity, the diet can play a role in the occurrence of kidney stones. Indeed, otters are often fed with a diet high in protein which is highly digestible compared to their natural prey.
Besides, many ingredients high in purine content are used which will increase the uric acid excretion (for example, herring has a high content of purine). This could be a reason for the high rates of uric acid calculi in captive otters compared to the wild populations (Ruff, 2007).

Limiting the dietary purine helps to lower the risk of high uric acid concentration in the urine. Besides, lowering the protein content of the diet would help reduce the hydrogen and ammonium ion load. Thus, it would be possible to reduce the purine and protein intake in captivity to lower the risk factors renal concentrations of uric acid, ammonium and hydrogen ions for the formation of calculi (Ruff, 2007).

Infections due to injuries can cause death. Indeed, injuries from bites are not immediately apparent and often lead to a systemic infection. As infection which is not treated can result to death, keepers should be take care to any fight or wound.

2.7.2. Infectious diseases

- *Viral diseases*

Diseases	Description
Rabies	Transmission: contact between mucous membrane and infected saliva. Incubation period : 1 week to several months. Signs : dysphagia, neurologic problems.
Canine distemper	Transmission : contact with urine, feces, conjunctiva or nasal exudates. Signs: decreased appetite, diarrhea, weight loss that lead to lung disease.
Infectious canine hepatitis	Transmission : contact with an infected animal or with contaminated objects (dishes, …) Signs : anorexia, weight loss
Parvovirosis	Transmission : direct contact *Signs:* gastroenteritis, diarrhea, vomiting

Figure 21: Table of Viral diseases

To prevent diseases, a yearly vaccine is suggested.

Use of formalin-inactivated CDV (Canine Distemper Virus) containing Al $(OH)_3$ as adjuvant seems to be ineffective in otters (Günther-Weil, 2009). Modified live virus CDV vaccines containing avian derived canine distemper strains (Onderstepoort type) are more efficient than those containing dog kidney cells (Rockborn type). Indeed, Canine kidney cells attenuated strains caused most of the vaccine induced incidents in carnivores and did not induce antibody titers in Eurasian otters (Günther-Weil, 2009).
For example, Nobivac SHP/LT from Intervet contains the Onderstepoort strain. After a first vaccine against Distemper and Parvorvirosis (SP or SHP), it is recommended to administrate a booster with SHP+LT three weeks later. This will give a good protection for at least one year in Eurasian otters (Günther-Weil, 2009).

Use of this MLV vaccine is not problematic in otters but there is still a risk in using domestic dog vaccines in non-domestic carnivores. The best would be to use the recombinant vaccine Purevax distemper (Merial) registered for the use in ferrets in the USA. But this vaccine is not available all over the world (Weber, personal communication).

- *Bacterial diseases*

Diseases	Description
Tuberculosis	Transmission : contact or by food infected by *Mycobacteria tuberculosis, Mycobacteria bovis* or *Mycobacteria avium* Signs: weakness, anorexia, diarrhea
Salmonellosis	Transmission : by infected food (*Salmonella anatum*) Signs : hemorrhagic gastroenteritis with diarrhea and vomiting
Leptospirosis	Transmission: food or water infected by rodents or their urine (*Leptospira icterohaemorrhagiae*) Signs: sudden dullness, high temperature, vomiting, diarrhea
Staphylococcus	Transmission : contact Signs : high temperature, diarrhea, vomiting possible

Figure 22: Table of Bacterial diseases

- *Parasites*

Parasite infection seems to be less important than in other carnivores.

But Otters should have fecal examinations regularly (at least each year) to check for internal parasites. New animals need to be examined too.

At Paris zoo, otters are regularly dewormed. Indeed, 2 times per year, they have:

- Panacur 500
- Profender for medium dog

2.7.3 Traumatic diseases

- *Hyperthermia*

The quality of the fur helps otters to have a good insulation. But it make them sensitive to high temperature and hyperthermia can cause death, especially when they are immobilized on hot summer days or in a non-ventilated crate during transport.

- *Intoxication*

Water should be enough cleaned to avoid intoxication that can cause kidney failure. The fish should also be checked before feeding otters.

2.7.4 Anesthesia

Contrary to pinnipeds, otters don't have much fat to protect them against cold. Their fur has this function. So, an alteration to the fur can cause hypothermia and can lead to respiratory diseases.
However, when they are anesthetized, they are prone to hyperthermia, due to the insulating quality of the fur.

A contention crate can be used to anesthetize an otter. It seems to be less stressful.

Due to skin laxity, an intramuscular injection can become unintentionally subcutaneously; then, the response time to anesthesia can be increased (Jacques & al, 2015). The para-lumbar muscles or thigh seem to be the best injection sites (Spelman, 1999).

Different combination of anesthetics can be used for otters. For example, Ketamin with Diazepam can be used.

Apnea, slow breathing, tachypnea and hypoxia are the most encountered problems during anesthesia with injectable products.
In addition, there are risks of hypertension during induction of alpha-agonists and hyperthermia for the first 20 minutes. The use of diuretics and temperature monitoring are recommended during anesthesia (Jacques & al, 2015)

After the anesthesia, otter should wake up in a quiet and dark place, without wounding objects. Depending on the temperature, heat mats or lamps or freezer packs can be used (Jacques & al, 2015).

2.8. Recommended research

2.8.1. Genetic Research

In the Seventies, Norfolk Wildlife Park in Great Britain exhibited two subspecies: *Lutra lutra lutra* and *Lutra lutra barang*. It was supposed that these two subspecies were maybe maintained together and bred. But the data are not enough reliable to say for sure if there were ever crossed. Because of this possible hybridization within the captive population, it was decided to separate the population in 2 lines: A-line (where the genetic pedigree is completely known) and B-line (where the pedigree is not sure; descendants from animals bred in Norfolk Wildlife Park)

So, these 2 lines are separated for many years even if we are not sure for the hybridization. This decision was taken because at this moment, the captive population was stable and can rely on new wild founders regularly. But it's not the case today.

The objectives of this study is to determine if these 2 lines have genetic differences and so the presence of hybridization within the B-line population.

Samples of hairs from captive otters (A and B-line otters) were collected and send to a lab. The chosen lab (from the University of Liege, Belgium) already worked on European otters and developed a method for genetic analyses. Researchers used genetic markers (set of microsatellites) to determine if there were differences between wild otters in different French Regions. So this method will be used to determine if there are genetic differences between the 2 lines within the captive population.

Besides, as the lab has genetic pedigree of wild otters, this genetic research can also show if there are genetic differences between the wild and captive otters.

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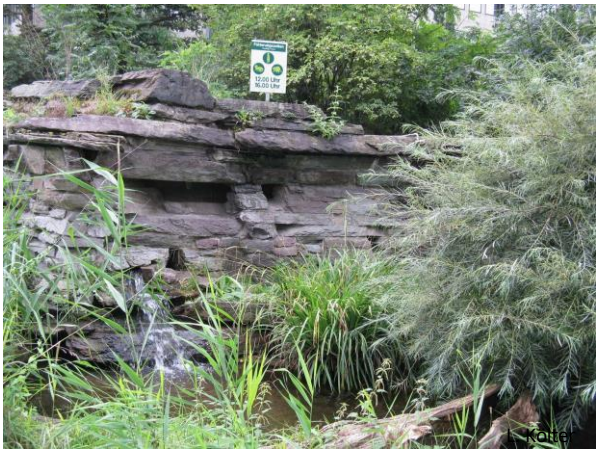
Appendice 1

Examples of enclosures



KOLN

NORDENS ARK

POZNAN

WARSAW

PARIS

AQUAMARINE FUKUSHIMA

Appendice 2

Development of young (Novosibirsk Zoo)

- Newborn otters: no teeth, eyes and hearing closes, body weight :85-133 g
- 15 day-old : hair colour begins to change
- 25-30 day-old : same colour as adult, eyes and hearings are opened, first milk teeth appear
- 60 day-old : dental formula: I_0^0 C_1^1 PM_2^2 M_1^1
- 3 month-old : dental formula: I_3^3 C_1^1 PM_3^4 M_2^1

Otter Body Weight and Metric Measures Dynamics

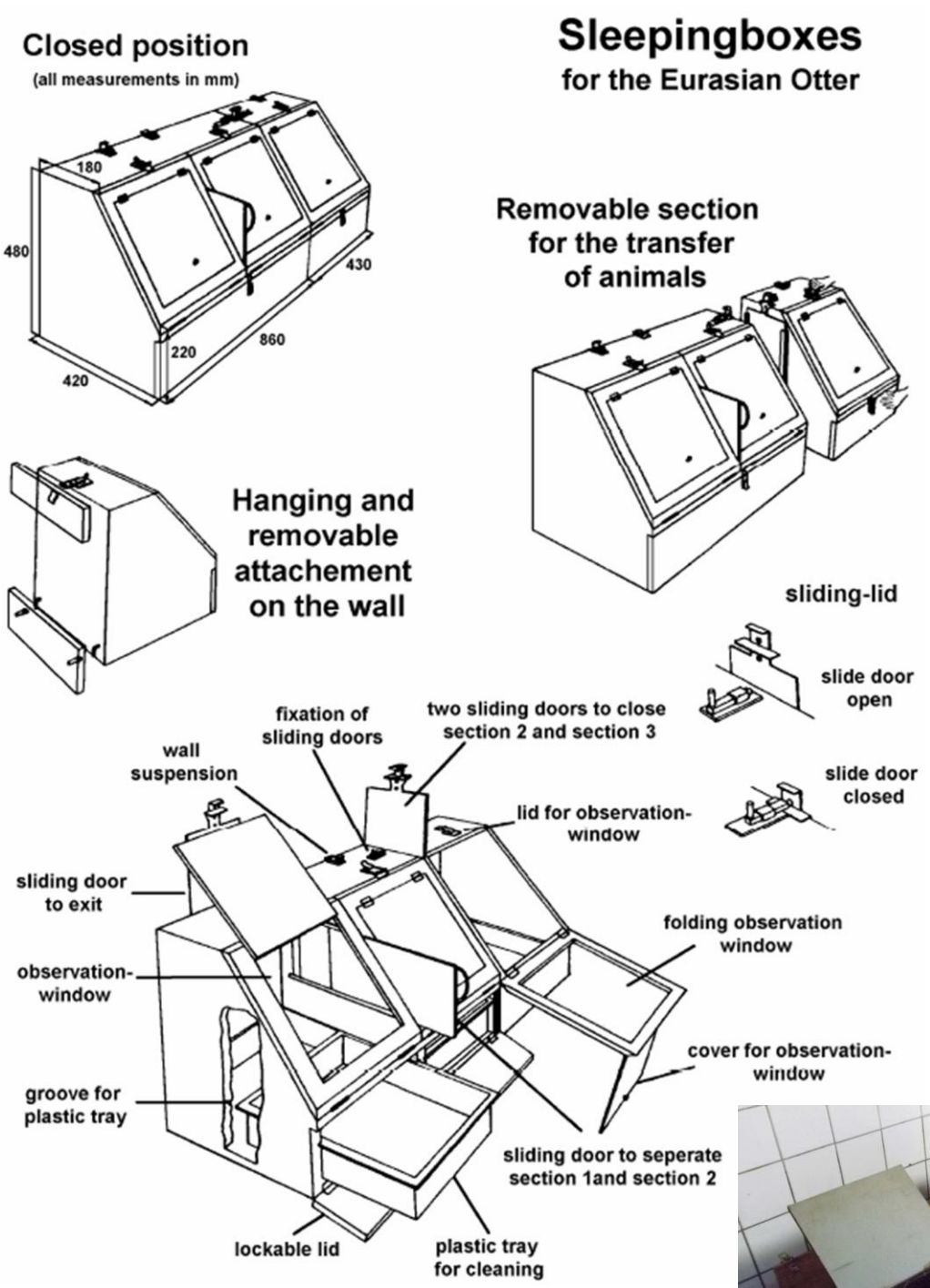
During Postnatal Development Period

Age, days	Body weight, grams	Body length, mm	Tail length, mm	Foot length, mm	Palm length, mm
1	85-133	140-180	49-67	18-25	16-19
10	170-200	185-197	76-80	30-33	18-20
15	260-490	170-260	72-100	33-46	22-29
20	360-540	245-250	93-110	44-60	25-31
25	500-840	260-300	95-130	45-60	27-43
30	500-920	260-320	100-140	49-78	28-46
45	690-1,100	310-370	122-165	60-85	35-56
60	1,000-1,680	320-490	140-220	62-100	50-58
90	2,100-3,200	456-516	170-272	97-110	54-60

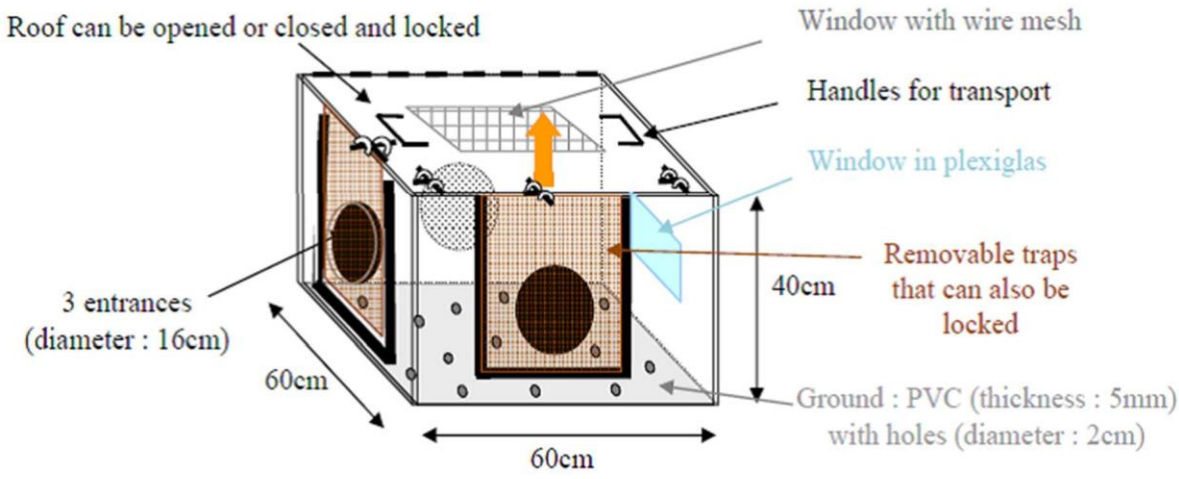
Appendice 3

Examples of nest and transport boxes

Nest boxes at Otter Zentrüm



Nest boxes at Paris Zoo



Nest boxes at Warsaw Zoo

Appendice 4

Examples of diet

KOLN

Day	**Morning**	**Noon**	**Afternoon**
Monday	300 g minced meat & 40 g dog food	200 g rumen	110 g fresh meat*
Tuesday	300 g minced meat & 40 g carrots	200 g meat	1 trout ~ 300 g
Wednesday	300 g minced meat & 40 g dog food	150 g heart	5 chicken ~ 200 g
Thursday	150 g minced meat & 80 g shrimps	150 g rumen	110 g fresh meat
Friday	300 g minced meat & 40 g dog food	5 chicken ~200 g	1 trout ~ 300 g
Saturday	300 g minced meat & 40 g carrots	200 g meat	5 chicken ~ 200 g
Sunday	300 g minced meat & 40 g dog food; Vit.B ~ 40 mg	200 g meat	5 chicken ~ 200 g

Fresh meat: mice, pigeon, hen, rabbit or guinea pig = Vit. B supplement = Forte Hevert (1/4 pill/week)

Total amount of food:

- ➔ Summer/individual & day: 700 – 800 g;
- ➔ Winter/individual & day : 900–1300g depending on ambient temperature

PARIS

Days	Morning	Afternoon	Evening
Monday	200 g de Capelin	1 trout alive	2 chicks 100 g of chicken breast
Tuesday	150g de herring 100g smelt	1 trout alive	100g of beef heart or diced poultry 1 chick
Wednesday	200g mackerel	1 trout alive	100 g of chicken breast 100g of mackerel
Thursday	200g de herring	1 trout alive	80 g of red meat 100g of chicken breast
Friday	150 g de Capelin 100 g smelt	1 trout alive	100 g of chicken breast 2 chicks
Saturday	200 g mackerel	1 trout alive	2 chicks 100 g of mackerel
Sunday	1 trout alive	1 trout alive	200 g of heart beef or diced poultry 50g of red meat

Winter: animals can have more food (1/4 more)

HydroSol PolyVitamin Roche : 2 drops /animal each day during 10 first days of each month

Diet European otter *Lutra lutra* :
GaiaZOO
Group of 2.2
Datum: 06-06-2014

When freezing at night

Product	**female**	**male**	**times a week**	**per group**
Mackerel (g)	400	600	7	2000
Smelt/ capelin/ roach (g)	100	100	7	400
Day old chick (nr)	5	6	7	22
Vitaminepill (nr)	0,5	1	ma, do	

under 20 degrees Celcius

Product	**female**	**male**	**times a week**	**per group**
Mackerel (g)	350	500	7	1700
Smelt/ capelin/ roach (g)	150	150	7	600
Day old chick (nr)	5	5	7	20
Vitaminepill (nr)	0,5	0,5	ma, do	

above 20 degrees Celcius

Product	**female**	**male**	**times a week**	**per group**
Mackerel (g)	250	300	7	1100
Smelt/ capelin/ roach (g)	50	50	7	200
Day old chick (nr)	2	3	7	10
Vitaminepill (nr)	0,5	0,5	ma	

NOVOSIBIRSK

Diet of Otters					
Animal groups	**Season**	**Daily received calories**	**Food items**		
			Meet (horse fillet, beef fillet, liver, heart), kg	**Fish (blue whitings, horse-mackerel, hake, herring, cod, navaga etc.), kg**	**Eggs, pcs.**
Adult males and females during rest period	May-Sept.	900-1400	0.5 – 0.7	0.2 – 0.4	-
	Oct-April	1250-1600	0.7 – 0.9	0.1 – 0.2	1
Females during lactation period		1600-1800	0.8 – 1.0	0.3 – 0.5	1
Young animals at the age of four months		450-650	0.2 – 0.3	0.1 – 0.2	0.5
Young animals at the age of six months		700-900	0.3 – 0.4	0.2 – 0.3	0.5

1.Trivitamin	1.0 ml	5. Bran	5.0 g
2. Glycerophosphat Ca	1.0 g	6. Milk substitute for human babies	5.0 g
3. KJ	0.3 g	7. Greenery	5-7 g
4. Vitamin-mineral suppl	2-3 g		

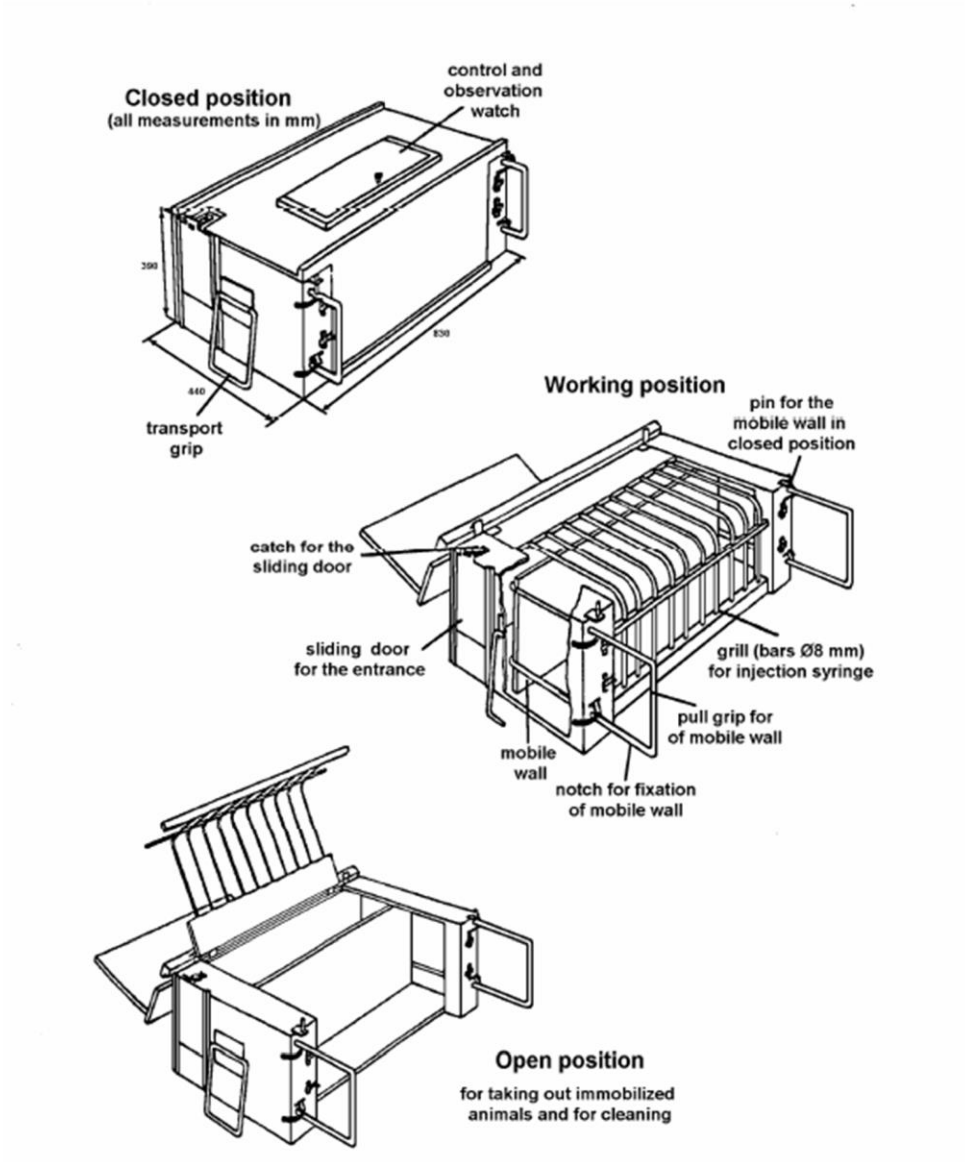
Appendice 5

Contention crates

Otter Zentrüm

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.



Appendice 6

Anesthesia

The table below shows different anesthetic used for European otters (according Spelman, 1999 and Jacques & al., 2015)

Anesthetic	Dosage	Comments
Ketamin	Between 6 and 30 mg/kg according bibliography	Apnea, hyperthermia, inadequate muscle relaxation and turbulent awakening have been recorded with the use of this anesthetic alone.
Ketamin + Diazepam	15 mg/kg 0.5 mg/kg	This combination allows a better muscle relaxation and extends anesthesia. But risk of respiratory depression can happen.
Ketamin + Midazolam	10 mg/kg 0.25-0.5 mg/kg	Short period of anesthesia (20-30 minutes) with a good relaxation and a slight respiratory depression. Totally awake one hour after the induction.
Ketamine + Xylazin	10 mg/kg 1-2 mg/kg	Good muscle relaxation. But long awakening, risk of respiratory depression, transient hyperthermia, high blood pressure (antidote after 40 minutes to avoid only effect of Ketamin: atipamezol)
Ketamin + Acepromazin	10 mg/kg 0.1-0.25 mg/kg	Risk of hypotension and possible long awakening
Ketamin + Medetomidin	5 mg/kg 50µg/kg	Good muscle relaxation. An antidote can be used. Respiratory depression, bradycardia, changes of the blood pressure. Do not use with highly stressed otters (O'Néill & al, 2008)
Isoflurane		Used to maintain anesthesia after intubation or to induce anesthesia Light hypotension, bradycardia, hypothermia can appear. But reliable and low-risk anesthesia for otters