DISTRIBUTION OF THE EURASIAN OTTER (*Lutra lutra*) IN AUSTRIA 1990-1998

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Abstract: In the absence of a national survey, the status of the otter in Austria for the period 1990-1998 is outlined based on as many sources as possible. The majority of otters occur in the northern and southeastern border areas. As far as is known very few, and probably transient individuals, occur in the rest of the country. For large parts of Austria, however, no information is available.

INTRODUCTION

The Eurasian otter (*Lutra lutra*) was once widespread throughout Austria. After heavy direct persecution in the 19th century, continued destruction of habitat brought the species to the verge of extinction. Regulation of rivers, drainage of the extensive marshlands along the rivers, intensification of agriculture and human settlement, and especially the exploitation of running waters for hydroelectric purposes has degraded the formerly prime habitats. Only in a few parts of Austria has the otter survived.

MATERIAL AND METHODS

Data on the occurrence of otters in Austria during the period 1990-1998, originating from various sources, were analyzed and collected, and distribution points mapped. Data accrued from, e.g., systematic investigations, random catches, direct sightings and the occurrence of indirect signs or dead otters. In some cases and for some localities, use of particular symbols are approximations only.

RESULTS AND DISCUSSION

The present status of the otter varies greatly within Austria. The vast majority of country's otters are found in the northern and southeastern border areas, where a lower level of industrial development allows more natural habitat to exist, while the interaction with healthy populations in neighbouring countries enables a constant exchange of animals. In addition, the presence of fishponds seems to have been important for the survival of the species in Austria. It is to be expected that their occurrence in these regions will expand. The rest of the country contains, as far as is known, only a few, and probably migrating otters. Large parts of Austria have, however, not yet been investigated.

Vorarlberg: On account of otter footprints found there in 1985, and of its nearly natural river habitat, the Bregenzerwald in the northern part of Vorarlberg was the focus of an otter survey in 1995. Despite a questionnaire being distributed, with some positive indications forthcoming, the survey found no evidence of otters. Otters could, therefore, have lived there at very low densities on account of a shortage of fish as well as disturbance by a hydroelectric scheme, until the flushing of a reservoir caused them to abandon the region (KRAUS, 1997).

Northern Tyrol: In the Tyrol otters are considered to have been extinct for several decades. However, an otter found dead in southern Bavaria close to the Austrian border, and the discovery of otter footprints in the vicinity indicate that individual otters could migrate into this region. The most promising area to search for otters in Northern Tyrol was considered to be the Lech valley. Although a survey was carried out here in 1997, no sign of otters was found (KNOLLSEISEN, 1997).

Eastern Tyrol: Otters seem to have disappeared from Eastern Tyrol after the flood disasters of 1965/66, and the subsequent management of rivers. Field surveys in 1994 revealed no evidence of their presence (JAHRL, 1995). This absence has been confirmed by other surveys (BODNER, pers. comm.; KNOLLSEISEN, pers. comm.; MICHOR, pers. comm.).

Salzburg: Of this federal state mainly the southern part has been surveyed. Despite repeated and credible reports, field surveys in 1994 failed to reveal any definite signs. Accounts on a questionnaire have concentrated on the area around the capital city (JAHRL, 1995). Focussed research has now revealed that otters are actually present in many parts of the town (JAHRL, 1998a).

Upper Austria: The northern part of Upper Austria is one of the strongholds of Austria's otters. KRANZ (1995) postulated an expansion of otters in this area, which forms part of a large common population that inhabits parts of Bavaria, the Czech Republic, and Upper and Lower Austria. Local surveys (FISCHER, 1993; HAUNSCHMID, pers. comm.; JAHRL, 1996; KRANZ, 1995; SCHMALZER, pers. comm.) show a clear picture of the situation in this area. Few records are available for the area south of the Danube; here only a few signs were found (MICHOR, pers. comm., KRANZ, 1995).

Lower Austria: The highest otter densities within Austria occur in the northwestern part of Lower Austria. Here a large number of fishponds enhances the carrying capacity of the region for otters, but the damage these fish-eaters are said to cause leads to increasing problems (BODNER, 1995). An expansion of the population is presumed (KRANZ, 1995). KNOLLSEISEN (pers. comm.) surveyed the eastern part of Lower Austria in 1998. He found several spraints at the boundary of the River March, while its tributaries and the Danube east of Vienna yielded negative results. In addition, an otter was found dead (GUTLEB, loose-leaf collection) while sparse otter signs (KRAUS, pers. comm.; SIEBER, pers. comm.) indicate rare visits of otters to this region. In the southwestern part of the country KRANZ (1995) and KRAUS (pers. comm.) proved the scattered but extensive presence of otters, which stretches eastwards to Vienna along the Danube. The southeast neighbouring Burgenland was surveyed in 1997, but only a few sites yielded otter sign (JAHRL, 1998b).

Vienna: Up to the early nineties, single otter signs were found only in the southeast of Vienna (SIEBER, pers. comm.; SIEBER and BRATTER, 1987). The discovery of an otter track in the western outskirts in 1997 illustrates, however, how close single otters have already come to the town.

Burgenland: Surveys in 1996 and 1997 indicate a population that increases markedly from north to south. The resident otters of southeastern Styria and Burgenland seem to benefit from being part of a larger common otter population of Hungary, Slovenia and southeastern Austria (JAHRL and KRAUS, 1998; KRAUS and JAHRL, in prep.). KRAUS (pers. comm.) on account of his research in the eighties assumes an increase in the population in southern Burgenland.

Styria: The first otter survey was in 1986 (KRAUS, 1986). A second in 1993/94 provides more recent data on otter distribution. The results reveal a widespread occurrence only in lowland rivers and streams in southeastern Styria, bordering on Burgenland and Slovenia (SACKL et al., 1996). Isolated signs in the alpine regions of northern and western Styria (GUTLEB, pers. comm.; KRANZ, 1995 and pers. comm.; SACKL et al., 1996) presumably originate from migrating individuals, which could be relics of a population which formerly covered the entire country, decimated initially by persecution and subsequently by destruction of habitat. Although SACKL et al. (1996) do not assume an increase in the Styrian otter population, KRAUS (pers. comm) believes that a slight increase has been taking place in the southeast.

Carinthia: As a result of the returns of questionnaires, a survey of the most promising rivers was carried out in 1991/92. Only a single otter sign could be found (WIESER, 1993). Surveys and the results of other authors (AUER, pers. comm., EISNER and SIEBER, 1993; FORSTNER, 1990; HUBER, pers. comm., JAHRL, 1995; KNOLLSEISEN, pers. comm.; MICHOR, pers. comm.; SENITZA, pers. comm.) support the notion of a few otters migrating through Carinthia, possibly coming from Slovenia. Destruction of habitat, especially by hydroelectric power plants, is thought to be the main reason for this situation (WIESER, 1993).

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SLOVAKIAN PROJECT ON OTTERS A BASIS FOR AN ACTION PLAN FOR THE EURASIAN OTTER (*Lutra lutra*) IN SLOVAKIA

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Abstract: The Eurasian otter is one of the most studied species of mammals in Slovakia since 1989. Field surveys and toxicological analysis of the species and it prey in a specialised long-term project have produced the first objective information on the status of the otters and threats to its survival in Slovakia. The species occurs in most parts of the country, but water pollution, the degradation of rivers and the drainage of wetlands have caused its decline or extinction from the Western and South-Eastern lowlands of Slovakia. Several toxicological analyses in otters and fish have not indicated high levels of pollutants, but mortality caused by road traffic accidents is a significant threat. The otter population in Slovakia represents an important core area of the species in Europe. Measures for otter protection and for conservation of its habitat are proposed in an Action Plan prepared by the Slovak Environment Agency, and some of these measures have since been implemented.

INTRODUCTION

Systematic and coordinated research and monitoring of the Eurasian otter *(Lutra lutra)* in Slovakia has been carried out since 1989. A national otter conservation programme for Slovakia will be developed in 2000 by the Slovak Environmental Agency, using results of this long-term project including otter survey, monitoring and conservation, implemented by a group of specialists from governmental and non-governmental organizations (KADLEČÍK and URBAN, 1997).

DISTRIBUTION, CORE AREAS AND CORRIDORS

During the last eight years, most of Slovakia has been surveyed (KADLEČÍK and URBAN, 1997). When compared with the last national survey 20 years ago, no great changes in otter distribution have been recorded in (HELL and CIMBAL, 1978). Otters are widely distributed in the northern and central part of the country, while some populations also survive in the lowlands of southern Slovakia. Results of the otter survey have been used to identify core areas of otter distribution and possible corridors for the species migration to formerly occupied areas. This has resulted in proposals for new protected sites and important core areas in land-use planning and ecological network documents. At the same time, processes and activities that have significantly adverse impacts on otter habitats have been identified. A nationwide project evaluating and classifying water bodies in Slovakia from the nature conservation point of view has been developed in the Slovak Environment Agency. Further otter surveys will be a part of this.

MONITORING

Selected parts of the otter range in Slovakia are monitored on a regular basis with winter counts of otters prints on fresh snow. This monitoring has been carried out in several basins and mountain ranges of central and eastern Slovakia and population trends have been assessed. The individual home-range of the otter has been estimated at between seven and 19km along a stream, and only a small fluctuation in otter numbers in these catchments has been recorded.

THREATS

Data collected on dead otters were used to assess threats caused by human activities. The most important factor of recorded otter mortality is road traffic. Its importance has increased during last ten years.

Several otter carcasses from central and eastern Slovakia have been studied for pollutants (heavy metals, PCBs and organochlorine pesticides). Generally, the levels of bioaccumulative contaminants in otter tissues analysed in Slovakia are lower than in Western Europe (GUTLEB, 1995). The concentration of PCBs was in most cases less than 0.1 $mg.kg^{-1}$ - much lower than a proposed PCB standard, 10 mg kg^{-1} (MACDONALD and MASON, 1994). High concentrations of some specific elements were found occasionally, e.g. a high level of cadmium in one sample from the Orava River catchment, or high levels of mercury in some otters from industrial areas.

Otter diet analyses from spraints and analyses of contaminants from otter prey (fish samples) were also made during the otter project. Adverse effects of pollution on the otter population and its distribution are assumed in some rivers of Eastern Slovakia downstream of large cities. KOŠČO and KOŠUTH (1995; 1996) reported high concentrations of PCBs in fishes from two rivers of Eastern Slovakia, levels that exceeded those thought to have adverse effects on otter population. Two otters found dead in two rivers of this part of Slovakia also had high concentrations of PCBs in their organs - 1144 mg kg^{-1} (fat weight) in an otter from the Poprad River (CHOVANCOVÁ, 1991) and 0.24 mg kg^{-1} from the Laborec River (BUDAYOVÁ, 1994). Other chlorinated hydrocarbons (DDT, HCH, HCB, aldrin, dieldrin) occurred in such low concentrations that they were not considered significant.

The increasing number of road kills indicate that road traffic will be a serious problem in otter core areas. There is an increasing number of cars and an increasing density of roads and highways built during the last few years in core areas of otter distribution.

Passages under bridges have been assessed as potential barriers for otter migration as well. Special guidelines for passage assessment and for measures needed for improving them were developed for cooperating people and agencies.

Road-signs warning of otters crossing were placed in areas of high mortality. Adaptations to roads were made in critical parts of the highway in the Liptov Region, where otter mortality due to traffic was extremely high.

HABITAT PROTECTION

The national strategy for wetland conservation and wise-use, developed at government level and the accompanying Action Plan 1997-2002, among others, also cover the conservation and management of otter habitat. The National Programme of river and wetlands restoration is still being prepared and will include priority actions in otter habitats.

In the identification of areas that could be considered as strongholds of the species and corridors in transfrontier areas, there is cooperation with experts from Austria, the Czech Republic, Hungary and Poland. Common bilateral or multilateral surveys and consultations have been carried out. Many new protected areas and Ramsar sites have been designated in habitats used by otters in various parts of the country.

Improvement of fish stocks in some streams with low fish densities has been also supported from the State Fund for Environment during recent years.

CONCLUSIONS

There is a viable population of the Eurasian otter in the Slovak Republic. This population seems to be stable with population trends increasing in some areas to the point that otters are expanding into former ranges. We consider this population to be important and want to ensure its survival and to support its dispersal as a part of the European Otter Network. The action plan and management plan development is of high priority in the work of the Slovak Environment Agency.

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TRACKS AND OTHER SIGNS OF THE HAIRY-NOSED OTTER (*Lutra sumatrana*)*

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Abstract: The hairy nosed otter, an endemic species and the most rare otter species in Asia, has been rediscovered again in southern Thailand, after many years with no reliable information. Their main habitat appears to lie in two types of swamp forest; pure stands of Melaluca cajeputi, and evergreen swamp forest composed of a three-story formation of climax vegetation with a continuous crown canopy. Within the overall hairy nosed otter survey, indirect observations, such as tracks, faeces, and characteristic spraint sites, were collected to obtain more information on the ecological requirements of this species. Spraint composition was also analysed to compare its diet with other otters.

INTRODUCTION

Four species of otters are known to exist in Thailand (LEKAGUL and MCNEELY, 1977). The smooth coated otter (*Lutra perspicillata*), the Eurasian otter (*L. lutra*), and the small-clawed otter (*Amblonyx cinereus*) are all known to occur and their status has been assessed in many areas (KRUUK et al., 1994; KANCHANASAKA, 1996, 1997). Though the hairy-nosed otter (*Lutra sumatrana*) was believed to occur in southern Thailand (LEKAGUL and McNEELY, 1977), there had been no report or reliable information on this otter species for a long time; it was therefore considered to be a highly endangered species within its range in Thailand. The recent rediscovery of the hairy nosed otter in the Toa Daeng peat swamp forest in southern Thailand has allowed us to begin an intensive study of this species, including information on tracks, spraints, spraint sites, and diet composition, allowing us to increase the information available on the hairy nosed otter.

METHODS

Observations were made in a patch of swamp forest that was dominated by *Melaluca cajeputi*. This forest patch was about 0.5 km^2 and is situated near a canal connecting the forest to a large patch of peat swamp forest (Fig. 1). Approximately 10 spraint sites were found in this area and 'camera trapping' was used to check on use by the species. Direct observations were made whenever the opportunity arose.

Tracks were studied by collecting a plaster cast of print, and these were compared with the tracks of the smooth coated otter and the Eurasian otter from previously published material (van STRIEN, 1983; BROWN et al., 1983). Spraint sites were recorded and compared with other Asian otters and the size and shape of the spraints were recorded. Spraint composition was analysed in order to differentiate the diet of hairy nosed otters from that of other otters.

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Diet composition is presented as frequency of occurrence (FO) and relative frequency (RF). The frequency of occurrence (FO) shows the percentage of spraints containing a particular prey item and the relative frequency (RF), the number of occurrences of a particular item as a percentage of the total number of occurrences of all items in the sample (sum = 100%).

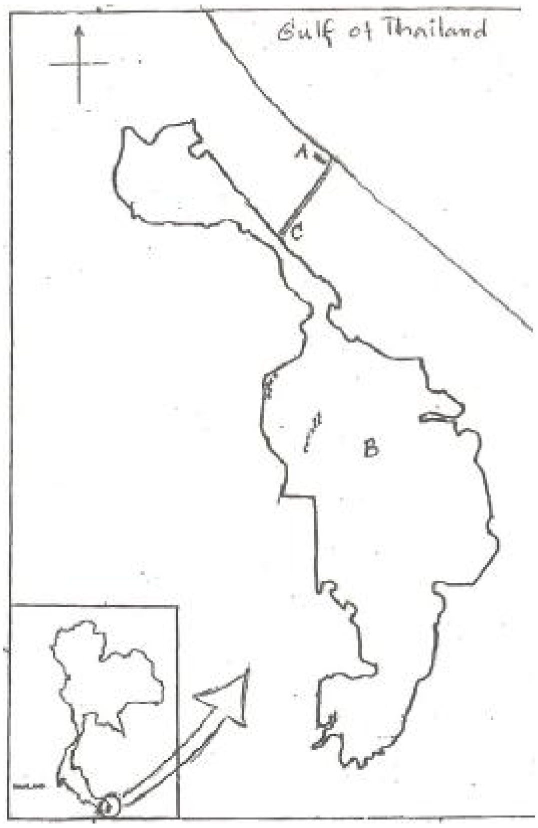

Figure 1. Location of the study site
A = study site, B = Phru Toa Daeng Peat Swamp Forest, C = Canal that connected the swamp to the sea

RESULTS

Observations

From information gathered from both 'camera trapping' and direct observation, we estimated that one group of three otters inhabited this area.

Description of tracks

Tracks of the hairy nosed otter showed five toes on each foot, as with other otters. The web between the toes was often clear in soft substrate. The toes are small, pointed and often showed the imprint of the claw on sand or mud. The toe width is about 0.7 to 1.1 cm. The footprint of the hairy nosed otter is both smaller and less oval than the smooth coated otter, but similar to the track of the Eurasian otter, in both size and shape. The first and the fifth toe are not aligned and it is possible to separate the fore and hind feet from the position of the first and the fifth toes, i.e. the first toe in the hind foot is lower than the fifth toe to a much greater degree than in the fore foot. The position of the five toes in the fore foot is therefore more symmetrical than in the hind foot. The fore feet often showed four inter-digital and proximal pads, while the proximal pads are absent in the hind feet (Fig. 2-4). The fore feet are rather smaller than the hind feet (Fig. 4), the approximate width of the fore feet being 5.8 cm (n=24) and the hind feet 6.6 cm (n=16).

Although there were distinctions between the tracks of the three Asian otter species, the footprint of the hairy nosed otter and the common otter are very difficult to distinguish. The width of the footprint of the hairy nosed otter is slightly larger than that of the common otter, however, the width of some footprints overlapped with that of the common otter and, though the toe was rather small in size and pointed in shape, they were also very similar.

Spraints and Spraint sites

Hairy nosed otters deposit their faeces, or spraints, at similar sites to the other otter species. Most spraints were found on the ground and, whereas some were found in the shade of a tree, many were found on a mound in the open. Because the hairy nosed otters live in swamp forest, where the forest floor is covered by water, many of the spraint sites were on the tree trunks or on a mound near a tree trunk or on the trunk or root of a fallen tree. Spraint sites could be as close as 2–5 metres apart and were situated near the waters edge, approx. 0.5 to 2 meters from the bank, or on a mound surrounded by water, at least 0.3 metres above the water level. The hairy nosed otter did not appear to produce a large pile of spraints, such as small-clawed and smooth coated otters do; however, they appeared to defecate frequently along a path.

Spraints were shapeless, black in color when fresh, and did not have a strong smell like the smooth coated otter. Some spraints contained a green/brown mucous. The size and shape of spraints varied, from a tiny scat, a shapeless dropping (Fig. 5), to a cylindrical spraint (Fig. 6), usually around 1–1.5 cm in diameter. Some spraint sites contained 2–3 shapeless droppings, about 5 x 2.2 cm in size, whereas others had a single dropping, approximately 4.5 x 2.2 cm in size. Spraint sites on a tree trunk or log had both single tiny scats and multiple spraints of small dropping, with the multiple spraints often deposited on the base of a big tree. The single tiny spraint, sometimes containing only mucous, usually placed on a log or tree trunk, were often as close as 1 metre apart.

Spraint composition

One hundred and twenty two spraints were collected over the nine months between March and November 2000 this period covering both the wet and dry seasons in southern Thailand.

Vertebrae were the remains most often found in spraint (Frequency occurrence: FO = 99.2 %, Relative frequency: RF = 93.8%), most of these being from fish (FO = 98.4 %, RF = 78.6 %), with snake being the second most important item (FO = 18 %, RF = 13.5). Invertebrate remains were also found, including crab and insect, though the latter were only found in small quantities (Table 1). The results indicate that fish were the main food item of the hairy nosed otter throughout the study period, with other vertebrates and invertebrates taken in small amounts.

Figure 2. Fore foot of the hairy nosed otter showing the interdigital pads

Figure 3. Hint foot of the hairy nosed otter showing the interdigital pads

Figure 4. Fore left and hind left track from the plastercasts

Figure 5. Shapeless dropping of the hairy nosed otter

Figure 6. Cylindrical dropping of the hairy nosed otter

Table 1. Occurrence of different prey categories in spraints

prey items	% spraints with (OF)	rel. % spraints with (RF)
fish	98.4	73.6
frog	5.7	4.3
snake	18	13.5
mammal	1.6	1.2
reptile	1.6	1.2
crab	2.5	1.9
insect	5.7	4.3

DISCUSSION

Our observations on tracks suggest that the tracks of the hairy nosed otter and the Eurasian otter are very similar and will be difficult to separate from each other if these two species occur in the same area. However, the tracks of hairy nosed otters and the smooth coated otter are different and can be separated by their size. The tracks of the smooth coated otter are large and often more than 8 cm wide (KRUUK et al., 1993). Whilst the track width of young or small female smooth coated otters can be smaller than 8 cm, their toes will be bigger and their shape oval, whereas the tracks of the hairy nosed otter are rather small and have pointed toes and long claws.

According to KRUUK et al. (1993), there was large variation and overlap in appearance among the faeces of the three otter species (*L. lutra, L. perspicillata and Aonyx cinerea*) and hence evidence from spraint sites should be used with caution. The results of this study supported these findings, with some spraint types of the hairy nosed otter being very similar to those of the smooth coated otter and the Eurasian otter. However, the type of spraint comprising many small droppings of faeces of the same age on a tree trunk belonged only to the hairy nosed otter.

Analysis of spraint composition indicated that the diet of the hairy nosed otter in this region contained many more fish remains than other vertebrate or invertebrates, similar to the diet of the smooth coated otter; whereas spraints of the Eurasian otter contain roughly equal amounts of amphibian or crab as fish (KRUUK et al., 1994; KANCHANASAKA, 1997).

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HABITAT SUITABILITY AND APPARENT DENSITY OF THE EURASIAN OTTER (*Lutra lutra*) IN SAXONY (GERMANY)

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Abstract: In 1993 the government of the federal country Saxony (south-eastern Germany) started a conservation programme for the Eurasian otter. In the first part of the programme scientific investigations and a few pilot projects were made. Only the results of relevant parts of this programme, obtained from a habitat survey in an area of 75% of Saxony and a field survey of otter signs, were presented. With the results from the habitat survey a habitat suitability index was computed and visualised together with the estimated apparent density of the otter in a grid of official topographic maps by GIS. Between both parameters a good correlation (r=0.735, P<0.05, n=47) was found.

INTRODUCTION

In 1993 the government of the federal country Saxony started a conservation programme for the Eurasian otter (*Lutra lutra*). In order to give the following practical projects a professional foundation, first there were made scientific investigations and a few pilot projects (KLENKE, 1993; LANDESAMT FÜR UMWELT UND GEOLOGIE, 1996). Main parts of the scientific programme were:

- studies about the historical and recent otter distribution,
- a survey of possible otter habitats in the known area of occurrence, and an estimation of the apparent density of the otter in his main area of occurrence,
- some ecological studies, for instance about age composition and reproduction, movement, estimation of sex from faeces, and composition of otter diet in different habitats,
- studies about threats - causes of death, the distribution of dangerous sites on roads, pollution - even as about problems caused by a high concentration of otters in fish pond areas which could result in a higher risk for the otter to be shot or trapped by the fishermen.

On behalf of the Office for Environment and Geology, the scientific programme, managed by the author, was carried out not only by scientists but also by experienced trained volunteers. This paper will inform only about selected results, obtained from the habitat survey and from a field survey for otter signs. The methods are described in detail (PEPER and PEPER, 1996, for the habitat survey; KLENKE, 1996a, for the survey of otter signs).

STUDY AREA

The federal country Saxony is situated in the mid-east of Germany (see also Figure 2). The habitat survey covered an area of 75% of Saxony. The field survey for otter signs was concentrated on east Saxony.

MATERIAL AND METHODS

Habitat Survey

Aim of this survey was to get information about the general situation of potential otter habitats in Saxony. For the evaluation of these habitats, a data sheet was developed which contained questions about the main habitat factors as listed in Table 1. The experience made by BAUER (1990), BINNER (1992) and HEIDECKE (1989) was taken into consideration, when the habitat factors were selected.

Table 1. Main factors and components for the ecological rating of the watershed

„Hydromorphological" Factors			
Running Water	Standing Water	Surrounding Landscape up to 100m around the Water (Percentage of Type of Land Use)	Otter-specific Components
Length of the Survey Segment	Surface Area of the Water Bodies	Roads and Railway Lines	Percentage of Bankside Hardwood
Morphology of the Running Water	Shape of the Water	Build up Areas	Percentage of Bankside Softwood
Morphology of Bank and Bottom	Type of Structure Elements in the Water	Pastures and Meadows	Width of Running Waters
Type of Structure Elements in the Channel	Type of Bank and Scarp	Fields and Fallows	Average Depth of Water
Type of Bank and Scarp (fortification, strengthening)	Vegetation along the Bank	Hedges and Woodedges	Submersed Vegetation
Vegetation along the Bank	Vegetation in the Water	Wetlands, Reeds and Fens	Potential Prey
		Wood	Threats

Each component was rated along a scala of five degrees (according to BAUER 1990) from very good (5) to dangerous (1) with respect to the suitability for the otter. Beside these main factors, the amount of water in the landscape is also an important factor for the occurrence of the otter because of the strong relation between water and the existence and amount of food, but the rating of watershed gives no information about the amount of water in the landscape. For instance there can be only a few brooks and small lakes with a high quality of clear water and surrounding landscape in a big area. The resulting rating is quiet good. Therefore the index (Figure 1), which we computed to get general information about the habitat suitability, must consider both the rating and the amount of water in the landscape (see also KLENKE, 1996b).

$$\overline{x_t} = \frac{\sum_{i=1}^{5}(n_i \cdot i)}{\sum_{i=1}^{5} n_i}$$

$$N_t = \frac{n_{t,mtb}}{\sum n_{t,mtb}}$$

$$I_t = \frac{\overline{x_t} \cdot N_t}{\max(\overline{x_t} \cdot N_t)}$$

$$L = \frac{I_{Lakes,\ Ponds} + I_{Running\ Waters}}{2}$$

i – *Rating*
t – *Type of Water (Running Water, Lake, Pond)*
mtb – *Grid Cell*
n – *Area in ha / Length in km*
$\overline{x_t}$ – *Arithmetic Mean of the Rating for each Type of Water*
N_t – *Portion of Area or Length of each Type of Water on the Grid Cell in Relation to the Area respectively Length of each Type of Water in the whole surveyed Area*
I_t – *Index specific for the Type of Water*
L – *Suitability Index*

Figure 1. Computation of the suitability index

Each index specific to the type of water can be normalised to 1 by division with the greatest value for the area of standing waters respectively the length of running waters found in a grid cell. The suitability index is the arithmetic mean of both type-specific indices (see Figure 1). The used notion is related only to the factors considered. The index gives good general information, but no information to the single reasons. Therefore a detailed analysis of the main factors used in the habitat survey is necessary, which was also taken from PEPER and PEPER (1996).

Survey of Otter Signs

In the winter months of 1993 to 1995 after snowfall 93 (1993/94) and 113 (1994/95) experienced volunteers surveyed all fresh otter signs in 600m long segments along all waters in the main area of distribution in order to estimate the apparent density of the otter. In contrast to REID et al. (1986) all segments were to be surveyed. We only used hard signs like snow tracks and spraints from the last night. Fresh spraints were counted only once. Sometimes the tracks gave information about the number of animals leaving them. Related signs (signs from same individuals in subsequent elements) were counted only once too. Because of lacking experienced people in the other regions of the country (north-west Saxony, Middle Erzgebirge) our survey was not complete for the whole region. In these regions the apparent density corresponds to the sum of separate signs and observations randomly taken by only a few specialists.

RESULTS

The results from the habitat survey by PEPER and PEPER (1996) and the field survey of otter signs were computed and visualised by GIS in a grid of official topographic maps (width 10 minutes longitude, height 6 minutes latitude, corresponding to about 11,65 x 11,14 km edge length) similar to the UTM grid (Figure 2). Between the results of both surveys we found a good correlation (r=0.735, $P<0.05$, n=47). Because of the concentration of grid cells with higher values of both measurements (habitat suitability and apparent density) only in a small strip of fish pond rich landscape in Upper Lusatia, fishponds with distinguished productivity or, in other words, food will be the main factor for occurrence and high stock of the otter especially in this small region in Saxony. Only some grid cells out of the named area showed better values of habitat suitability caused by a higher density of clear streams and small rivers in the mountains or better habitats along the river Elbe in the north-west of Saxony.

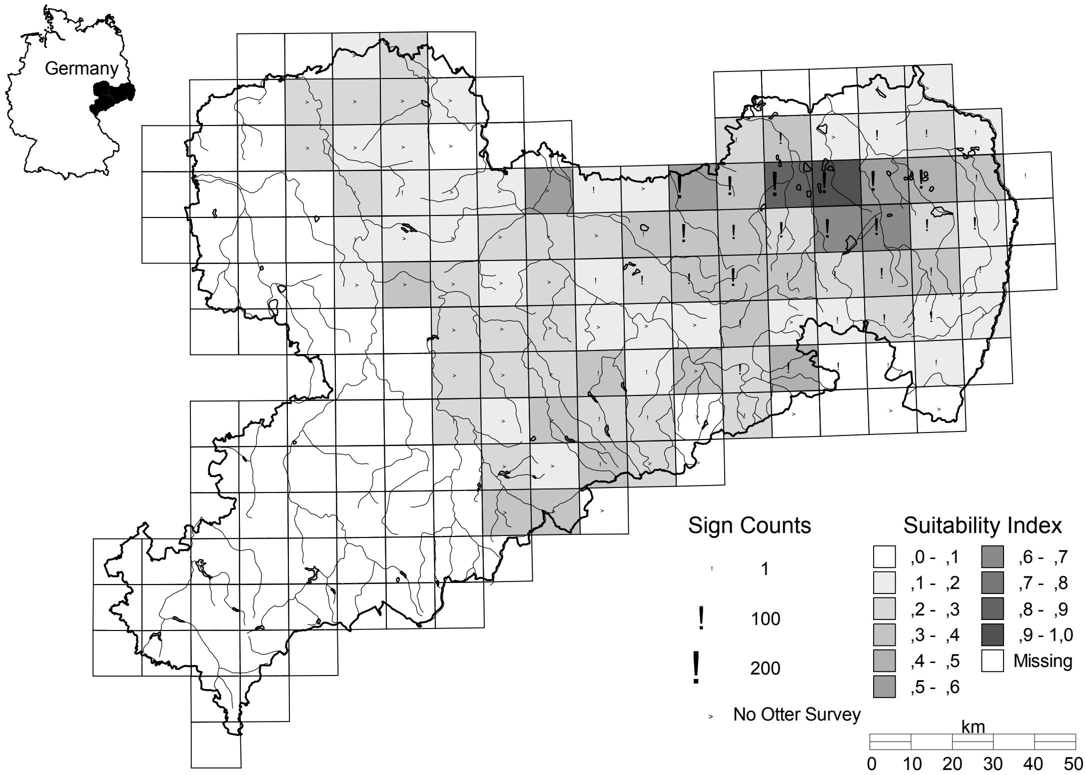

Figure 2. Results from the habitat survey and the field survey of otter signs visualised together by GIS in a grid of official topographic maps (10 minutes longitude, 6 minutes latitude, corresponding to about 11,65x11,14km edge length).

DISCUSSION

The results of the field survey of otter signs are similar to those found from ANSORGE and STRIESE (1993). New information could get from outside Upper Lusatia. However, as mentioned above these measurements are not completely comparable with those taken in Upper Lusatia. The result does allow only careful conclusions about the apparent density, but not about real numbers of animals. As discussed by FOSTER-TURLEY et al. (1990) there are several potential problems (influence of weather on activity, seasonality, unequal marking activity of different individuals), which must be considered, especially in populations, which are fragmented or at a very low level. This is true for the regions outside Upper Lusatia where the distribution of the otter reach their boundary.

From the habitat survey we could derive conclusions about the requirements and strategies of habitat restoration in the several named regions. PEPER and PEPER (1996) shows in their detailed analysis of the habitat survey data that there is a lack of running waters with higher rating. Therefore we see possibilities in the improvement of otter habitats mainly in the restoration of streams and small rivers in the whole country. Beside this also the preservation of the remaining pond fisheries outside the Upper Lusatia region should have good effects on the maintenance and growth of the otter population in Saxony.

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ARE THERE SEASONAL BOTTLENECKS IN FOOD RESOURCES FOR OTTERS FEEDING ON ARTIFICIAL FISH PONDS IN THE CZECH REPUBLIC?

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ABSTRACT: The traditional fish farming industry in Central Europe, producing mainly carp, provides abundant food for otters. However, there may be seasonal bottlenecks in the abundance or availability of this food, which could have an effect on otter numbers. The abundance of fish is drastically reduced during those weeks of the year when most ponds are drained for harvesting. The availability of fish may also be considerably restricted by ice cover on the ponds in winter. In order to get evidence for such bottlenecks, the diet and presence of otters were quantified along a number of ponds and a stream. The analysis of over 4,000 spraints showed that otters consumed significantly more stream-dwelling fish in winter, than in spring and summer (P<0.01). This significance was not detected between winter and autumn, presumably, because in autumn, ponds are emptied for harvesting, forcing otters to forage in streams. The presence of otters decreased on these larger ponds with the occurence of ice, as evidenced by tracks and fresh spraints. However, otters may stay along ponds and forage under the ice without leaving any fresh tracks or spraints, possible even for weeks, as indicated by radio-tagged otters . This will bias results from the spraint analysis, as well as any estimation of otter presence recorded by tracks (otter presence will be underestimated). Hence, at present there is some evidence that otter numbers might be determined by seasonal bottlenecks in food. However, this may be due to a lack of appropiate data and more detailed investigations will be necessary to settle this point.

INTRODUCTION

During the last 30 years otter (*Lutra lutra*) diet studies have been carried out almost everywhere in Europe (e.g., ERLINGE, 1967; KRUUK et al., 1993, KNOLLSEISEN, 1995). This paper, however, focuses not on otter diet along streams, lakes or coastal habitats, but on fish ponds. Fish ponds are an artificial habitat which is common in Central Europe for producing fish, mainly carp (*Cyprinus carpio*), but also other species. Due to the presence of fish farms, food for otters seems to be more than abundant. Usually ponds are stocked with 600 - 700kg of fish per hectare, a figure, which is several times higher than the natural fish biomass of the streams and rivers in this highland area (SPINDLER, 1992; WEISS, 1997). Nevertheless, otters do not seem to be so numerous as might be expected from the high amount of fish in the ponds (theoretically a one hectare fish pond can produce enough fish biomass per year to provide sufficient food for one otter). This may be due to thick ice cover in winter, which makes access to fish in ponds difficult. Another possible bottleneck could occur in autumn, when most ponds are drained for harvesting. The presence of otters along ponds and the seasonal diet was investigated, in order to get some evidence for the hypothesis that otters are limited by seasonal bottlenecks of food in this south Czech Moravian fish pond area.

STUDY AREA

The study was conducted in an area with approximately 210 small and medium sized fish ponds (between 0.1 and 10ha) on the border between Austria and the Czech Republic (see also KRANZ et al., 2000). The ponds are 0.5 to 1.5m deep and they are used mainly for the production of carp (90% of stocked biomass), but tench (*Tinca tinca*), pike (*Esox lucius*), zander (*Stizostedion lucioperca*), rainbow trout (*Oncorhynchus mykiss*) and whitefish (*Coregonus sp*.) are also stocked. The artificial ponds provided more than 95% of the total available fish biomass in the study area. Most streams in the area are less than three metres wide, partly canalized and contain brown trout (*Salmo trutta f. fario*), chub (*Leuciscus cephalus*), roach (*Rutilus rutilus*), perch (*Perca fluviatilis*), gudgeon (*Gobio gobio*) and bullhead (*Cottus gobio*).

MATERIAL AND METHODS

Otter spraints (n= 4,244) were collected and analysed from 210 ponds (KNOLLSEISEN and KRANZ, 1998; KNOLLSEISEN and KRANZ, in prep.) to get a general view of seasonal shifts in otter diet . Fish in the diet were scored as exclusive stream dwellers (brown trout, chub, gudgeon and bullhead), exclusive pond dwellers (carp, tench, rudd (*Scardinius erythrophtalmus*), common bream (*Blicca bjoerkna*), white fish (*Coregonus sp*.) and grass carp (*Ctenopharyngodon idella*)) and species present in both habitats (perch, roach, belica (*Leucaspius delineatus*), pike, eel (*Anguilla anguilla*) and stone loach (*Barbatula barbatula*). Other prey such as amphibians were far less numerous and are not shown in this paper. The results from the spraint analysis are shown as relative frequencies of occurrence (R.F.O.). All the spraints collected at a certain case study pond or stream and in the same month form one monthly sample. The statistical analysis of the seasonal variability in the otter diet is based on 82 monthly samples.

Six fish ponds of different size and fish stocking levels and one three metre wide trout stream were surveyed in more detail for otter presence over one year, from summer 1995 to summer 1996. The aim of the, up to, daily controls was to find a representative sample of spraints and to estimate the presence of otters in terms of nights per month. Presence or absence of otters was checked by either otter tracks or spraints. Surveyed ponds were not situated within bigger pond systems and it was assumed that otters got all their daily food in the pond classified as used by otters due to the presence of fresh tracks and spraints. The amount of fish eaten by the otter in a certain pond was calculated by the multiplication of otter nights per month, daily food requirements of a medium sized otter and the proportion of a certain species in the diet of this month (KRUUK et al., 1993). Data on fish stocks were obtained from fish farmers. For statistical analysis a Kruskal Wallis H-test and a post-hoc test after Tukey and Kramer was used (SACHS, 1990).

RESULTS AND DISCUSSION

The analysis of 4,244 otter spraints showed a shift in the otter diet from pond to stream dwelling species in winter (Figure 1).

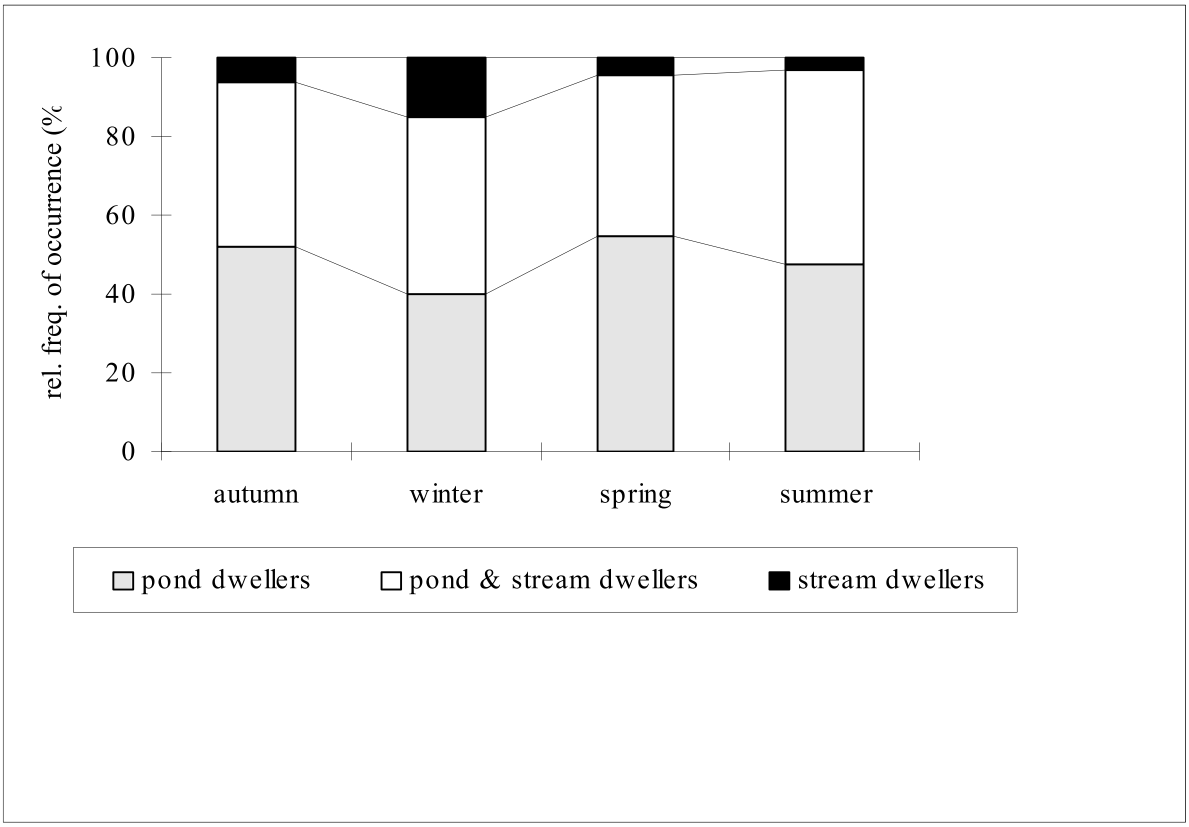

Figure 1. Seasonal variability of pond-, pond and stream- and stream dwelling species in the diet of otters (n=4.244 otter spraints)

These seasonal differences were significant between winter and spring, respectively summer (H-test, *P*<0.001 and a post-hoc test after Tukey and Kramer, *P*<0.01), but not between other seasons (Table 1).

Table 1. Net differences of mean ranks for the seasonal proportion of stream dwelling fish in the otter diet, a posteriori test after Tukey and Kramer (SACHS, 1990)

n=82, *P*<0.001		autumn	winter	spring	summer
	mean rank	41.67	57.85	33.03	30.45
autumn	41.67				
winter	57.85	16.18			
spring	33.03	8.64	24.82***		
summer	30.45	11.22	27.40***	2.58	

Kruskal Wallis H-test, n=82 monthly samples, *P*<0.001; ***.significant *P*<0.001.

The higher proportion of stream dwellers in autumn might be because in this season many ponds are drained for harvesting and otters are forced to forage more in streams, but the lack of significant differences from summer to winter and the high proportion of pond dwellers in the autumn otter diet indicates that pond draining is no real problem for otters. In two of the intensively studied ponds, those 0.1ha and stocked with carp, the proportion of stocked carp eaten by otters was calculated as 90% (Table 2). Due to technical features (small size, open inflow, holes cut in the ice for food supply), otters had access to these ponds even during very cold periods this, despite a thick ice layer. The same was true in the 1ha large trout ponds, where the otter took about 60% of the stock. In the two larger ponds, however, otters consumed only 4% of the carp (Table 2). At these ponds, the presence of otters decreased once they were covered with a thick layer of ice, from about four to one nights per week, as indicated by tracks and fresh spraints. The total amount of fish consumed per pond was not related to its size.

Table 2. Basic data from the six case study ponds surveyed in more detail from summer 1995 to summer 1996

pond and main fish species		size (ha)	stocking (kg/ha)	no. of surveys	no. of spraints	% of stocking eaten by otters
1	carp	0.1	1000	20	47	90
2	carp	0.1	1000	20	47	90
3	carp	7.2	600	110	536	4
4	carp	3.5	600	110	536	4
5	carp	0.5	400	40	57	10
6	trout	1	450	90	114	60

Comparisons are, however, difficult, because the small carp ponds were almost totally depleted by otters, probably they might have eaten more, if there had been more prey. In addition, the situation is further complicated because otters may live at a pond in severe winters, but leave no signs of their presence, such as tracks or spraints, because of resting under ground and hunting under the ice, as was found happen with several radio-tagged otters in this area (KRANZ et al., 2002). This may lead to underestimating the presence of otters as estimated by tracks in the snow and hence the overall amount of carp consumed at this time. The data collected so far seems to indicate that otters may be limited by the accessability of fish in this area. More information will be necessary concerning the otter in general, the behaviour of fish in the ponds and the abundance of fish in streams, in order to assess the role of food as a limiting resource for otters in this habitat.

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SURGICAL INTRAPERITONEAL IMPLANTATION – A PRACTICABLE METHOD TO FIT EURASIAN OTTERS WITH RADIOS TRANSMITTERS

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Abstract: From 1992-1997 laparotomies were performed on 13 Eurasian otters in order to implant radio transmitters into the intraperitoneal cavity through the linea alba. Ketamin-xylacin-halothane was used as anestetics and atropin was used to prevent complications which can occur when using xylacin. Handling of the otters and surgery are described in detail. Three pathological results of radio implanted otters dying 32 to 255 days after the operation did not show any macroscopic irritation due to the transmitter. However, the histological results gave concurring evidence of a chronical peritonitis because of the mechanical irritation of the implant. One otter died because of inproper wound healing, probably related to too high stress and a secondary infection.

INTRODUCTION

In continental Europe, otters (*Lutra lutra*) display a mainly nocturnal and elusive life style (KRANZ, 1995). Hence, many aspects of their ecology can only be studied by using radio telemetry. The way how a radio transmitter can be fixed on the otter is, however, still a matter of discussion (e.g. Workshop Neschwitz, Germany 1998), because the transmitter itself must not effect the behaviour patterns or even life span of the otter and it must not cause irritation or pain for the otter. In addition any kind of manipulation of wild otters such as catching and the immobilization can cause harm and stress, even with lethal consequences.

The aim of this paper is to describe the surgical procedure of intraperitoneal implantation in detail, to give some morphological and physiological data recorded and to discuss this method under special consideration of four post mortem examinations of radio implanted otters.

MATERIAL AND METHODS

ANIMALS

Within three projects, two field studies (Kranz, Dulfer) and one reintroduction programme (Toman) conducted in the Czech Republic, 14 otters were anaesthetized and in 13 transmitters were implanted; one otter was found to be lactating and was hence immediately released without a transmitter. All otters were transported in a dark box a few up to 100 km to the place where the operation was conducted.

TRANSMITTERS

Most transmitters were supplied from Telonix (Arizona , USA), nine of which weighted 30g (8cm long, diameter 2.1cm) and two of them weighted 102g (9.6cm x 3.4cm). Another two transmitters (34g; 8.5cm x 1.8cm) were from Wagener (Germany). In all of them, the transmitter, antenna and battery were encapsulated in physiological inert material.

IMMOBILIZATION AND ANAESTHETICS

First the animals were brought into a squeeze box (n = 11) or into a net (n =3) where they were weighted in order to calculate the quantities of anaesthetics needed. Then they were anaesthetized with a hand held syringe (a blend of Ketamin, Xylacin and Atropin) by a subcutaneous injection. A mixture of halotan and oxygen was used to maintain the anaesthesia if need during the surgery. In order to apply this, a face mask was used which was pulled almost all over the head.

SURGERY

The animals were placed in dorsal recumbancy. With a single exception, all otters were shaved in order to obtain sterility. Then the skin was desinfected and covered with a steril cloth. The abdominal cavity was opened with an incision along the linea alba 6cm caudal the navel. The transmitters were temperated to body temperature in an antiseptic solution of 1% benzalconiumchlorid half an hour prior to the operation; right before the implantation they were cleaned with a solution of NaCl to remove remnants of the disinfectant (ARNEMO, 1988). The transmitter was inserted in cranioventral direction into the cavity. The peritoneum and the linea alba were closed with a simple continuous suture using a needle-stitch combination of 2-0 Vicryl (Ethicon, Germany). The subcutaneous tissue was closed in the same way with a 3-0 Vicryl. The skin was closed with a continuos intracutan suture with 3-0 Vicryl and with three additional single button-knots (Einzelknopfhefte). A dressing spray (Leukospray, Beiersdorf AG) and a small glue dressing were finally applied. During the laparotomy rectal temperature, heart frequence and breath frequence were monitored.

POSTOPERATIVE PROCEDURES

The animals were brought in a lateral position, halothan was reduced to zero and the otters were supplied for another 5-8 minutes with O2. Meanwhile blood was taken from the jugular vein. Except the first two animals, no antibiotics were applied at all. Fish and water for drinking was given ad libidum. No pre release immobilization was conducted, because visual observations did not reveal any abnormities in the behaviour patterns of the otters.

POSTMORTEM EXAMINATIONS

Problems of wound healing were observed in one otter at the fourth day after the operation, when the animal was still in captivity. When the animal arrived at the clinic a part of the intestines had come out already. Three hours after an emergency operation the otter died. Own results as well as pathohistological ones from the Veterinary Pathological Institute in Jihlava, Czech Republic (MVDr. O. Vavra) are available. Another otter was shot 255 days after the implantation. Pathohistological results exist from the Institute of Pathology from the Veterinary University in Vienna (Prof. Dr. H. Burtscher). Another otter was found skinned floating in the river 32 days after the operation. This case is documented by autopsy findnings of the veterinary pathological institute in Jihlava (MVDr. O. Vavra) and a pathohistological result from the vet-pathologist Dr. D. v. Bomhard in Munich, Germany. Finally another otter was found 5.5 months after the operation killed by a trap. Again pathological and histological results were done by Vavra in Jihlava.

RESULTS

IMPLANTATION

The surgical implantation of the transmitter was done between one and 14 days after the capture. The average weight of the 9 females was 5,844g, of the 5 males 6,240g. The initial immobilization was achieved by on average 15.5mg ketamin / kg body mass (13.3 - 20.7) in combination with 1.7 mg xylacin/kg (1.3 - 2.3) and 0.05 mg atropin / kg (0 - 0.08). In 11 cases this immobilization was prolongated using halothan (0.2 - 1.2% flow 0.8 - 1.2 l). The otters were immobile 3 - 18 minutes (average 8 min) after the injection. The operation itself took 15 - 28 minutes (average 21 min), 28 minutes took the procedure for the individual which was not shaved which made suturing more difficult. The rectal temperature was found to be between 39.0 and 41.3 oC, the heart rate was highly variable between 68 and 144 / min (average 109) and also the breath rate (32 - 68 / min; average 45), however, there were no signs of complications due to the narcosis.

PATHOLOGICAL AND PATHOHISTOLOGICAL RESULTS

The otter, which died four days after the operation showed highly necrotic wound edges, there were no signs of an active opening by the otter itself. The actual reason of death was a general heart and lung failure. Blood of this animal, taken right after the implantation, showed very high values of creatinkinase (CK over 1,000 I.U./l.). An addition complication was a severe inflamation on the right hind extremity after injecting a radio-isotope there (applied by another veterinary after the implantation).

The otter, which was shot 255 days after the implantation with a 102 g transmitter had died from inner bleedings. Macroscopic, there were no visceral or parietal alterations visible on the omentum mayor or on the peritoneum. However, a histological investigation revealed signs of a chronical non-proliferative peritonitis on the large net and the peritoneum.

The otter, which was found without skin floating in the water, was already 11 - 12 days dead. The pathological results indicated a blunt trauma of the chest and the backbone with lethal consequences (probably caught in a trap). The histological results of Bomhard indicated again a (fibrotic?) peritonitis because of the transmitter (34 g) and micro parasites in the muscle (Sarcosporids).

Another otter was killed due to sharp and blunt traumas (trap) 5.5. months after implantation (transmitter: 102 g). Again, the histological results revealed a microscopic peritonitis due to mechanical irritations of the transmitter.

DISCUSSION

Immobilization and Anesthesia

The use of ketamin and xylazin is generally used for immobilizing otters (e.g. MELQUIST and HORNOCKER, 1979 a,b; ARNEMO, 1988). The additional use of atropin as an anticholinergicum reduces bronchospasmen and prevents myokardiale disturbances and heart-arhythms as they can come to being when using xylazin (PADDLEFORT and ERHART, 1992). It would be even better to apply the atropin 20 min before the ketamin-xylazin mixture, but this would ask for a second catching with additional stress. The generally low dose of ketamin and xylacin and the prolongation of the anesthesia with halothan worked very well and made any use of an anti-anastheticum needless. The increased body temperature did not cause any problems, it was never a maligne hyperthermie, because a sudden increase of heart rate, also REUTHER, 1983, REUTHER et al., 1984, WILLIAMS et al., 1981).

OPERATION AND POSTOPERATIVE ACTIVITIES

With a single exception, all otters were shaved approximately 5 X 12 cm to reach a permanent asepsis during the surgery (NIEMAND and SUTER, 1994). The otter, which was not shaved, did not get an inflammation and did not show any problems with the wound healing either, but it complicated sewing considerably which caused also a longer operation time. Problems with thermoregulation due to shaving were not recorded as mentioned by ARNEMO (1991) as a possible complication; however, none of the animals were released in winter when temperature will be more critical. All sutures were permanent which in general is considered to speed up wound healing. The intrakutan suture was conducted to reduce possibilities of opening the wound by biting. Blood samples were taken from the jugular vein to identify basic parameters of the *Lutra lutra* blood as well as possible signs for stress (KÖNIG and KÖNIG, 1998). All sutures were from resorbable material, which made a second immobilization for removing them unnecessary. Due to very sterile conditions during the surgery an antibiotic prophylaxe was not necessary.

PATHOLOGICAL AND PATHOHISTOLOGICAL RESULTS

The otter, which died four days after the implantation is another example of complications with wound healing (ARNEMO, 1991, ELMORE et al. 1985, WOOL et al., 1984). The very high CK values, recorded after the operation, indicated extraordinary high stress. This animal was operated on the second day after capture and it might well be that the high stress level during the operation originated from the capture. A prolonged captivity of at least four days before the surgery might prevent such complications. However, a suture break in the linea alba will always cause a protrusion of the intestines with lethal consequences. Therefore the alternative implantation in large bones as successfully applied with transponders in parrots (KUMMERFELD, 1998) is tested in dead bones (KÖNIG et al., 1998).

The results of three pathohistological examinations gave concurring evidence of a chronical peritonitis due to the implanted transmitter. This was only revealed by the histological analysis and was not reported before by other authors. The macroscopic evaluation of these three otters as well as of otters in several other studies did not reveal any reaction towards the transmitter. However, the low degree of the chronical peritonitis even after eight months of surgery indicates that these implants are well tolerated by the otter as it was also stated by MELQUIST and HORNOCKER (1979), REID et al. (1986) and ARNEMO (1991).

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FISH PONDS IN CENTRAL EUROPE - A RICH BUT RISKY HABITAT FOR OTTERS

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Abstract: Fish pond areas in Central Europe support thriving otter populations. Such a habitat, its otter relevant parameters and its utilisation are described for the Czech Moravian Highlands with its numerous carp ponds. Preliminary data on mortality factors of otters are presented. It seems that not pollution, a lack of suitable habitats or few prey, but illegal persecution may be at present the main threat for otters.

INTRODUCTION

In Central and Eastern Europe carp (*Cyprinus carpio*) are farmed in artificial ponds for human consumption. Due to their age, size and bank side vegetation, many of these ponds look rather like natural lakes. This and the fact that these ponds are stocked with a high density of fish makes them extraordinary attractive to otters (*Lutra lutra*). This contribution describes carp ponds as otter habitat, gives examples how otters make use of it and discusses mortality factors of otters in an area with plenty of such ponds.

The Habitat

The pond size, their distribution and number may differ considerably even in an area of 50 to 50 square kilometres as it can be demonstrated by three neighbouring 100 km^2 sample areas. One of these areas is located in the highlands around the town Litschau (520 - 650 m a.s.l.) in Lower Austria. There are many ponds (187), but they are small (on average 0.7 ha). Just 15 km north-east, in the Czech Moravian Highlands (500 - 650 m a.s.l.), there are fewer ponds but they are larger (96 ponds within 100 km^2 and an average size of 1.3 ha). In the Trebon Bioshphere Reserve (420 - 440 m a.s.l.), 15 km west of Litschau, ponds are considerably larger than those in the neighbouring highlands; 104 ponds were counted in 100 km^2 with an average size of 11 ha. These very basic factors alone may have a considerable influence on otter numbers. Other factors such as bankside vegetation, stocking levels and harvesting regimes are also variable and might be important as well. Austrian ponds, for instance, have a more strictly managed bankside vegetation. There, grassland, which is cut twice a year, frequently goes right to the edge of the ponds. However, no investigations have been conducted so far to quantify such differences except some data on resting sites of two radio-tagged otters (KRANZ, 1995).

The following pond description originates from the Czech Moravian Highlands. The fish farmers and pond owners provided information on species composition and stocking levels of each pond.

In the 100 km^2 sample area, 74% of the total pond area was identified as fish farms. These ponds are drained usually once per year, mostly in autumn and a few in spring for harvesting and manipulation of the fish. They are stocked mainly with carp (92% in terms of numbers). The average stocking density in spring is 680 kg/ha, in autumn 1.200 kg/ha. Tench (*Tinca tinca*), whitefish (*Coregonus* sp.), pike (*Esox lucius*) and zander (*Stizostedion lucioperca*) are sometimes stocked as well. In some ponds roach (*Rutilus rutilus*), perch (*Perca fluviatilis*) and other fish are also present. They are either considered as pest species, because they compete with the carp for food or they are welcome as prey for pike and zander.

The other main type of ponds is for angling (24% of the total pond area). They are also stocked regularly but are not or very seldom drained (every five to ten years). The species of human interest are again carp, pike and zander. These ponds show a much higher amount of other fish than in the fish farms. However, exact stocking levels are not know, they are estimated to be between 300 - 500 kg/ha. Finally, about 2% of the pond area is recently abandoned, they are inhabited by some fish.

Abundance of Fish

In the 100 km^2 sample area of the Czech Moravian Highlands all ponds are stocked in summer whereas in winter 23% of the number of ponds are not stocked. This is, however, only 7% of the pond area. Hence, mainly small ponds are empty in winter, they are also less suitable to overwinter carp. The total biomass of fish in fish farms in winter is about 94% of the biomass at the beginning of the summer. As the summer proceeds, this difference gets larger, because the fish are growing.

Availability of Fish

There may be considerable differences in the availability of fish due to the size of ponds (not because of the depth which hardly exceeds 2 m), as well as the age class of carp stocked. However, the most obvious factor influencing the availability of fish is the ice cover in winter. This can be highly variable in its duration. In the winter 1995/1996 it was extraordinary long with 16 weeks of permanent ice cover, in the next year it was 6 weeks and in 1997/1998 it was only 2 weeks.

Fish Consumption in Ponds

In contrast to larger ponds (> 1 ha), small ones can be totally depleted by otters (KNOLLSEISEN and KRANZ, 2002), which suggest an important difference, perhaps in some availability mechanism, perhaps in otter territoriality or something else. In larger ponds the direct losses due to the predation are marginal. Two neighbouring ponds, the Maly and Velky Hvozdec near Cesky Rudolec, 3.5 ha and 7.2 ha in size, were selected to estimate the presence of otters and also their total consumption of fish during 1.5 years. The amount of fish eaten was calculated by the multiplication of otter nights per month, daily food requirements of a medium sized otter and the proportion of a certain species in the diet of this month (KRUUK et al., 1993). Both ponds together were stocked with 7,000 carp (K2), 2,000 zander, roach and able (*Leucaspius delineatus*) as prey for the zander. The ponds were checked at least twice per week for estimating the presence of otters and for collecting 536 spraints. Otters were found to be present at the ponds slightly more than every second night and they consumed 250 kg carp plus 77 kg of other cyprinids from these two ponds in 1.5 years, which is less than 4% of the stock at the end of the observation period.

The Significance of Fish in Streams

A three meter wide trout stream, the Bolikovsky Potok downstream of the village Cesky Rudolec, was searched over a length of 2 km for otter spraints from winter 1995/96 until spring 1997. The sample stretch started at the outflow of an angling pond, and several ponds for carp production were located along feeder creeks nearby, the nearest one just 100 m from the stream. A total of 654 spraints were found along this trout stream and their analysis showed a dominance of pond dwelling fish in the diet (*Cyprinus carpio, Tinca tinca, Scardinius erythrophtalmus, Blicca bjoerkna, Coregonus* sp. and *Ctenopharyngodon idella*) during almost all seasons (Fig. 1). In winter, fish species such as *Salmo trutta* f. fario, *Leuciscus cephalus, Gobio gobio* and *Cottus gobio*, which live only in the stream, were more frequently found in the spraints than in other seasons (see also KNOLLSEISEN and KRANZ, 2002). Some fish species (*Perca fluviatilis, Rutilus rutilus, Leucaspius delineatus, Anguilla anguilla* and *Noemacheilus barbatulus*), which may inhabit pond and stream habitat, were sometimes also frequent. In this case, they might have come mainly from the angling pond, located at the upper end of the stretch. The generally low occurrence of fish from streams in the spraints might reflect the low abundance of fish in the stream. In winter streams might be more important for foraging, because ice restricts the access to the water more at ponds than at streams. However, this might be also because of the probability to find spraints in such severe frost periods, when otters reduce their activity and movements (see below).

Otter Density

Within the Czech Moravian Highlands sample area, snow surveys were conducted in order to identify the number of otters living here. This was done by up to six experienced people, walking along all streams and ponds right after a new snow from the last day (only tracks of one night could be found). Only those surveys were considered for estimating otter numbers, which were conducted in not too cold periods, when otters still had access to the water (see below). Under such conditions, one otter (juveniles included) was found per 4 - 5 ponds. The largest survey covered 55 km^2 with 56 ponds and showed 14 otters, nine (sub-)adults plus five juveniles, identified as walking in family groups.

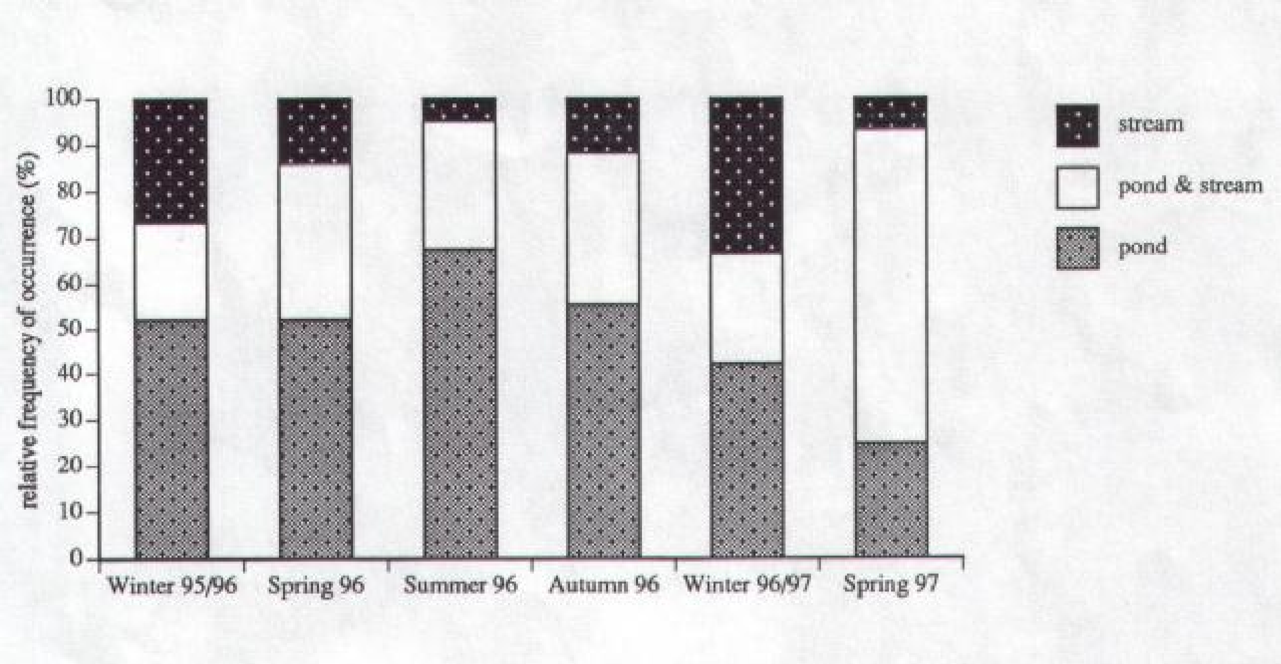

Figure 1. The seasonal occurrence of fish in 654 otter spraints found along a 3 m wide trout stream shows an all year dominance of pond dwelling fish in the diet of otters. The fish were scored into species living only in ponds, in ponds and streams and only in streams.

Movements of Otters During Severe Frost

When the temperature drops below 10 degrees Celsius, otters tend to reduce all activities except foraging. Once they have found a favourable place with food they stay there for several days or even weeks. In such periods ponds are covered with a thick layer of ice, usually with no air layer between water and ice, and otters frequently enter the pond by an underwater entrance of an underground den. As a result, no tracks, spraints and food remains can be found on the surface. In winter 1996/97 three radio-tagged otters were tracked in such conditions. These periods of invisible life style (n=6) lasted between 3 and 15 days, mostly 6 days.

Resting Sites

Radio-tagged otters showed a distinct pattern of sleeping above (couches) and below ground (holts) as demonstrated with one female, which was followed intensively over 13 months (Fig. 2). In summer and autumn the otter was almost always found sleeping above ground mainly in non-managed grassland, reed (*Phragmites communis*) fields and overgrown zones in ponds. In late November she switched to underground dens and used them also throughout the winter. In spring she did not return to couches. Even in May, she was still found more often under than above ground. Finally, in July, when grass and shrubs were high and dense again, she returned to using couches and this continued until the end of August, when the radio contact with the animal was lost. Hence it was probably not the temperature, but the loss of sufficient cover, caused by frost and snow, which was responsible for these patterns. As the female used only a few underground dens, this had also an influence on the daily movement patterns. When she was using couches, the average distance travelled per night was five kilometres (n=35 nights permanent radio tracking), whereas when she used holts she travelled on average more than 8 km per night (n=12). Two very cold periods were excluded from this analysis, when the otter used holts and did not move to another pond at all (see above).

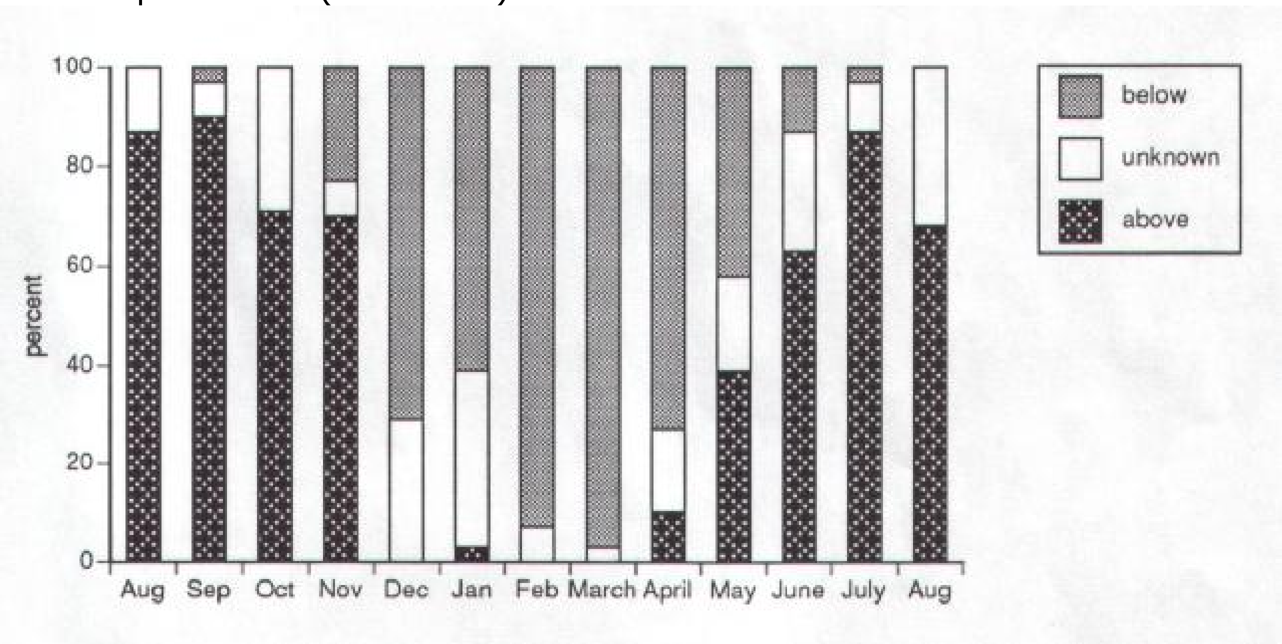

Figure 2. The location of day resting sites of an adult female otter, scored into above and below ground and unknown might be influenced by climatic aspects such as air temperature as well as cover (annual vegetation).

Other Mortality Factors

Any assessment of natural predation, road kills and illegal persecution as mortality factors is entangled by methodological problems. Records of natural predation will be always under represented whereas those of road kills are far more obvious. Poachers usually don't publish catching and shooting statistics.

The fate of radio-tagged otters may, however, give some insight into the relative importance of road kills, poaching and other casualties. In the fish pond area of the southern Czech Republic, 8 otters were radio tracked since 1992 (KRANZ, 1995 and unpublished; DULFER et al., 1998). None of them were killed on the road, but three of them were killed by poachers, one was shot and two were caught in traps.

Pollution, which causes shortage of fish, will of course have a negative effect on otter numbers, but this is not a main point of concern in the fish pond area with its high abundance of fish. Other contaminants effecting directly the life expectancy or reproduction of otters might have an effect on the population performance in the fish pond area as well. However, as otters are synchronised increasing throughout Europe in the last decade such a factor, whatever it was (MASON, 1997; KRUUK, 1997), has probably lost its power.

Concluding Remarks

The role of different mortality factors for otters inhabiting the Czech Moravian Highlands with its plenty of fish farms is far from being understood.

Nevertheless a rough evaluation of such factors, even if based more on gut feelings than precise data, might be useful as a comment for further investigations concerning otter conservation in this area (Table 1).

Table 1. Mortality factors of otters in the Czech Moravian Highlands, scored from unimportant (0) to very important (5)

	at present (in the 1990ies)					
	unimportant					important
MORTALITY FACTORS	0	1	2	3	4	5
Poor Food Availability			?	?		
Lack of Resting Sites		X				
Poor Cover		X				
Road Kills		X				
Natural Predation	X					
Persecution					X	
Pollution		X				

Habitat loss and a decrease in habitat quality are usually considered as a main factor limiting otters. As far as resting sites and cover are concerned, they seem to be rather unimportant factors at present in this area. Even the availability of fish does not seem to be limiting otter numbers, but more information regarding fish populations and behaviour will be needed to settle this point with more accuracy.

Predators seem negligible and also road kills appear to have no severe effect on the population level. In the recent past, only 87 otters were found killed on the road during 8 years throughout the Czech Republic (TOMAN, 1997). Considering the present increase of otters here as well as elsewhere in Europe, contaminants are also not likely to cause a high otter mortality here. Illegal persecution, however, seems to be a major problem, at least in the Czech Republic and conservation efforts should pay particular attention to this.

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LEGAL ASPECTS OF OTTER CONSERVATION IN THE CZECH REPUBLIC[1]

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Abstract: The otter is classified in the Czech Republic as a severely endangered species. Whilst alive the otter is protected under Czech Nature Law (the Law for conservation of nature and landscape). Unfortunatly, dead otters and parts of their body are not under legal protection and the present hunting law still mentions the otter on the list of huntable game species.
The Czech Republic became a contracting party to CITES in 1993, as a successional state of Czechoslovakia, and signed the Bern Convention in 1997. However, the Bern convention will not be valid in the Czech Republic before June 1998 and, therefore, dead otters are presently protected only under CITES.
As a means of partly addressing the problems, the conservation authorities recently participated in the preparation of a new law concerning responsibility for some protected species. This includes a new method for partial compensation of losses caused by the otter and the addition of the otter to the list of species protected when dead. However, this law is still being discussed in the Ministry of Environment of the Czech Republic.

INTRODUCTION

The escalating discussion on the problems between otter conservation and fish farming is an example of the conflict that can arise between nature protection and economic interests. Hopefully, a recently passed law, aimed at protecting populations of endangered species, will ease the tension between the conflicting interests of fishermen, hunters, and conservationists in the Czech Republic.

Present national legislation

The otter is classified in the Czech Republic as a severely endangered species; therefore, whilst alive it is protected under Czech Nature Law (the Law for conservation of nature and landscape no. 114/1992 and no. 395/1992). Endangered species are protected in all stages of their development, as are their habitats. It is prohibited to disturb the animals' development, especially through catching, keeping in captivity, injuring or killing. According to this law, species that are protected when dead will be stipulated by a special decree of the Ministry of Environment. Unfortunately, as a result of the incompleteness of Czech Nature Law, the decree has not been provided for the otter to date, which means that dead otters and parts of their bodies are not covered under national legal protection. Other factors complicating otter research and conservation arise from the present hunting law, which mentions the otter on the list of game with a whole year open season. Not only does this mean that the otter can be hunted with the permission of the Ministry of Environment (not granted to date), but the ownership of dead otters falls to the local hunting association.

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[1] Note: This text was updated from the original and now presents the situation as of 2001.

International legislation and conventions

The Czech Republic became a contracting party to the Convention on the International Trade in Endangered Species of Wild Fauna and Flora (CITES) in 1993, as a successional state of Czechoslovakia, and signed the Convention on the Conservation of European Wildlife and Natural Habitats (Bern Convention) in 1997. The Bern convention states that the otter is a protected species under Appendix II and prohibits the possession and internal trade in these animals, dead or alive. Though the Bern convention has been valid in the Czech Republic since 1998, dead otters are still presently protected only under CITES, which only prohibits cross-border trade. The internal trade and keeping of dead otters and parts of their bodies is not legally covered.

A new law on damage compensation

In the late 1990s, a means of partly addressing these problems, conservation authorities and other organisations participated on the preparation of a new law concerning responsibility for some protected species. This included a new method for partial compensation of economic losses caused by the otter and the addition of the otter to the list of species protected when dead. It also defined the responsibility of the State for damages caused by some protected species; with the otter included on the list. However, though the law has now been valid since April 2000, it still does not include any list of species protected when dead and, therefore, dead otters remain the property of the hunters. Further, the law did not include a recommended methodology for calculating losses, this being left up to individual 'experts', though this term is also not defined.

Following a report from the Czech Otter Foundation Fund (KUCEROVA et al., 2000), three methodologies have now been accepted as 'recommended'; one simplified calculation for smaller fishponds, one for larger fisheries, and one detailed methodology requiring more intensive monitoring of the site.

Recommended methods for calculating damage

SIMPLIFIED METHOD

This calculation is based on fish stock, size of pond, and the level of otter activity:

$$C = p \times 0.5\ \text{kg} \times d \times s$$

C - estimated compensation in Czech Crowns (CZK)
p - price of fish stock per kg
d - number of days (coefficient of activity)
s - coefficient for size of pond

Estimated loss (C) does not take into account secondary damage (i.e. mortality caused by factors other than direct predation), as it is very difficult to prove the actual cause (e.g. disturbance, weather, bad management, poaching, etc.). The average price of the most abundant commercial species (p) is multiplied by 0.5 kg - assuming the average otter diet is 1 - 1.5 kg a day and 30 - 50 % consists of commercial species (KUCEROVA, 1998; ROCHE, 1998). The number of days depends on the level of otter activity. Three classes of activity are recommended: 300 days - full time present, 100 - present through 2 seasons, and 30 - present only in 1 season. The fishponds are put in four size categories with different coefficients:

< 1 ha	s = 1
1 - 5 ha	s = 0.7
6 - 15 ha	s = 0.5
> 15 ha	s = 0.2

When more than 1 adult animal or cubs are present, the loss is multiplied by the number of individuals (for a cub - x 0.5).

For larger fisheries

This method can be used, for example, if there is one company owning a large number of ponds concentrated in one area and the approximate number of adult and permanently resident otters is known.

C = p x 0.5 kg x 365 days x Number of otters

C - estimated compensation in Czech Crowns (CZK)
p - price of fish stock per kg

DETAILED ASSESSMENT

This method is very expensive in terms of time and manpower, as it requires intensive monitoring of water quality, intensity and frequency of otter predation, presence of other predators, climatic factors, etc. The assessment will be based on the final fish harvest, but will take into account the factors previously mentioned, as well as published coefficients for natural mortality and average growth rate for the fish. This is similar to the method presently used in Austria (BODNER, pers. comm).

DISCUSSION AND CONCLUSIONS

There are two main conservation problems arising from the present legal situation in the Czech Republic. Firstly, it is almost impossible to prove the illegal possession of dead otters through poaching. The people in question claim that, once a carcass is ‘found’, under Czech hunting law it is then legal to own that carcass. A list of species protected both when alive or dead is still required for the future control and punishment of illegal hunting. Validity of the Bern Convention has, as yet, not helped solve some of the problems mentioned above, particularly regarding the possession and internal trade in wild animals and wild animal products, as the Convention has no legal backing within national legislation.

Secondly, though the responsibility for damage caused by the otter is now defined; and there is a standard methodology recommended for the assessment of economic damage to fish stocks, the distribution of information regarding both the law and the methods to be used is less than satisfactory.

After more than one year in operation, many fishermen, the public, and the media remain uninformed. It is clear that, if this is not also to become a source of conflict, that greater efforts must be made by the Government and the Nature Conservation Authorities to spread detailed information on this new law more widely. To assess the scope of this problem, the Czech Otter Foundation Fund has agreed to become a central collection point for data on claims made so far. Data will be analysed for trends and a report will be provided to the Government, including recommendations for improvements in the implementation of the law.

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INFLUENCE OF HABITAT QUALITY FACTORS ON OTTER (*Lutra lutra* L.) DISTRIBUTION IN BRITTANY, NW FRANCE A STATISTICAL APPROACH FOR ASSESSING RECOLONIZATION PROBABILITIES

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Abstract: Brittany, NW France (28,077 km^2) is a region showing strong disparities in otter distribution, and also in hydrogeographical factors and land use. So this situation offered a good opportunity to compare these different criteria with otter distribution as indicated by occurrence levels, through a multifactorial analysis on the scale of water catchment subunits (n=295). Of 18 factors tested, 13 appeared to be statistically correlated with otter distribution ($P<0.05$), along two poles joining respectively hydrological and man-caused factors. In particular five factors link these two poles: hinterland physiognomy, rate of drained/irrigated land, general watercourse quality, overall nitrogen excess and overall fish biomass. For each factor the thresholds have been estimated beyond which otters are, respectively, mainly absent, or resident/widespread. Perspectives for understanding the role of antagonist factors in otter distribution on a large enough scale, and predicting short-term recolonisation movements are discussed.

INTRODUCTION

For the last two decades, several studies have examined the relative influence of different habitat quality factors on otter occurrence, but often on a restricted scale (sites, according to "standard" methods for otter surveys; e.g. MADSEN (1996), (PRENDA and GRANADO-LORENCIO, 1996), despite the fact that otter (*Lutra lutra*) ranges are considerably larger. PRAUSER and RÖCHERT (1991) have underlined the need to examine various parameters on different scales (region, water system, site) and recently, concerning the effects of PCBs on otter, KRUUK (1997) has pointed out the importance in differenciating individuals and populations.

STUDY AREA

Brittany, NW France (28,077 km^2, 47°13'-48°50' N, 1°-5°10' W; Fig. 1) is a region showing strong disparities in otter distribution (Fig. 2), and also in hydrogeographical factors and land use, especially in agriculture. For instance, this is one of the first European regions for pig production (in the early 90s, with more than 6.1 million pigs being produced a year, this compares with three million people inhabiting the region). This farming has a well known impact on water quality degradation. In this paper, all data (otter occurrence, environmental factors) are formatted on a large scale: the subunits of water catchments (n=295, mean surface area: 95.2 km^2, namely equivalent to 10x10 km UTM squares), regularly used by the water autorithies.

Figure 1. Study area

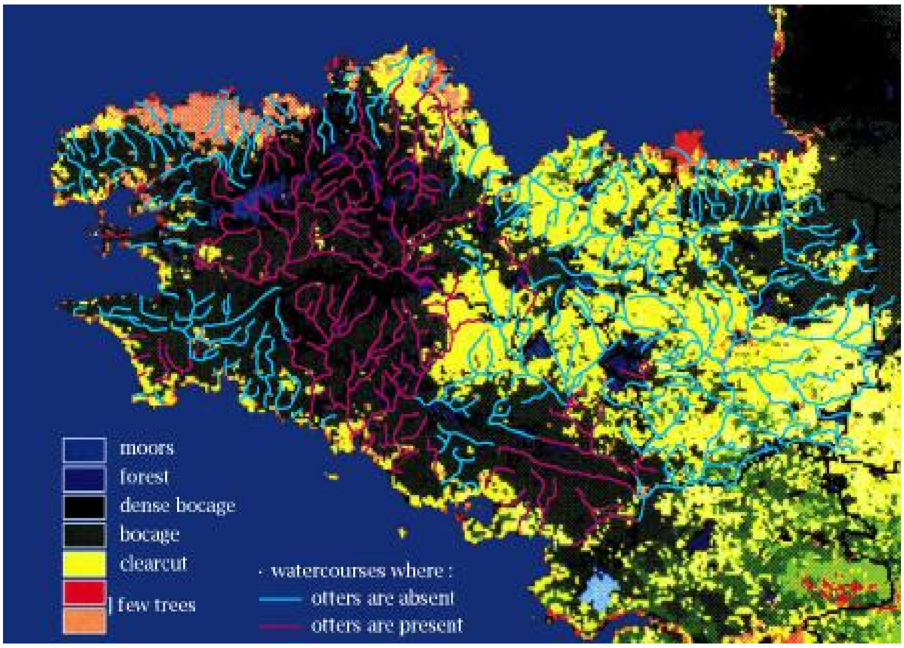

Figure 2. The rural landscape typology (hinterland physiognomy factor) shows in Brittany strong disparities, particularly between the western and eastern halfs, such as other related factors (Map from NOAA satellite pictures, processed by V. Dubreuil / Costel Team, University of Rennes 2, France). The superimposition of watersheds (and here associated watercourses) used or not by otters shows the highest correlation concerning otter distribution vs all tested factors (c^2 = 97.37, *P*<0.001; see below).

MATERIAL AND METHODS

Regular otter surveys have been carried out, following the standard field recommendations (at each site, 600m of waterway searched for signs of otters), and at least 3 sites/100 km^2 surveyed. All data (corresponding here to the early 90s) are displayed by subunits of water catchments, and by occurrence levels as follows: otter absent (no signs), non-resident or confined to less than 50% of the subunit, and resident/widespread (LAFONTAINE, 1993).

All raw data concerning factors, which are thought to influence otter distribution have been collected and initially formatted on the basic scale of water catchments subunits. These raw data have been removed either from administrative reports and charts (rainfall: MÉTÉO-FRANCE; low run-off: VILLEY et al., 1993; general watercourse quality: AGENCE DE L'EAU LOIRE-BRETAGNE, 1989; human population density: INSEE, 1990; hinterland physiognomy: DUBREUIL, 1995; agricultural data: DRAF-BRETAGNE, 1990). Or when unpublished, the data have been provided by administrative authorities (hydrographic network length: 'Course' GIS hydrological data, LEPETIT et al. /DDAFs; fish data: Chapon and Porcher /CSP; overall nitrogen excess: AUROUSSEAU and BAQUÉ/LSSSN-ENSAR). Fish data have been collected throughout the region by electrofishing (43 fish species, 545 specimens from 1978 to 1990) and then processed by size biomass and density (following the Carle and Strub Method). Unfortunately some data, either unavailable or quantitatively insufficient on the regional scale (use of pesticides, fish contamination etc.), could not be tested.

For each factor, each subunit is characterized by qualitative levels (otter distribution, three levels, see above; general watercourse quality & hinterland physiognomy, five levels) or arithmetic means (all other factors characterized by numerical data).

The data were then statistically processed in a multifactorial analysis. The degree of closeness between each factor *vs* another is assessed by the χ^{2}-test for qualitative factors (nonparametric test), and the analysis of variance F test for quantitative ones (parametric test). Statistical tables give the respective significance levels (error threshold: *P*), according to the values of F and χ^2 and the sample size (degrees of freedom). The lower the value of *P*, the higher the significance and it is usually admitted that the test is significant when the error threshold (*P*) is lower than 5% (SIEGEL, 1956; WONNACOT and WONNACOT, 1991).

RESULTS

The results show that in the early 90s, otters were absent (no signs) in 205 subunits (18,305 km^2, 65.2%); non-resident or confined in 41 subunits (4,391 km^2, 15.6%); and resident/widespread on 49 subunits (5,381 km^2, 19.2%). Total used subunits: n=90, 9,772 km^2, that is to say 34.8% of the total surface of the region. Of the 18 factors tested, 13 appear to be statistically correlated with otter distribution ($P<0.05$), as shown by the contingency table (Table 1), and pointing out thresholds beyond which otters are respectively mainly absent, or resident/widespread (Table 2). The contingency table underlines two poles gathering respectively hydrological and man-caused factors. Five induced factors in particular link up these two poles: overall fish biomass, rate of drained/irrigated land, hinterland physiognomy, overall nitrogen excess and general watercourse quality (Fig. 3). For each subunit, the combination of each of the 13 factors gives an overall quality index map (5 levels, from unfavourable to favourable criteria, Fig. 4), showing otter populations are absent on subunits with the lowest quality index (level 1), and mainly resident/widespread on the most favourable one (level 5).

DISCUSSION

The combination of several unrelated factors appears to be determinant for otter distribution, via the particular link of the induced factors, among which three show favouring effects: overall fish biomass, hinterland physiognomy and general watercourse quality (and all hydrological factors), whereas the two others show limiting effects: rate of drained/irrigated land and overall nitrogen excess (and man-caused factors). These results suggest the role of several antagonistic factors in otter distribution on a large enough scale, and in particular the positive effects of factors favouring subunits where man-caused effects are very prominent. It suggests also that one single factor, such as food availability, depends on other factors, positive or negative, and that otter distribution is linked to the combination of themall. Of course several data expected to show an impact on otter populations have not been processed here, such as use of pesticides and fish contamination, because such data were unavailable on a large scale.

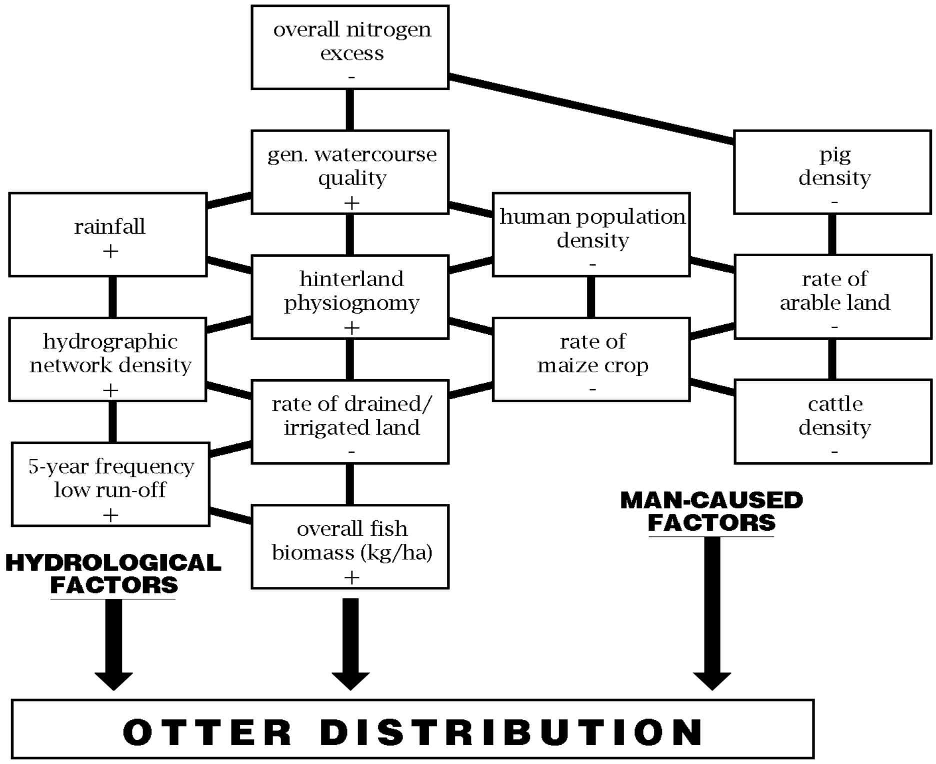

Figure 3. Strongest correlations and relative architecture between the 13 factors related to otter distribution; the second left column displays the 5 induced factors linking up hydrological and man-caused poles (+ : favourable factors; - : limiting factors).

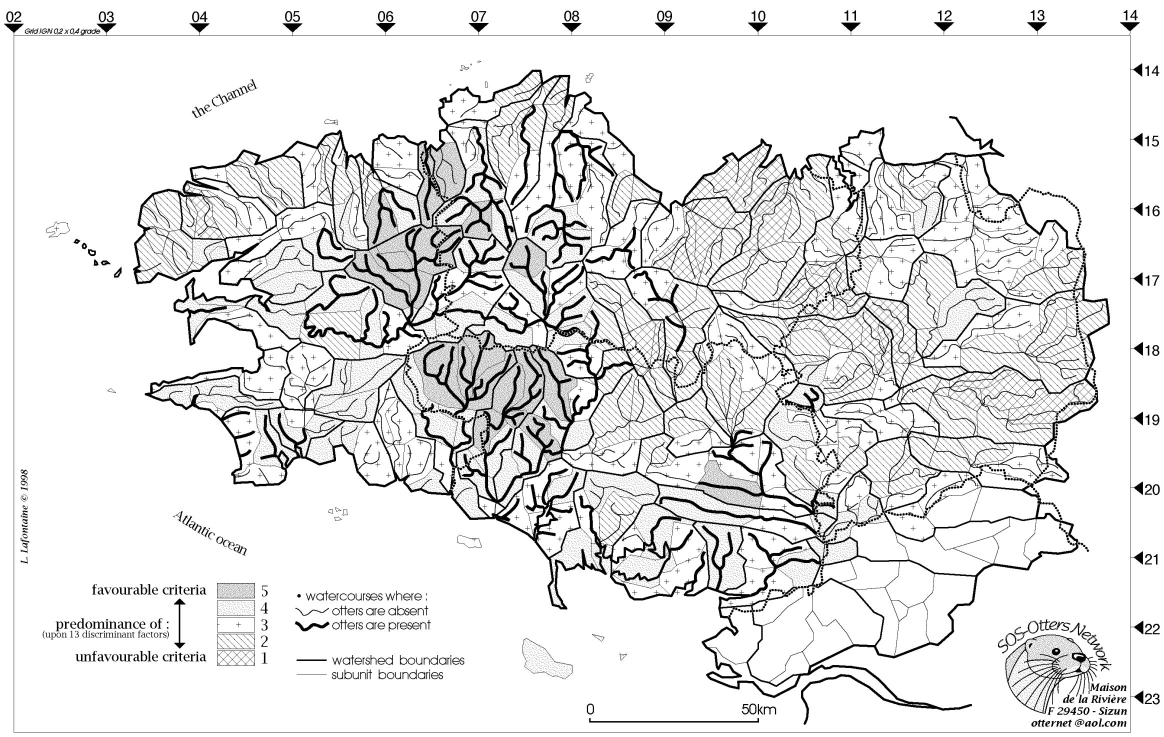

Figure 4. Overall quality index map, showing the combination of 13 factors related to otter distribution (see text). The quality index is distributed from the level 1 (lowest quality) to the level 5 (highest quality). Level 3 is intermediate.

Table 1. Respective values of F and c^2 and significance levels between each of the 13 factors related to otter distribution, on the scale of water catchments subunits (n=295)

66.76 •••	16.68 •	25.99 ••	17.91 •	87.77 •••	97.37 •••	31.16 •••	35.65 •••	40.08 •••	16.81 •	27.32 •••	35.01 •••	38.19 •••	otter distribution [OTD*]
[RFL]	[HND]	[LRO]	[OFB]	[DIL]	[HLP*]	[ONE]	[GWQ*]	[RMC]	[CAD]	[PID]	[ARL]	[HPD]	human population density [HPD]
Â	27.86 •••	44.39 •••	12.59 •••	36.24 •••	126.57 •••	11.88 •••	52.11 •••	0.49 ΔΔΔ	1.82 ΔΔ	0.86 ΔΔΔ	0.43 ΔΔΔ	3.21 Δ	rainfall [RFL]
	Â	7.34 ••	5.68 •	29.62 •••	39.41 •••	0.04 ΔΔΔ	17.97 ΔΔΔ	15.18 •••	6.89 ••	8.33 ••	4.76 •	1.24 ΔΔΔ	hydrographic network density [HND]
		Â	18.99 •••	8.38 ••	49.15 •••	13.00 •••	34.90 ••	10.71 ••	0.04 ΔΔΔ	3.12 Δ	0.09 ΔΔΔ	1.47 ΔΔ	5-year frequency low run-off [LRO]
			Â	14.59 •••	36.54 ••	0.07 ΔΔΔ	16.67 ΔΔ	4.23 •	7.90 ••	0.63 ΔΔΔ	8.30 ••	0.26 ΔΔΔ	overall fish biomass [OFB]
				Â	110.34 •••	14.93 •••	23.55 Δ	44.59 •••	92.16 •••	6.75 •	57.97 •••	0.36 ΔΔΔ	rate of drained/irrigated land [DIL]
					Â	21.21 ΔΔ	67.55 •••	135.18 •••	26.62 •	39.25 ••	70.47 •••	60.86 •••	hinterland physiognomy [HLP*]
						Â	24.10 Δ	0.07 ΔΔΔ	0.22 ΔΔΔ	305.94 •••	10.62 ••	2.88 Δ	overall nitrogen excess [ONE]
							Â	26.93 •	42.35 •••	28.72 •	33.21 ••	42.20 •••	general watercourse quality [GWQ*]
								Â	386.25 •••	47.61 •••	151.75 •••	14.23 •••	rate of maize crop [RMC]
									Â	38.24 •••	179.12 •••	55.35 •••	cattle density [CAD]
										Â	103.46 •••	5.04 •	pig density [PID]
											Â	39.55 •••	rate of arable land [ARL]

••• highly significant ($P<0.001$); •• very significant ($0.001 \leq P < 0.01$); • significant ($0.01 \leq P < 0.05$); Δ unsignificant ($0.05 \leq p < 0.10$); ΔΔ very unsignificant ($0.10 \leq P < 0.25$); ΔΔΔ : highly unsignificant ($P \geq 0.25$). (*) factors for which c^2 test has been used.

Table 1. Thresholds for each of the 13 factors, beyond which otters were mainly absent or resident/widespread in Brittany, on the scale of water catchment subunits.

thresholds beyond which otters are mainly :	absent	resident /widespread
1 : rainfall ($mm.year^{-1}$)	<700	>900
2 : hydrographic network density ($km.km^{-2}$)	<0.9	>1,3
3 : five-year frequency low run-off ($l.sec^{-1}.km^{-2}$)	<0.2	>0.8
4 : general watercourse quality	middling	good
5 : overall fish biomass ($kg.ha^{-1}$)	<120	>240
6 : human population density ($.km^{-2}$)	>80	<50
7 : rate of arable land	>64%	<56%
8 : rate of maize crop	>20%	<12%
9 : rate of drained/irrigated land	>8%	<2%
10 : cattle density ($.100ha^{-1}$)	>130	<80
11 : pig density ($.100ha^{-1}$)	>400	<100
12 : overall nitrogen excess ($kg.ha^{-1}$)	>170	<90
13 : hinterland physiognomy	clearcut	bocage

On the other hand, it allows us to predict short-term recolonization movements of otters: e.g. the one and only subunit with the best index unused by otters in the early 90's has been recently recolonized in 1996, and this situation can be expected on 19 subunits at least, mainly from the western half of the region. Adversely, according to this preliminary model, the recolonisation probabilities on the eastern part appear to imply the limitation of some unfavouring factors, because positive ones are generally less favourable. It is needed now to improve this model by adding more raw data, to update this situation from early 90s with regular evolutions of each factor, and to compare with other regions and countries, with a similar methodology.

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INVESTIGATION OF THE FISH DIET OF OTTERS (*Lutra lutra*) FROM AN ECONOMIC ASPECT AT A FISH POND IN HUNGARY

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Abstract: The composition of otters' diet was determined by spraint (faeces) analysis, with 1,942 spraints were collected and analysed over a period of six years. The fish pond habitat studied was located in south-western Hungary. In the first two years, the fish pond had a surface area of 12ha, in the fifth and sixth years 18ha. In the third and fourth years the fish pond was neither filled or stocked. Correlation coefficients between the pond's fish supply and the relative frequency of fish species in the otters' diet were (r_P): 0.56 ($P<0.05$), 0.87 ($P<0.0001$), 0.93 ($P<0.0001$), 0.79 ($P<0.05$), 0.36 ($P=0.12$) and 0.81 ($P<0.0001$) in the order of the years. Different species and size categories were differently preferred. Fish supply and the size distribution of the otters' diet was highly correlated (r_s= 0.70: $P<0.0001$) according to the analysis made on the six years' summarized data. The ratio of the economically important fish in the otters' diet was on average: 33, 9, 3, 0, 34 and 36% in the order of the years. This ratio had a high correlation with the stocked biomass of the pond (r=0.82: $P<0.05$).

INTRODUCTION

More than 50% of Hungarian fish-ponds have been privatised in recent years. Demand for compensation for damage caused by the Eurasian otter (*Lutra lutra* Linnaeus, 1758) has emerged primarily from the owners of fish and angling ponds. Most of these problems can be observed in the south-western region of the country where the biggest otter population lives.

Several publications report on the diet of the otter (e.g. ERLINGE, 1967; WISE et al. 1981; MASON and MACDONALD, 1986; KRUUK, 1995), and from the economic aspect for Hungary (KEMENESNÉ and NECHAY, 1990; LANSZKI and KÖRMENDI, 1996).

The aim of this study was to investigate the relationship between the otters' diet and the available fish stock based on the evaluation of relative frequency, size and economic value of fish at a fish pond stocked differently every year in the six year period.

STUDY AREA, MATERIAL AND METHOD

Fonó fish pond (FFP) is located in the south-western part of Hungary. The vegetation and the farming conditions varied markedly in different years. The main changes in the farming conditions and in habitat were as follows:

the surface area of the pond was 12ha in the first two years, the pond was neither filled nor stocked in the third and fourth years, when it became covered by weed,

after dam reconstruction in the fifth and sixth years the surface area of the pond increased to 18ha.

The total area of all the attached watery habitats is about 30ha.

The diet of the otter was studied by spraint analysis. Spraints were collected every two weeks on a standard route from November 1991 to December 1997. The total number investigated was 1,942, over the six years. Prey determination was performed by microscope on the basis of feather, bone, scale, pharyngeal teeth, dentition and hair characteristics (e.g. for fish see BERINKEY, 1966). A reference collection of scales and teeth was made from the fish collected at times of harvesting and trial fishing. The frequency of occurrence of the food items belonging to different categories was determined as the minimum number of individuals found in the spraints. The availability of fish as food for the otters was surveyed qualitatively and quantitatively based on the results of the fish harvests carried out in November (in the first, second, fifth and sixth years) and also by trial fishing using square fishing nets in November (in the third and fourth years). Fish that had been impossible to determine were classified as economically unimportant if their weight was less than 100g and important above 100g. We classified fish of economic importance the same way in every year, independently of the habitat changes.

The data were evaluated by two sample *t*-tests, correlation analysis (arcsin transformation STEEL and TORRIE, 1980) (SPSS 7.5) and Ivlev's electivity index (KREBS, 1989).

RESULTS

Fish dominated in the otters' diet independent of year and season; its ratio was 41-80%. Fish supply and fish diet of otters in the investigated six years are summarised in Tables 1a and 1b. Correlation coefficients between relative frequency of fish supply in the pond and in the otters' diet were (r_P): 0.56 ($P<0.05$), 0.87 ($P<0.0001$), 0.93 ($P<0.0001$), 0.79 ($P<0.05$), 0.36 ($P=0.12$) and 0.81 ($P<0.0001$), in the order of consecutive years investigated.

Results of fish preference are shown in Table 2. Otter avoided big fish (above 1000g) independent of species, while preferring carp (*Cyprinus carpio)*, pike (*Esox lucius), perch* (*Perca. fluviatilis)* and giebel (*Carassius auratus gibelio*) between 100 and 500g.

Table 1a. Relative occurrence of various fish species in the pond (FFP) and in the otter diet in the 1st, 2nd and 3rd year of study (based on LANSZKI and KÖRMENDI 1996). [“+” = ≤0.1 (occurrence altogether 0,1 % per year); “-“ = no occurrence in the otter diet; % Biom = % of biomass; % Occ. = % of occurrence; Wt. cat. = Weight category of fish: 1 = below 50 g, 2 = 50-100 g, 3 = 100-500 g, 4 = 500-1000 g, 5 = above 1000 g.]

Fish species	Years											
	1st (Dec. 1991- Nov. 1992)				2nd (Dec. 1992- Nov. 1993)				3rd (Dec. 1993- Nov. 1994)			
	Wt. cat	Fish supply present in the pond		Otter's diet	Wt. cat.	Fish supply present in the pond		Otter's diet	Wt. cat.	Fish supply present in the pond		Otter's diet
		% Biom	% Occ.	% Occ.		% Biom	% Occ.	% Occ.		% Biom	% Occ.	% Occ.
Economically important species:												
Cyprinus carpio over 3 yrs old	5	1,9	0,1	-								
Cyprinus carpio 3 yrs old	5	70,3	23,7	-								
Cyprinus carpio 2 yrs old	4	13,0	10,5	33,1	4	5.1	2.2	4.9	3	-	-	3.2
Hypophthalamihthys molitrix					5	86.1	11.6	1.3				
Hypophthalamichthys nobilis					5	0.3	+	-				
Stizostedion lucioperca 1 nyaras	3	11,0	27,8	-	3	2.5	7.1	3.0				
Silurus glanis	5	1,0	0,4	-								
Economically injurious species:												
Lepomis gibbosus	1	2.7	36.5	24.9	1	1.7	18.9	19.4	1	12.5	9.0	17.8
Perca fluviatilis	1	+	+	3.3	2	+	0.1	2.1				
Pseudorasbora parva	1	+	0.2	14.4	1	3.4	56.5	55.7	1	83.4	89.5	64.5
Economically indifferent species:												
Carassius auratus gibelio	3	+	0.2	7.2	3	0.6	0.4	0.4	3	-	-	0.8
Carassius carassius	3	+	+	0.6					3	-	-	4.8
Abramis ballerus/ A. brama	3	+	+	1.1	1	+	0.2	0.4				
Scardinus erythrophthalmus	2	+	+	-	2	+	0.1	0.2	2	0.8	0.2	-
Rutilus rutilus	2	+	+	-	1	+	0.1	0.8				
Alburnus alburnus	1	+	0.2	0.6	1	+	0.4	1.9	1	0.8	0.9	0.8
Tinca tinca	1	+	+	-								
Rhodeus sericeus amarus	1	+	+	-								
Misgurnus fossilis/ Cobitis taenia	1	+	+	-	1,2	+	2.4	0.8	1,2	2.5	0.4	1.6
Unidentified fish	1	-	-	14.8	1	-	-	9.1	1	-	-	6.5

Table 1b. Relative occurrence of various fish species in the pond (FFP) and in the otter diet in the 4th, 5th and 6th year of study. [marks see on Table 1a]

Fish species	Years											
	4th (Dec. 1994-Nov. 1995)				5th (Dec. 1995-Nov. 1996)				6th (Dec. 1996-Nov. 1997)			
	Wt.	Fish supply present in the pond		Otter's diet	Wt.	Fish supply present in the pond		Otter's diet	Wt.	Fish supply present in the pond		Otter's diet
	cat	% Biom.	% Occ.	% Occ.	cat	% Biom.	% Occ.	% Occ.	cat.	% Biom.	% Occ.	% Occ.
Economically important species:												
Cyprinus carpio 3 yrs old					4	0.1	+	14.8	4	0.15	+	1.4
Cyprinus carpio 2 yrs old					3	35.1	43.3	1.8	3	47.2	45.1	30.7
Hypophthalamichthys molitrix					5	35.0	2.6	3.2	5	35.4	2.0	0.3
Ctenopharingodon idella					3	17.5	6.5	4.0	3	10.0	2.9	2.8
Stizostedion lucioperca					3	0.6	0.7	0.7	3	0.05	+	0.1
Esox lucius					3	0.6	0.4	7.5	3	0.1	+	0.4
Silurus glanis					3	4.7	1.2	0.4	5	0.6	+	-
Economically injurious species:												
Lepomis gibbosus	1	12.5	9.0	10.9	1	0.3	1.4	7.2	1	0.6	2.3	3.6
Perca fluviatilis					1	+	+	1.1	2	+	+	0.1
Pseudorasbora parva	1	83.4	89.5	52.5	1	5.6	41.2	28.2	1	5.3	30.4	52.7
Economically indifferent species:												
Carassius auratus gibelio	3	1.7	0.4	1.0	3	0.1	0.2	12.6	3	0.2	0.3	3.1
Abramis ballerus/ A. brama	1*	-	-	25.7	2	+	+	2.2	2	+	+	0.1
Scardinus erythrophthalmus	2	0.8	0.2	1.0	2	+	+	1.4	2	+	+	0.7
Cyprinidae sp., small					2	-	-	2.9	2	-	-	1.0
Rutilus rutilus					1	+	+	0.4	1	+	+	-
Alburnus alburnus	1	0.8	0.9	1.0	1	0.3	2.2	-	1	0.3	16.9	0.1
Tinca tinca					2	+	+	-	3	+	+	-
Rhodeus sericeus amarus					1	+	+	0.4	1	+	+	-
Misgurnus fossilis/ Cobitis taenia	2&1	0.8	0.01	1.0	1	+	+	0.4	1	+	+	-
Unidentified fish	1	-	-	6.9	2	-	-	9.0	2	-	-	2.9
Unidentified fish					4	-	-	1.4				
Unidentified fish					5	-	-	0.4				

Table 2. Otters' fish preference in the pond (FFP) over the six years of the study. Preference: "+" preference, "-" avoidance, "o" indifferent, (var.) - varying; fish weight category as in table 1.

Fish species	Fish weight category	Year of study 1	2	3	4	5	6	Preference
		Ivlev's electivity index						
Economically important species								
Cyprinus carpio pooled	3-5	-0,02	0,38			-0,45	-0,17	(o)
Cyprinus carpio	5	-1,00						-
Cyprinus carpio	4	0,52	0,38			1,00	0,98	+
Cyprinus carpio	3					-0,92	-0,19	-
Hypophthalamichthys molitrix	5		-0,80			0,10	-0,74	-
Ctenopharingodon idella	3					-0,24	-0,02	o
Stizostedion lucioperca	3	-1,00	-0,41			0	0,82	(var)
Esox lucius	3					0,90	0,95	+
Silurus glanis	5	-1,00				-0,50	-1,00	-
Economically injurious species								
Lepomis gibbosus	1	-0,19	0,01	0,33	0,01	0,67	0,22	o
Pseudorasbora parva	1	0,97	0,01	-0,16	-0,26	-0,19	0,27	o
Perca fluviatilis	1,2	0,97	0,91			0,98	0,82	+
Economically unimportsnt species								
Carassius auratus gibelio	3	0,95	0	1,00	0,43	0,97	0,82	+

Relative occurrences of fish in the pond and in the otters' diet by weight categories are shown in Figure 1. The data were significantly correlated over the investigated period ($r_s = 0.70$, $P<0.0001$).

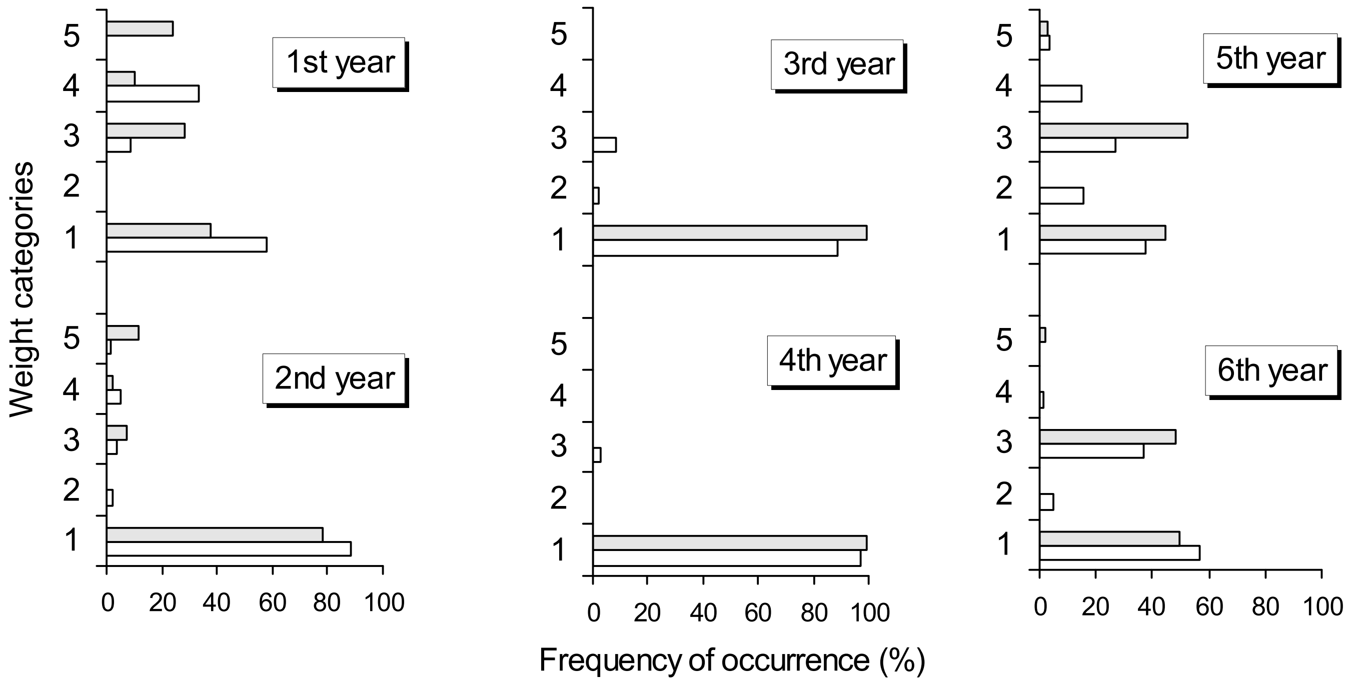

Figure 1. Relative occurrence of fish in different weight categories in the pond (shaded bar) and in the otter diet (open bar).

The seasonal distribution of the economically important species in the otters' diet is shown in Figure 2. Economically important species in the diet showed higher ratios principally in spring, after fish stocking. The total fish biomass in the pond and the ratio of economically important fish in the otters' diet was significant (r = 0.81: P= 0.054), as was the ratio of economically important fish by biomass available and in the otters' diet (r = 0.82: P<0.05).

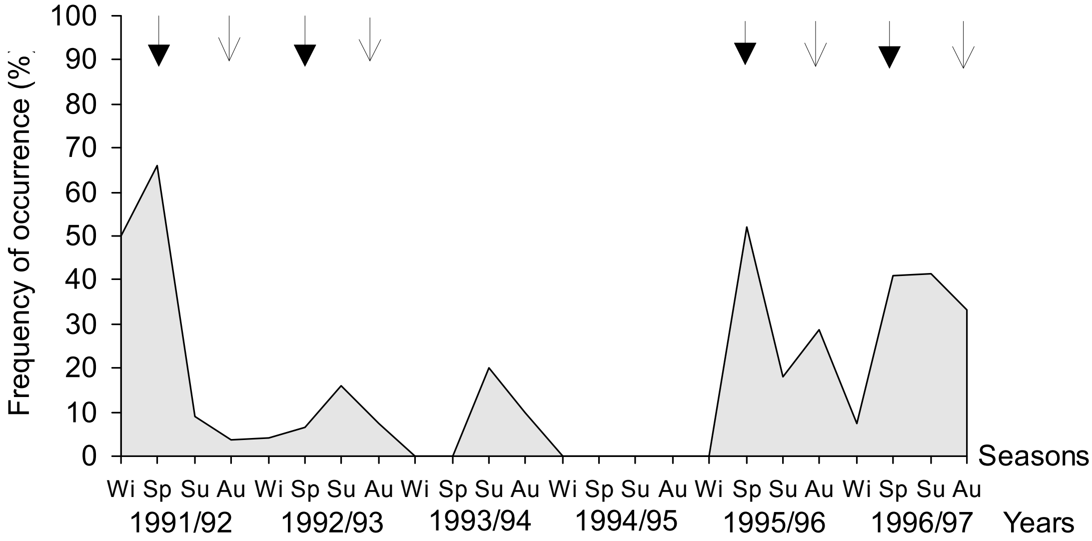

Figure 2. Seasonal distribution of the economically important species in the otters' diet. Seasons: Wi= winter, Sp= spring, Su= summer, Au= autumn, thick arrow= fish stocking, thin arrow= fish harvesting, arrow with dotted line = stocking by predatory fish only.

DISCUSSION

Analysis of the otters' diet showed that the species consumes a higher ratio of those fish species, which are available as a higher proportion of the fish supply in the pond. In the years when the fish pond was not filled and stocked otters that visited the area periodically consumed species which were not present in the pond's fauna (e.g. *C. carpio* in the third and *A. brama* in the fourth years). It shows that otters check regularly the areas that previously were suitable habitats for them.

In the fifth year a difference was observed between the diet composition and fish supply, following investigation of food preference for species and size categories. It seemed that in the case of the most important Hungarian pond fish, common carp (*C. carpio*), Ivlev's electivity index (Ei about 0) does not give enough information about the real preference as different age-groups showed substantially different values. According to the findings of ERLINGE (1967), WISE et al. (1981) and KEMENES and NECHAY (1990), otters avoid the large fish, and captive otters prefer certain species, e.g. pike and perch (ERLINGE, 1968 cit., MASON and MACDONALD, 1986) In interpreting these indices it is advisable to take into account the preferred habitat of fishes. Pike and sunfish (*L. gibbosus*), living in the shore region occupied by water plants, are easy prey for otters. Low visibility in the deeper open waters impedes the capture of larger fish (KRUUK, 1995).

High correlation was found between fish supply and otters' diet according to size categories. Relative frequency data, which significantly differ from biomass data, were used in our calculations. As the intensity of pond production grew, that is higher yields were obtained, the damage caused by otters grew in parallel. The low reliability of the best linear regression model we found shows that more data are necessary to clear up this question. Collecting data of biomass and relative frequency of fish supply are equally important in the evaluation of the damage caused by otters.

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EFFECTS OF HABITAT CHANGES ON THE OTTERS' HABITAT USING, TROPHIC NICHE BREADTH AND RELATIVE ABUNDANCE AT AN EUTROPHIC FISH POND

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Abstract: The effects of habitat changes on otters were studied in a six-year period by analysing the number and density of spraints in the different habitats. The fish pond investigated is situated in south-western Hungary. The water surface area of the pond was 12 ha in the first and second year (first period) and 18 ha in the fifth and sixth year (third period). The fish pond was not filled and stocked in the third and fourth year (second period).
The otters, according to the given possibilities, preferred different habitats in the three periods of investigations, adapted well to the changing environment and were faithful to the area. Values of niche breadth show no differences among seasons but were highest in the second period ($P<0.05$) when amphibians and water insects represented 26 and 10 % respectively in the otters' diet. The ratio of fish in the food was 63, 52 and 73 % respectively in the three periods. Changes of the otter population can be followed for several years by the tendencies of spraint densities. The number and the ratio of sprints showed significant annual fluctuation (average: 324, min. 113 and max. 636).

INTRODUCTION

The most important habitats of the Eurasian otter in Hungary are linked to the presence of fish ponds. Fish ponds cover about 23,000 ha, of which 30-35% is out of production because of the lack of water, the lack of licences by the water authority or for economic reasons. The environmental factors affecting the otters' presence and habitat use and territory size, were studied earlier by radio-telemetry (ERLINGE, 1967, 1968; DURBIN, 1996), radionuclides (review in MASON and MACDONALD, 1986) and direct signs such as spraints and tracks (ERLINGE, 1967; MASON and MACDONALD, 1986; DUBUC et al*.,* 1990; KEMENES and DEMETER, 1995). Spraints are suitable not only to verify the presence of otters, but by collecting with standard methods trends of population changes can be assessed (ERLINGE, 1972; JENKINS and CONROY, 1981; KRUUK et al*.,* 1986; MASON and MACDONALD, 1986; KRUUK and CONROY, 1987; KRUUK, 1995).

The aim of this study was to investigate the otters' 'habitat use', trophic niche breadth and relative changes of the population distribution during a six-year period under changing vegetation cover and farming conditions.

STUDY AREA

The Fonó fish pond (FFP) is located in the south-western part of Hungary (46°22' N, 17°55' E). The stream feeding the pond belongs to the catchment area of the Kapos River which flows into the Danube. The region is basically ploughed land divided by 10-80 ha forests and fish ponds along the nearby waterways. In the area of FFP, the following otter habitats can be found: three fish ponds, one water reservoir and four streams; the nearest pond is 4 km from the FFP.

The main changes in the farming conditions and habitat during the stusy were a) the surface area of the pond was 12ha in the first two years, b) the pond was neither filled nor stocked in the second two years, when it was covered by weed, and c)after reconstruction of the dam, in the last two years the surface area of the pond was 18ha. Other habitat changes (Figure 1) included the nearby forest being partially cut down or thinned, and ploughed land was given up for game. The total area of all the joined aquatic habitats was about 30ha.

The western shore of the pond was covered by a 60-year-old oak forest (*Quercetum petraeae-cerris*) divided by ploughed areas. In the first two years between the forest and the water surface there was reed (*Scirpo-Phragmitetum*), but in the third two years they contacted directly. In the northern part there is a small meadow, with willow (*Salicetum triandrae*), and sedge (*Caricetum acutiformis-ripariae*). In the first four years, one third of the pond surface and a strip of neighbouring land was covered by reed, representing a diverse vegetation. A large area of ploughed land in the east, a human settlement with orchards in the south-east and open pasture and pasture with trees (*Betula pendula*, *Robinia pseudo-acacia*) in the south bordered the study area.

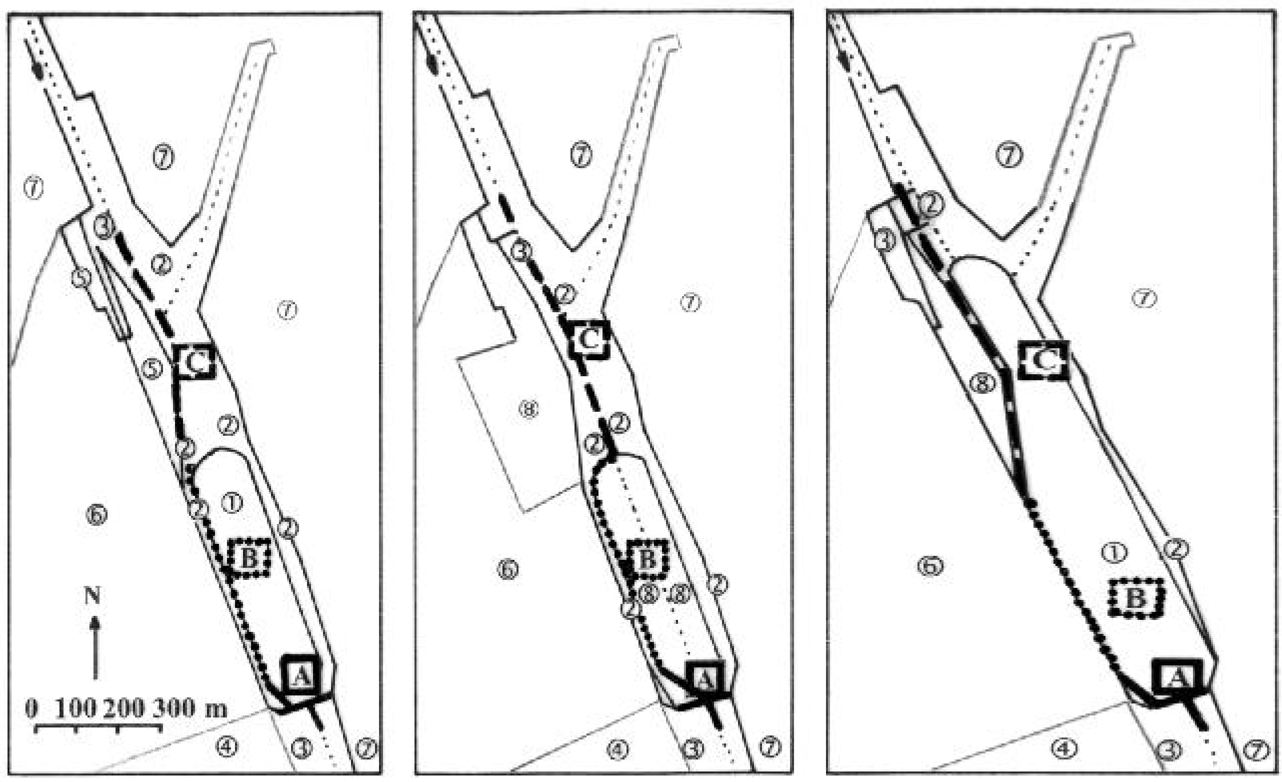

Figure 1. Map of the FFP region: Periods: 1= 1st + 2nd years; 2= 3rd + 4th years; 3= 5th + 6th years together, 1=water surface, 2=reed and bulrush, 3= meadow and willow, 4= pasture with trees, 5= game field, 6= forest, 7= plough-land, 8= weed communities. The first subregion (**A**) was the dam and the first part of the water outlet of the fish pond (altogether 250 m). The second subregion (**B**) was the western side of the pond, which was covered by forest and 1-2 m littoral reed in the first, by weed associations in the second and by forest and a reed belt narrower than 1 m in the third period (altogether 400 m). The third subregion (**C**) was covered by sedge, reed, bulrush, willow and meadow (550 m altogether).

MATERIALS AND METHODS

Spraints were collected every two weeks on a standard route from November 1991 to December 1997. The total number examined over the six years was 1942. The specification of otters' diet and the evaluation of data was performed similarly to that outlined in a previous study (LANSZKI and KÖRMENDI, 1996).

Food taxa identified were: 1. small mammals, 2. carcasses, 3. birds, 4. reptiles and amphibians, 5. fish, 6. invertebrates and 7. plant material. Other materials were not taken into account in the calculations.

Calculations of the food niche breadth [$B = 1/\sum p_i^2$, where p_i= the relative frequency of occurrence of the i^{th} taxon] and standardised niche breadth [$BS = (B-B_{min})/(B_{max}-B_{min})$, where B_{min} = minimum value of niche breadth (=1); B_{max} = maximum value of niche breadth (= number of general prey taxa)] were made in accordance with KREBS (1989).

The area investigated was divided in three main parts (Figure 1) according to the habitat type.

The data were evaluated by χ^2-test and ANOVA (SPSS 7.5 for Windows, 1996).

RESULTS

Otters of the investigated area used landing and defecating places differently in the three periods (Figure 2). During the first period in subregion A, the area of the highest anthropogenic influence, was used mostly (χ^2=165.3, df=2, P=0.0001), especially in winter. It can be explained by the fact that there were no fish in the ice-covered pond, so otters could feed only in the permanently flowing stream. They scarcely used landing spots in the 1-2m wide reed zone and none in the unbroken reed areas wider than two meters, on the eastern shore (Figure 1). After the unfavourable habitat changes in the second period, there were no landing spots in the weed-covered pond bottom. During this period in subregion C, the stream shore covered by high sedge was preferred (χ^2=403.2, df=2, P=0.0001). During the third period, after pond reconstruction, the otters preferred the bordering forest (subregion B), where the rich shrub cover offered a good place for hiding, moving, playing and marking territorial limits (χ^2=137.8, df=2, P=0.0001).

Fish generally dominated the otters' diet (41-80%), irrespective of year and season (Table 1). After the deterioration of habitat conditions (2^{nd} period), amphibians played a more significant role (43% in spring and 24% in summer) and the percentage of water insects was 23% in autumn. Average values of food niche breadths were 1.6, 2.4 and 1.9 ($P<0.05$) and standardized niche breadths were 0.23, 0.30 and 0.19 ($P<0.05$), respectively in the three periods, showing the wide food spectrum of otters in the second period. After the rehabilitation of the habitat in the third period, when fish production was restarted in the pond, the dominance of fish in food lowered the niche breadth to the level of the first period (Table 1).

Table 1. Diet of otters on the FFP region (1991/92-1997). Periods see on Fig. 1; n = number of spraints investigated; * = occurred in the samples

Diet categories	Seasons											
	Winter			Spring			Summer			Autumn		
	Periods*											
	1	2	3	1	2	3	1	2	3	1	2	3
	Relative occurrence %											
Mammals total		0.8	2.0	1.3	1.6	3.4	0.3	2.4	2.5	0.5	3.7	0.3
Insectivora *(Sorex* sp.*)*		0.8										
Lepus europaeus				0.3		0.1						
Ondatra zibethicus			1.2								1.3	
Other rodentia total			0.8	1.0	1.6	3.3	0.3	2.4	2.2	0.5	2.4	0.3
Capreolus capreolus									0.3			
Birds total	2.2	-	0.8	7.0	1.6	3.1	14.4	4.7	6.9	2.4	-	1.9
Passeriformes sp.	2.2		0.8	7.0	1.6	2.8	14.0	4.7	6.3	1.9		1.9
Phasianus colchicus							0.3		0.3	0.5		
Fulica atra						0.3			0.3			
Reptiles total	-	-	-	1.0	-	-	0.7	7.1	-	1.4	-	-
Natrix natrix.				1.0			0.7	7.1		1.4		
Amphibians total	10.5	26.3	24.4	10.4	43.4	11.0	20.0	23.9	9.1	1.9	11.0	7.7
Fish total	67.6	60.9	53.9	62.7	41.4	78.5	44.5	50.0	78.3	78.0	53.6	80.5
Arthropods total	8.0	9.8	14.9	9.4	10.5	3.2	13.7	9.5	2.1	12.4	26.8	6.7
Dytiscus marginalis	4.8	8.9	14.1	6.3	7.3	1.5			1.8	8.6	23.2	5.6
Other insects	3.2	0.8	0.4	3.1	3.2	1.5	13.7	9.5	0.3	3.8	3.6	1.1
Crayfish (*Gammaridae* sp.)			0.4			0.3						
Molluscs (*Gastropoda* sp.)	0.3	0.8	1.2	-	-	-	1.0	-	-	0.5	-	1.0
Plants total	11.4	1.5	2.8	8.2	1.6	0.6	5.4	2.4	1.1	2.9	4.9	1.9
Typha/Carex sp.	5.4	0.8	2.0	1.3		0.6	1.7	2.4	0.7	1.5	4.9	1.3
Lemna sp.	5.1			6.3			3.0					0.3
Seed			0.4		0.8		0.7			1.4		
Grass	0.3	0.7	0.4	0.6	0.8				0.4			0.3
Leaf	0.6											
Stick	*			*			*		*			
Nylon							*			*		
Pebble			*	*								
Niche breadth	2.05	2.22	2.65	2.34	2.69	1.58	3.26	2.79	1.59	1.59	2.67	1.51
Std. niche breadth	0.26	0.30	0.33	0.27	0.34	0.12	0.38	0.36	0.10	0.12	0.42	0.10
n	182	83	141	224	122	353	198	26	172	156	42	243

The number of spraints collected was four times as many (n=594, 30.6%) in the second year than in the first (n=166, 8.8 %). The otter population responded quickly to the termination of fish stocking: spraints collected numbered 113 (5.8%) in the third year and did not change significantly in the next year (n=160, 8.2 %). The habitat fidelity of otters is shown by the fact that they were coming back to the study area quasi checking its conditions. The returning of otters to the area was slow after fish production was restarted in the fifth year (n=273, 14.1%). The number of otters reached the level of the second year in year six (n= 636, 32.8%) based on the number of spraints collected. Correlation between the fish biomass in the pond and the otters' density - based on the number of spraints collected in years - was high (r_S=0.81, P<0.05).

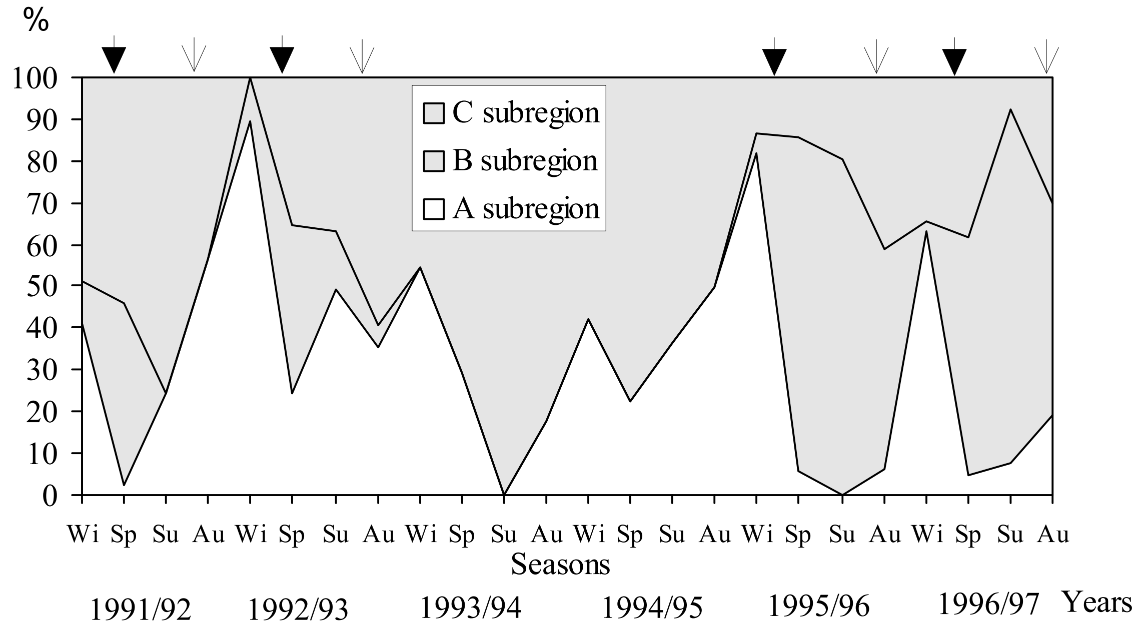

Figure 2. Habitat use of otters in FFP. Seasons: Wi= winter, Sp= spring, Su= summer, Au= autumn; thick arrow = fish stocking, thin arrow = fish harvesting, arrow with dotted line = stocking by predatory fish only; Subregions see on Fig. 1.

DISCUSSION

The habitat (defecating place) use of otters was influenced by environmental factors e.g. fish stocking densities, water level and littoral vegetation, and was similarly to the findings of other authors (KEMENES and DEMETER, 1995; MASON and MACDONALD, 1986). Otters preferred different habitats in the three periods investigated; that is, they adapted well to the changing environment. Influenced by the termination of fish production and vegetation changes in the area the otters utilized other prey (e.g. amphibians and water insects) and the ratio of fish in their diet diminished.

Reproduction of freshwater otters living in the temperate zones is not as strongly linked to fish abundance (and season) as in Scandinavia or in coastal otters; the former may breed at any time of the year (ERLINGE, 1968; MASON and MACDONALD, 1986, KRUUK et al*.,* 1991). During the study period, the number of spraints collected fluctuated considerably from year to year, the reasons for which, in addition to changes in the habitats, lay in the particular characteristic reproduction biology of otters (e.g., not producing progeny every year), their manner of rearing offspring (such as formation of the family group), and their territorial behaviour. In interpreting the conclusions relating to otter density drawn from the number of spraints collected it should be borne in mind that there are several known functions of defecation, such as the excretion of food remains and the communication of scent, and also a number of factors, such as season, sexual behaviour and level of activity, which also exert an influence (ERLINGE, 1967; KRUUK, 1995). Therefore, rather than total sample numbers for a month or for a season the sample numbers recorded over several years were taken into account for the determination of trends in change in population distribution.

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DISTEMPER IN FREE LIVING EUROPEAN OTTERS (*LUTRA LUTRA*) IN AUSTRIA

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Abstract: In winter 1995 two moribund juvenile otters were found in the little town Schrems in the northern Waldviertel region / Lower Austria within a few days of each other. Both animals died soon after capture. Clinically, they suffered from ceratoconjunctivitis, dermatitis and foetor ex ore. Postmortem examination revealed severe necrotizing dermatitis, gastritis and corneal ulcers. In smears from trachea and urinary bladder cytoplasmatic inclusion bodies could be demonstrated in epithelial cells. Immunohistochemically, canine distemper virus (CDV) antigen was found in many epithelial cells, e.g., in stomach, lung, cornea and skin.
Distemper is mainly an infectious disease in dogs, caused by a morbillivirus from the family Paramyxoviridae. Although CDV has been shown to be pathogenic for many mustelid species too, there is only one report on distemper in otters. To the best of our knowledge this is the first report on this disease in free living otters.

INTRODUCTION

Canine Distemper Virus - CDV (family Paramyxoviridae, genus Morbillivirus) is a cause of disease in eight of the eleven families of Carnivores including the mustelids (MONTALI et al., 1987). Although distemper is a well known disease in many mustelid species, there is only one publication on this disease in European otters (GEISEL, 1979). This outbreak has been observed in a zoo. To the best of our knowledge this report is the first description of distemper in free living otters.

CASE HISTORY

The northern Waldviertel in Lower Austria holds an important, viable population of the Eurasian otter (*Lutra lutra*). In February 1995 within few days two male juvenile otters (approximately 5 months old) were found within the little town Schrems. Both animals were disorientated and had lost their shyness. While one otter (otter 1) died before clinical examination could be carried out, in the other (otter 2) ceratoconjunctivitis, dermatitis, mainly around the mouth and in the ventral parts of the body and severe foetor ex ore were diagnosed clinically. Otter 2 died two days later, despite treatment with antibiotics and vitamins.

Both animals were necropsied and investigated histologically (fixation of organs in 7% neutral buffered formalin, paraffin-embedding, haematoxylin-eosin stain).

Both animals were emaciated, had multiple deep gastric ulcers and mild hyperplastic splenomegaly. While in otter 1 the mandibular, axillar and retropharyngeal lymph nodes were hyperplastic, the lymph nodes in the other animal were normal. Otter 1 suffered from severe chronic necrotizing glossitis and pharyngitis with large amounts of bacteria on the surface. Otter 2, however, had no lesions in this region, but severe mucopurulent ceratoconjunctivitis with corneal ulcers in both eyes. On the surface of these ulcers many bacteria could be demonstrated histologically. Histologic sections from the inflamed regions of the skin of otter 2 revealed severe necrotizing dermatitis with many bacteria and hyperkeratosis in adjacent regions.

The other organs had no alterations except for congestion (both otters) and purulent bronchitis in otter 2. In the brains no changes could be found either.

Smears from urinary bladder and trachea of animal 2 stained with the method according to Shorr and Harris-haematoxylin counterstain showed many cytoplasmic inclusion bodies in epithelial cells.

Immunohistochemically (Avidin-Biotin-Complex-technique, polyclonal rabbit anti-CDV-antiserum as first antibody) CDV antigen could be demonstrated in epithelial cells of the stomach, the skin, the trachea, the bronchi of both otters, the tongue of otter 1 and the cornea and conjunctiva of otter 2. In the spleen of both animals CDV antigen could be found, too.

Salmonella enteritidis was cultivated from liver, spleen and intestine of otter 1, while *Salmonella typhimurium* was found in liver and intestine of otter 2.

DISCUSSION

Canine distemper is a classical infectious disease of domestic dogs with enormous importance in times before vaccination was possible. In the last years, however, together with increasing numbers of imported dogs from Eastern European countries, incidence of this disease has risen again in Austria. Moreover, of all viral diseases, distemper seems to have the most far reaching implications for susceptible free-living and captive carnivores (MONTALI et al., 1987). Distemper in dogs is characterised by conjunctivitis, rhinitis, pneumonia, enteritis and encephalitis. While in affected dogs skin lesions are less important, in mustelids (especially in mink and ferrets) inflammation of skin is a prominent feature (PEARSON and GORHAM, 1987).

The diseased otters in our case had differing symptoms. One had the most impressive lesions in the skin and in the conjunctiva and cornea, the other primarily in the upper digestive tract. All these lesions were caused by the virus, as demonstrated immunohistochemically, and complicated by bacteria. Though both animals developed abnormal behaviour, their brains were morphologically unaffected. The two otters investigated by GEISEL (1979) showed dermatitis, purulent bronchopneumonia and haemorrhagic gastroenteritis. The diagnosis was based on the demonstration of cytoplasmic inclusion bodies in many epithelial cells. Neither virus isolation nor immunohistology were performed.

The source of the infection in our case is not clear, but it may be speculated that the virus has been transmitted from a dog. Infected dogs shed virus in all body excretions; the transmission of virus from clinically healthy but infected dogs is possible (ROLLE and MAYR, 1993). Since 1995, however, no further case of distemper in otters in Austria has come to our knowledge. So this disease does not seem to be a threat for the otter population.

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A PROPOSED ACTION PLAN FOR THE CONSERVATION OF THE SOUTHERN RIVER OTTER (*Lutra provocax*) IN FRESHWATER HABITAT IN CHILE

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Abstract: The isolation of populations of the southern river otter and the degradation and fragmentation of their habitat, emphasize the need for the implementation of an otter conservation plan in Chile. It is proposed that the three conservation approaches suggested by MEDINA (1996) be implemented in two stages, an overall 'Action Plan' followed by 'Local Approaches'. Both should follow protocols to assess conservation priorities, and select values for selecting the area and sites where habitat restoration, protection, translocation of otters, environmental education and public awareness should be implemented and evaluated for eventual adoption in conservation and management.

INTRODUCTION

The southern river otters (*Lontra provocax*), once had an extensive latitudinal distribution from the Cauquenes and Cachapoal rivers (34°S) to the Magellan region (53°S) in Chile (OSGOOD, 1943). At present known populations in freshwater habitats are confined to seven isolated areas between Cautín (39°S) to Futaleufú (43°30' S), all threatened by different factors that promote habitat degradation and disturbance (MEDINA, 1996). The design of an Action Plan with local conservation approaches to counteract this situation is therefore, of critical importance.

BACKGROUND

The present status of the southern river otters in freshwater habitats in Chile is precarious. The major reasons for their decline have been over-hunting, habitat destruction, and disturbance by man (MELQUIST, 1984; MEDINA, 1996). MEDINA (1996) proposed that the extirpation of southern river otters began in local river basins but may have become widespread owing to a lack of re-establishment. This is thought to be a consequence of high mortality, or reproductive failure due to the dispersal of otters into unsuitable areas on account of habitat destruction (vegetation removal, river canalization) and disturbance (agriculture, tourism, forestry, settlements, transports, domestic dogs). The relation between southern river otter signs and vegetation density recorded by MEDINA (1996), suggests that one of the important reasons of habitat degradation is the removal of the river bank vegetation and loss of seclusion or security for den sites. Therefore, the recovery of vegetation on the lake, river or stream banks, together with an increase in privacy and availability of otter den sites, could be the first step in an otter population conservation programme. However, MEDINA (1998) found significant differences between the diet of otters in rivers and in lake habitats, based on scats collected in both. These differences may also contribute to habitat selection by southern river otters. In addition, the southern river otter populations in freshwater habitat found by MEDINA (1996), are in different political and geographical areas and they have similar and different conservation threatening factors (MEDINA, 1996). Furthermore, the movement of a single individual or group may cover more than 5 km length of the shoreline of particular lakes, streams or rivers a day (MEDINA, 1992), so their habitat could be threatened in different parts by different situations such as farming, forestry, industry, fishing, towns and cities. Therefore, river otter conservation in freshwater habitat is not simple and should follow a protocol of priorities in selection according to the area, conservation needs (diversity, area, ecological fragility, threats, representativeness), local people and authorities' attitudes, development projects, and mean economical activities (MARGULES, 1991; KIRBY, 1991; COBHAN and ROWE, 1991).

CONSERVATION AND MANAGEMENT

MEDINA (1996) suggested three approaches to conserve the southern river otter in Chile: environmental education, the recovery of small or declining populations, and the re-establishment or restocking by translocation of otters. However, these approaches should be implemented in two stages. First an 'Action Plan' and secondly one or several 'Local approaches', depending of the funding situation.

Action Plan

For southern river otter populations in freshwater or marine habitats country-wide surveys to determine distribution, conservation status and threats should be made every 10 to 15 years (MASON and MACDONALD, 1990) (Fig. 1). Results of such surveys will suggest overall conservation priorities, and the areas that should receive priority for research. Areas with the highest conservation threats (populations isolated in patches of habitat faced with increasing habitat destruction and fragmentation, disturbance, pollution and poaching) (MELQUIST, 1984; WILCOX and MURPHY, 1985; BURKEY, 1989; LANDE, 1988; BEIER, 1993; DUNNING et al., 1995; MEDINA, 1996) should receive priority in the implementation of a 'Local approach' (Fig. 2). The progress in otter conservation and population recovery has to be evaluated together with the results of the subsequent overall survey to determine new priorities (Fig. 1).

Local Approach

Once an area has been selected, managers should follow a protocol for prioritizing sites and community values e.g. MARGULES et al. (1991), COLLIER and McCOLL (1992), GREEN and TUNSTALL (1992). After the site or sites are selected, all the following stages should be done in conjunction with a public relation programme (KLEIMAN, 1989; MELQUIST, 1984). Only after agreements with landowners, farmers, National Park Administrations and private and public developing projects have been reached can conservation be implemented.

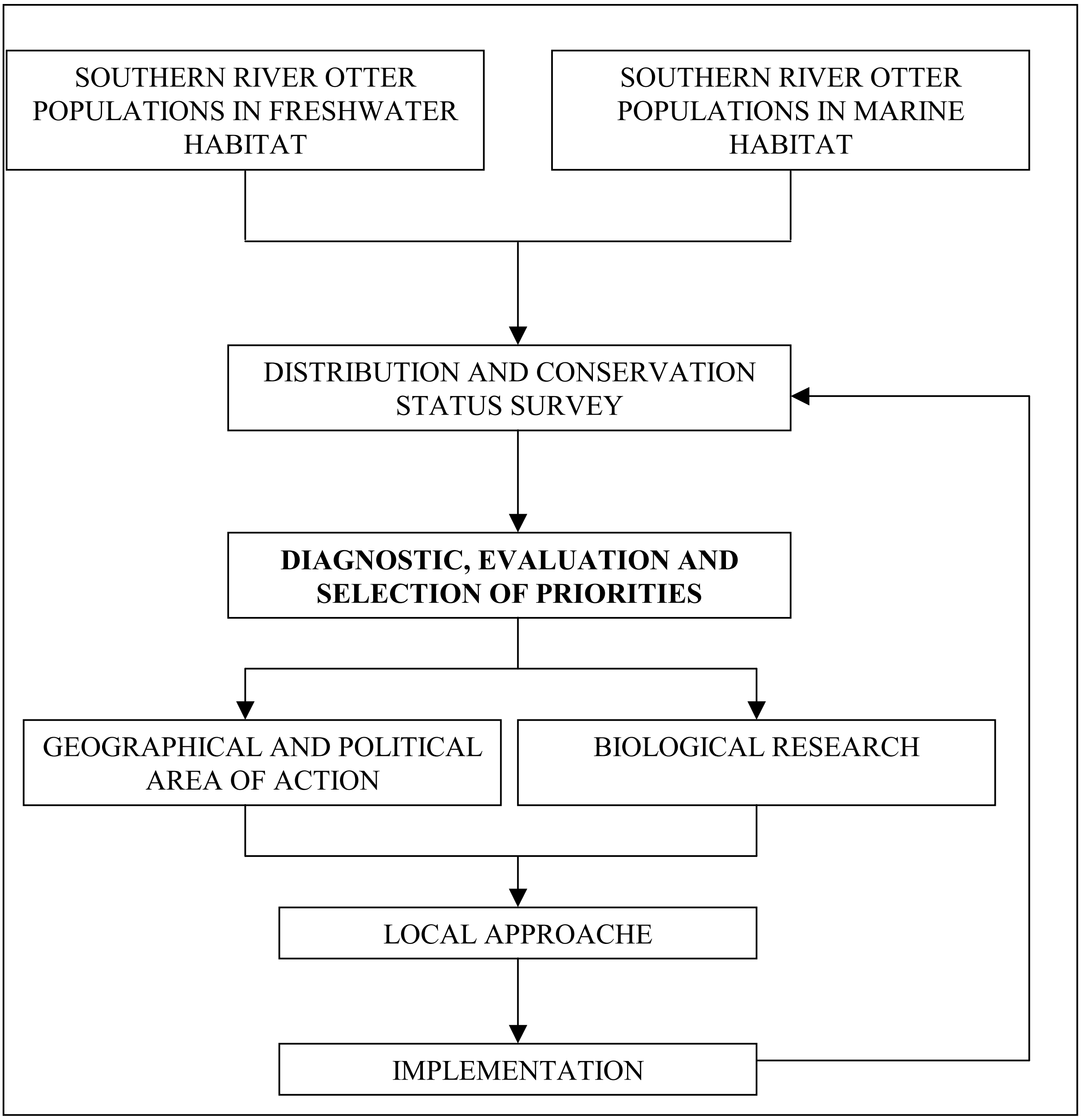

Figure 1. Proposed Action Plan for the conservation of southern river otter in Chile.

By analyzing the results of the habitat restoration and monitoring programme as a hypothesis testing exercise, it will be possible to obtain reliable knowledge about the habitat requirements of the otters and detect early special needs for habitat restoration and otter conservation (ROMESBURG, 1981; MACNAB, 1983; EBERHARDT, 1988; MATTER and MANNAN, 1989; MURPHY and NOON, 1991). Furthermore, this methodology will reduce the uncertainty of the results from habitat restoration and reintroduction or translocation of river otters (MURPHY and NOON, 1991).

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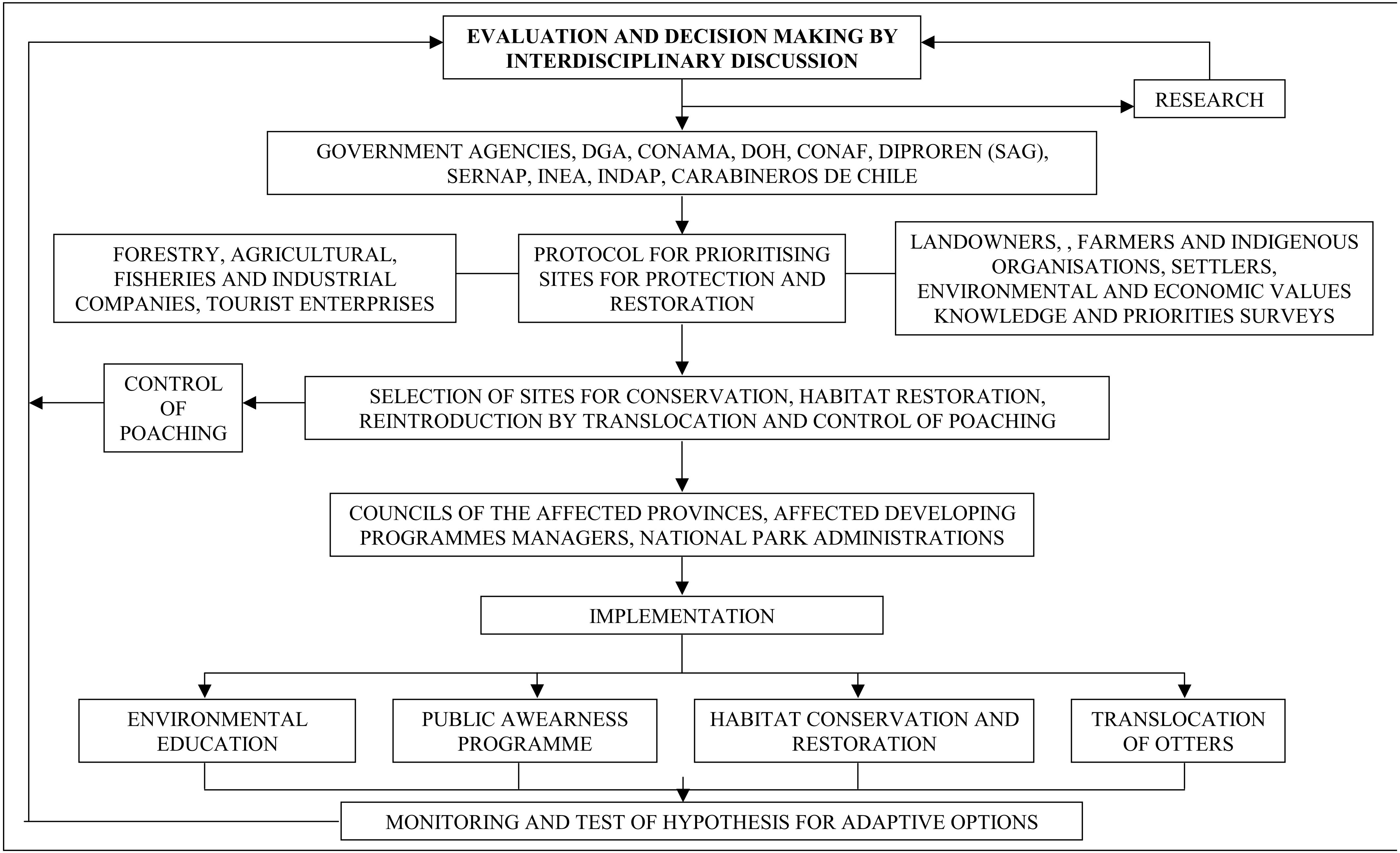

Figure 2. Proposed Local Approach for conservation of southern river otter populations inside the geographic and political area selected by the Action Plan.

THE STATUS OF OTTERS IN LATIN AMERICA - EIGHT YEARS AFTER THE OTTER ACTION PLAN

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Abstract: Eight years after the 'Otters. An Action Plan for their Conservation' was published, questionnaires were sent to 25 active otter biologists to review progress on otter conservation and research in Latin America. Fifteen questions related to the otter distribution, conservation and research, were included to cover all aspects mentioned in the Action Plan. Returns indicate that there has been progress in our knowledge of the distribution and conservation, especially of southern river otter and giant otters. All four species of otter currently found in Central and South America are under increasing threat due to habitat destruction and disturbance. Forestry, oil, mining and agricultural activities, as well as a lack of basin management plans or effective legal protection, are currently threatening the conservation of all the four species of otters in Latin America. It is important to design an Action Plans for each country with a selection of priorities and clear goals, so as to concentrate the limited funds into effective and immediate conservation actions.

INTRODUCTION

Four otter species are found in Latin America: the giant otter (*Pteronura brasiliensis*), the Neotropical otter (*Lontra longicaudis*), the southern river otter (*Lontra provocax*) and the marine otter (*Lontra felina*). Latin America displays a great diversity of climates, from equatorial to sub-Antarctic and from the sea coast to the high Andes. The two most widespread species are the neotropical otter, which ranges throughout Central and South America, and the giant otter, which inhabits the Amazon rainforest from the North of Uruguay to Colombia (Fig. 1) (CHEHÉBAR, 1990; FOSTER-TURLEY et al., 1990). The southern river otter and marine otter are much more restricted in their range (Fig. 1). All species are currently classified as endangered (CHEHÉBAR, 1990), with habitat degradation through vegetation removal and pollution, together with disturbance, being the main threats to their survival (CHEHÉBAR, 1990; STAIB and SCHENCK, 1994; MEDINA, 1996). This paper focuses on the comments and reports received from the otter specialists in Central and South America.

METHODS

Questionnaires were sent to 25 known otter biologist and conservationists. Each form had 15 questions, including subjects related to otter distribution, poaching, conservation threats and priorities, research funding and legal status. Also progress related to all subjects mentioned in the Action Plan for Latin American Otters (CHEHÉBAR, 1990) were asked to be discussed.

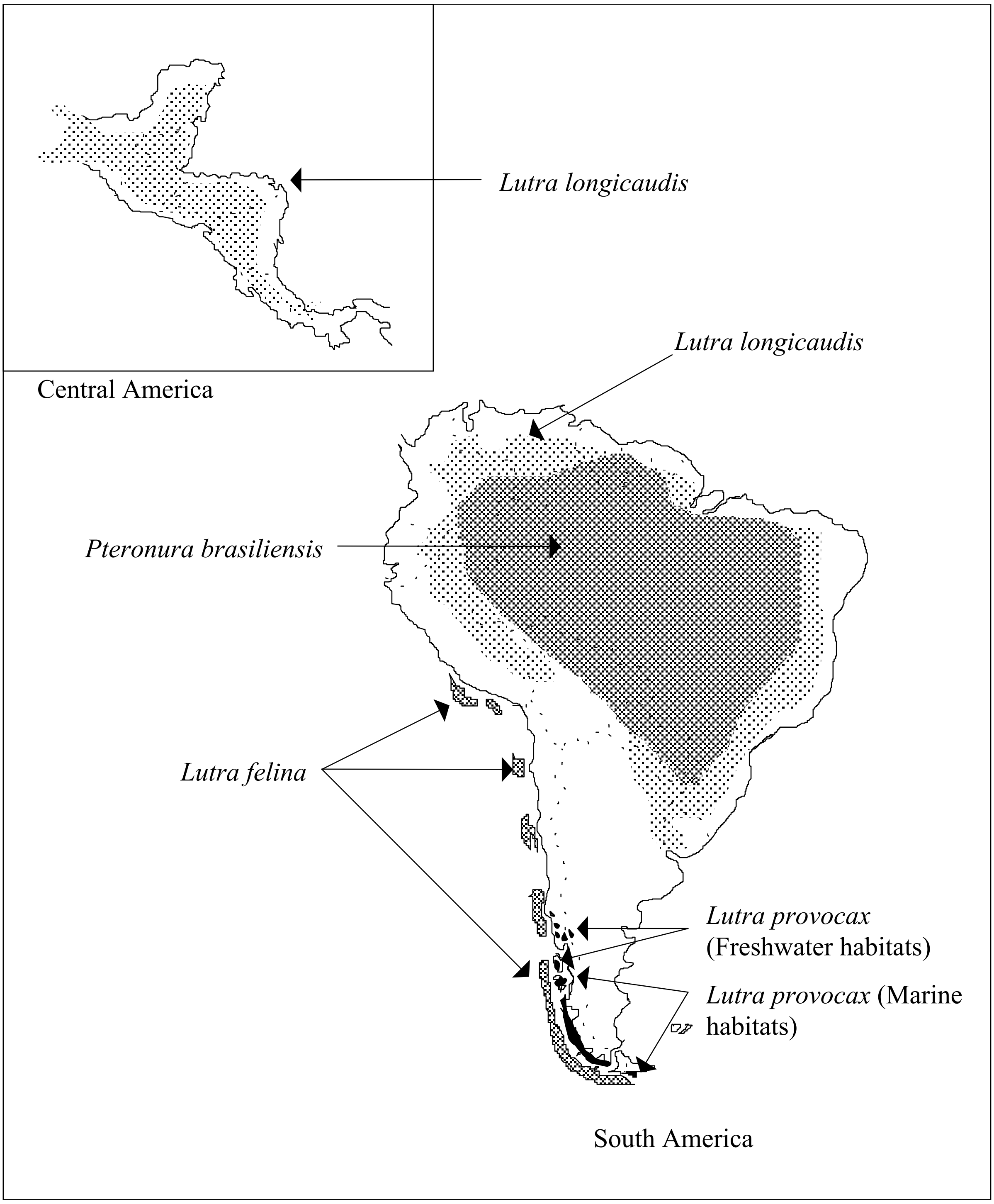

Figure 1. Geographic distribution of otters in Latin America (FOSTER-TURLEY et al., 1990; CHEHÉBAR, 1990; PARERA and BOSSO, 1991; GALLO, 1991, 1996; MEDINA, 1996)

RESULTS AND DISCUSSION

Six completed questionnaires about the neotropical otter (covering specialists from Argentina, Costa Rica, Ecuador, Mexico, Uruguay), six on the giant otter (Colombia, Ecuador, Netherlands), three on the southern river otter (Argentina, Chile) and two on the marine otter (Argentina, Chile, Perú) were returned.

Although the answers and comments in the returned questionnaires probably are only a rough representation of the real situation, it is clear that the distribution and status of the neotropical otter in Central America and South America, except for Mexico and Costa Rica, are still poorly known (CHEHÉBAR, 1990; GALLO, 1991, 1996).

However, new data on otter distribution in Argentina and Uruguay have been acquired during the last six years (PARERA and BOSSO, 1991; PARERA, 1993). The giant otter is now extinct in Argentina and Uruguay, and there is little information about its distribution in Bolivia and Paraguay (CHEHÉBAR, 1990; PARERA and BOSSO, 1991; PARERA, 1993). Recent observations in Colombia, Ecuador and Perú indicate that the species can be rare, unknown, or present depending on the area.

Much new information has been accumulated for the southern river otter, and its distribution, conservation status and threats in freshwater habitats in Chile and Argentina is now much better known (CHEHÉBAR, 1990; PORRO and CHEHÉBAR, 1995; MEDINA, 1996). *Lontra provocax* continental population is increasingly being split up into islands of habitats, so that this species is becoming the one with the smallest geographical distribution of all otters in the world (FOSTER-TURLEY et al., 1990; MEDINA, 1996).

The marine otter is currently guarded by several protected areas in Perú (CHEHÉBAR, 1990). However, over its distribution range, populations are becoming increasingly separated by extensive sections of degraded habitats (CASTILLA, 1982; CHEHÉBAR, 1990; MEDINA, 1996).

All four species are protected by law, but in all countries, especially Ecuador and Colombia, the effective protection afforded is poor (Table 1). Otters are still hunted in ignorance of the law by indigenous people and poor settlers, which in some cases regard otters as competitors for fish, or their fur as souvenirs and cubs as pets (giant otter). However, all the biologists questioned agreed that poaching is not a large threat, but with the current habitat loss and population fragmentation (Tab. 1), poaching could become a problem (MELQUIST, 1984; STAIB and SCHENCK, 1994; MEDINA, 1996).

In Ecuador and Colombia, forest, oil and mining exploitation are clearing the rainforests and polluting rivers, but it is not known how this is affecting both the neotropical and the giant otter. In Mexico, neotropical otter populations are declining in medium-sized rivers affected by industrial, mining and city wastes, intensive irrigation, forestry and agricultural activities (GALLO, 1991). Biologists estimated that in Argentina and Uruguay population fragmentation seems not to be a problem. However, in Uruguay the habitat for otters is severely threatened by the building of dams and the dredging of wetlands for agriculture. In Argentina the distribution of all otters species has been severely reduced, the marine otter is on the verge of extirpation and giant otter has already been extirpated. The remaining southern river otter population is apparently stable (CHEHÉBAR, 1990; PORRO and CHEHÉBAR, 1995). In Perú, the status and distribution of the neotropical otter is practically unknown and its conservation threats may be similar to those in Ecuador and Colombia. The giant otter has been studied recently and threats to its survival identified. Colonization of the rainforests strongly affect this species through vegetation removal, fishing, pollution, poaching and perturbations specially where there are family groups with young cubs (STAIB and SCHENCK, 1994).

For Brazil surveys to determine status and distribution of both the giant and the neotropical otter are still lacking. In Chile, an Action Plan with Local Approaches for the conservation of southern river otters in fresh water habitat is being developed. The most important threats in this country are habitat destruction and disturbance by vegetation removal, forestry, live stock, pulp factories and a lack of a basin management and effectively implemented conservation laws. There is little control and protection over the marine otter habitat and poaching (MELQUIST, 1984; MEDINA, 1996).

Table 1. Priorities in conservation and research determined by the surveyed biologist (N: number of responses, %: percentage of the total number of responses per subject)

Subject		*P. brasiliensis*		*L. longicaudis*		*L. provocax*		*L. felina*		TOTAL	
		n	%	n	%	n	%	n	%	n	%
Effective control of poaching	Very good					1	33			1	5
	Good	1	17							1	5
	Fair good			3	60	2	66			5	29
	Poor	3	50	3	40			2	100	8	47
	Very poor	2	33							2	12
Conservation threats	Habitat loss	6	29	5	29	1	29	2	20	15	27
	Perturbation	7	19	3	18	2	29	2	20	11	20
	Pollution	8	14	4	24			2	20	9	16
	Poaching	9	19	2	12			2	20	8	15
	Fragmentation	4	19	3	18	3	43	2	20	12	22
Conservation priorities	Monitoring	4	22	4	24	2	20	2	25	12	23
	Habitat protection	1	6	4	24	3	30	2	25	10	19
	Action Plan	2	11	2	12	1	10	1	13	6	11
	Law improvement	3	17	3	12	2	10			6	11
	Poaching control	2	11	4	12	3	20	1	13	7	13
	Education	6	33	3	18	1	10	2	25	12	23
Research priorities	Distribution,	2	16	4	27	1	13	1	20	9	19
	status	5	26	3	20	2	13	2	40	11	23
	Natural History	5	26	3	20	3	38	1	20	12	26
	Threatened	6	32	5	33	3	38	1	20	15	32
	factors										
	Ecology										
Conservation and research progress	Very good										
	Good										
	Fair good	3	50	4	67	3	100	1	50	11	65
	Poor	3	50	2	33			1	50	6	35
	Very poor										
Difficulties	Internal	5	38	2	43	1	67			12	48
	Priorities	2	31	3	29					6	24
	Implementation	4	31	2	29	1	33			7	28
Forms returned		6		6		3		2			

All biologists approached agree that habitat protection, education and public awareness, and otter population monitoring are the most important methods to counter the conservation threats. However, only a few of them (<11%) thought that an Action Plan should be an integral part of the strategy to limit threats and to improve the conservation of otter (Tab. 1). Furthermore, studies on the determination of conservation threats, and the distribution and status of the otter species, were considered as a second and fourth priority after research in ecology and natural history, as progress in these areas were considered to be poor or fairly good (Tab. 1).

The situation described above should encourage and support otter biologists in Central and South America to formulate an Action Plan for each country, with protocols to determine conservation priorities. With the limited funds available, slow progress with data acquisition and increasing conservation threats, research should focus on the detection and control of threats to the survival, following strict scientific methods to reduce the uncertainty of the conservation decisions. It is imperative to promote the research and conservation of otters in Central American countries, as well as in Bolivia, Paraguay, Venezuela and Guayanas.

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GROUP STRUCTURE, SEASONAL VARIATION AND BEHAVIOUR OF *Lutra perspicillata* AT TWO DIFFERENT ECOZONES

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Abstract: The Smooth-coated otter *Lutra perspicillata*, an endangered species, is a shy and secretive animal, being very sensitive to human presence and habitat changes. Little information is available on group structure, seasonal variation and associated behaviour of this species in India. A study was undertaken at two different ecozones, namely, Coringa (estuarine habitat) and Hampi (riverrine habitat) to try and address this. A total of 350 animals were sighted in 23 groups throughout the study period at Coringa. Each group consisted of 2-24 animals. While at Hampi, 150 otters in 12 groups were sighted each group consisting of 1-9 animals. The mean group size of otters at Coringa was 4.28 and 4.85 at Hampi. The overall mean group of otters in both the study areas did not show significant variation between seasons. Group size classes showed seasonal variations in both study areas, with group size of 5-7 animals and 2-4 animals were dominant through out the study period both at Coringa and Hampi, respectively.

INTRODUCTION

Otters in general live in small groups (MELQUIST and HORNOCKER, 1983), and the smooth-coated otter *Lutra perspicillata* has also been reported to live in small groups (POCOCK, 1949; PRATER, 1971; MASON and MACDONALD, 1986; HUSSAIN, 1993, 1996) throughout their range. The study aimed at understanding group structure, seasonal vaiation in it and the behaviour of smooth- coated otters in two ecozones.

STUDY AREAS

Two areas were selected for the present study (Fig. 1 and 2) . The first in the Coringa Wildlife Sanctuary covered an area of 235.70 km^2. The mangrove is 30 km long in north-south direction and is 15 km wide east-west. The entire mangrove system is drained twice in the diurnal tide cycle. The phytosociology of the area reveals that the mangrove vegetation is variegated. Numerous mudflats and narrow creeks that criss-cross the area are subject to tidal intrusion as a result of which a high level of productivity occurs, supporting a large population of otters. The climate of this area is wet with high temperatures and high degree of humidity.

Most dominant mangrove species are *Excoecaria* spp., *Avicennia* spp., *Sonneratia* spp. and *Rhizophora* species. Other dominant species are *Acanthus* spp., *Aegiceras* spp., *Bruguieara* spp., *Luminitzera* spp., *Ceriops* spp., etc.

The second area is Hampi where the habitat is characterized primarily by undulating sheet rocks or boulders with patches of vegetation between. It provides an ideal habitat with plenty food from rivers. However, being downstream of the dam on the River Tungabhadra, intermittent water releases affects food availability to the otters. The soil is basically black cotton type, and ranges from sandy to clayey. The climate of this area is dry with high temperatures, prolonged hot summer characterized by high temperatures and low degree of humidity.

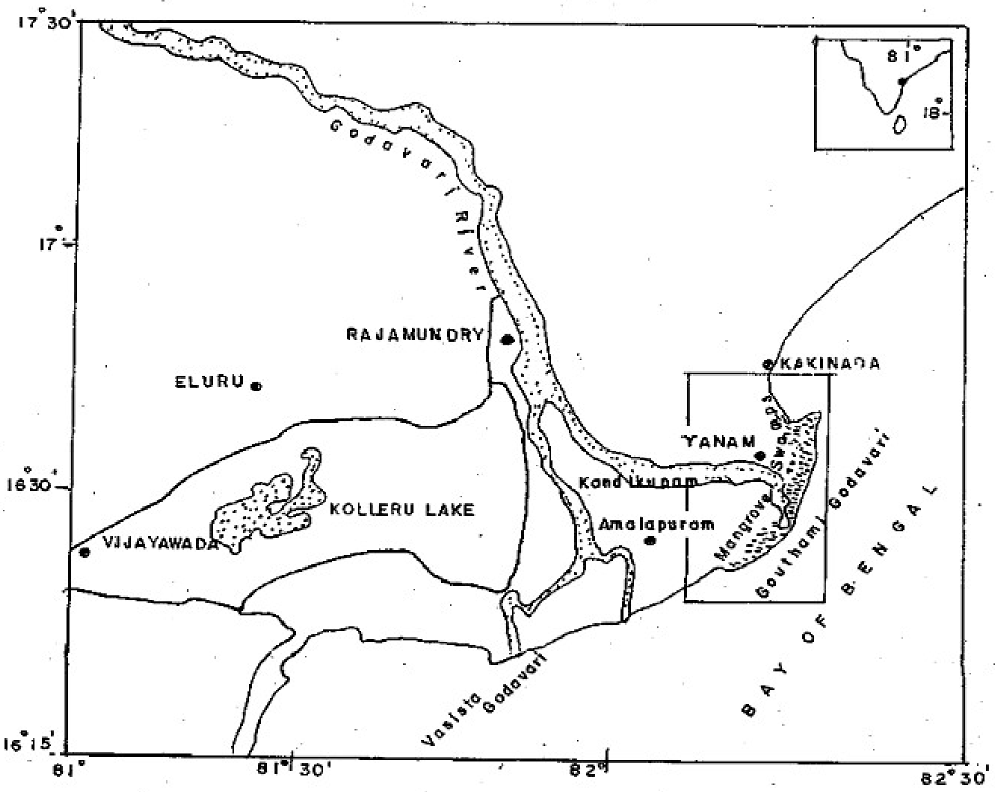

Figure 1. Study area: Coringa Wildlife Santuary – An estuarine habitat

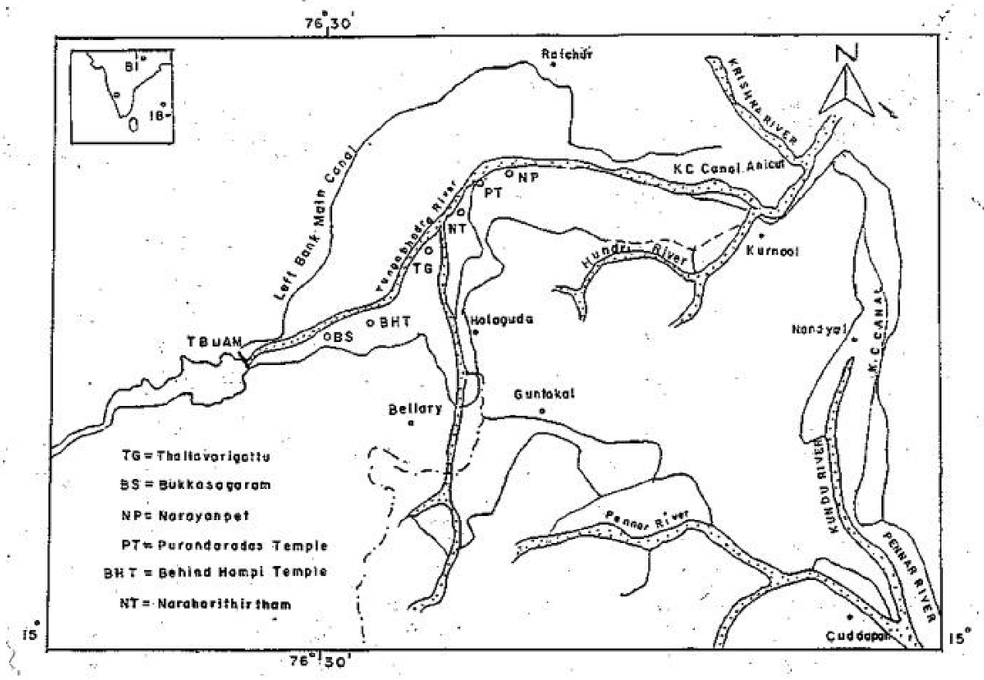

Figure 2. Study area: Hampi – a riverine habitat

Vegetation is primarily that of southern tropical thorn forest (6A/C1) type (CHAMPION and SETH, 1968). Cultivation and plantations dominate the vegetation on the banks. The major tree and shrub species are *Acacia* spp., *Prosopis juliflora*, *Zizyphus* spp., *Capparis* spp., *Calotropis gigantea* and *Carrisa* spp. Ecological descriptions of the study areas are outlined in Table 1.

At the Coringa Wildlife Sanctuary six potential sites were selected - Thalarevu (TL), Plantation (Coringa) (PL), Metlapalem (MP), Sarihaddu Kaluva (SK), Dindodivari Canal (DC) and Kandikuppam (KK), where regular observations were carried out. At Hampi six sites were also selected - Thalavarigattu (TG), Bukkasagaram (BS), Narayanpet (NP), Purandardas Temple (PT), Behind Hampi Temple (BHT), and Narahari Theertham (NT), for intensive monitoring.

MATERIALS AND METHODS

Most of the information about potential sites in both the study areas was collected through field surveys using standardized field techniques as described by MASON and MACDONALD (1986, 1987). However, keeping in view, the chances of sightings and feasibility of observation, these two ecozones were selected. All the field observations were carried out by boat and on foot at both study areas.

All observations were carried out with the aid of 8 X 40 and 7 X 50 binoculars. The major creeks at Coringa where otters were recorded were monitored regularly. At Hampi, potential sites along the river downstream of Tungabhadra dam were monitored. As the otter's nocturnal and elusive habits make direct counts almost impossible, care was taken to record all the indirect evidences of otter presence in the study areas. During each observation, location, number of animals, positive sites and habitat type were recorded on maps (1:50,000 maps). Special emphasis was made to record the number of individuals in the group in different seasons. Methods outlined by JENKINS and BURROWS (1980), LENTON et al. (1980), MACDONALD and MASON (1983), CHEHEBAR (1985), KRUUK et al. (1986), JEFFERIES (1986), MASON and MACDONALD (1987) and ROWE-ROWE (1992) with slight modification, of MACDONALD and MASON (1983), to suit local conditions were used for the survey. Relationships between variations in group structure with respect to seasons at both the study sites was analyses by Analysis of Variance.

RESULTS AND DISCUSSION

Group Structure

The mean group size and structure of the otter population at Coringa and Hampi, in different seasons, showed significant variation ($P<0.005$). At Coringa, 350 otters were sighted in 23 groups, each group consisting of 2-24 animals. The mean sighting of otters, however, changed with time of day and seasons. The mean group size of otters showed an increasing trend from winter to summer through the monsoon. The mean group size of otters during winter ranged between 1.96±2.1 (n=25) and 7.8±4.5 (n=52) and during summer between 1.52±2.1 (n=40) and 5.8±2.6 (n=55). During the monsoon the mean group size was less ranging between 0.8±1.4 (n=26) to 4±1.7

(n=48). During the first year of the study no significant variation was observed in group structure, while during other years a significant variation was noted (Tab. 2).

At Hampi, the mean group size during winter ranged from 1.73±1.9 (n=15) to 4.5±1.8 (n=42), while, in summer it ranged between 1.44±1.6 (n=18) and 4±1.8 (n=52). The smallest group size was recorded during the monsoon period and ranged between 1.0±1.3 (n=12) and 2.9±1.4 (n=46). No significant variation in group structure was noted during 1991-92 and 1992-93, but in later years a significant variation was noted (Tab. 3). About 150 otters were recorded in 12 groups each consisting of 1-9 animals. HUSSAIN (1993) observed 29 otters in 5 groups with 2-9 animals at Chambal National Park in North India.

Decreases in populations were recorded in both the study areas and this could be attributed many anthropogenic activities leading to habitat destruction and biotic pressures. Strict ecological measures should be implemented to enhance shrinking otter population to the minimum viable level.

Seasonal variation and behaviour

A significant seasonal variation in the sightings of otters at different study sites at Coringa (P<0.001) and and no significant variation in the same at Hampi was recorded, during the study period (Tab. 4 and 5). At Coringa, during the summer months the mean group varied between 7.42±1.81 at Dindodivari Canal (DC) in 1991-1992, followed by Plantation (PL) where it was 6.83±1.56 in 1993-94. The minimum was observed at Thalarevu (TH) in 1990-1991, with a mean group size of 2.8±1.32. During the monsoon, mean group size varied from maximum of 7.82±1.45 at Dindodivari Canal (DC) in 1992-1993 and the minimum of 3.01±1.4 at Thalarevu (TH) in 1990-1991. While, in winter months it ranged between 7.69±1.53 at Dindodivari Canal (DC) and 2.91±1.43 at Thalarevu (TH) in 1991-1992. In all the seasons during the study period a significant mean group size (F - 122.82: P<0.001) was recorded at the Dindodivari Canal (DC) site, ranging between 7.09±1.78 to 7.82±1.45; followed by Plantation (PL) - 5.84±2.05 to 7.16±1.38 (F - 129.68: P<0.001) and Kandikuppam (KK) - 3.95±1.61 to 5.28±1.28 (F - 47.02: P<0.001). At other sites the maximum group size was observed at Metlapalem (MP) being 5.47±1.53 (F - 25.71: P<0.001) (Tab. 4) The overall mean group size at Coringa in different seasons during the study period did not show significant variation (Fig. 3)

At Hampi, seasonal changes in group size showed slight variations at different study sites during the study period. The maximum group size in all the seasons was recorded from Thalavarigattu (TG). The highest was 3.17±1.04 during winter of 1990-1991, followed by 3.01±1.08 during summer of 1991-1992, 2.96±0.89 during winter 1992-1993. The smallest group size was 2.79±1.05 in the monsoon of 1993-1994. Interestingly, the mean group size during the monsoon was the lowest when compared to other seasons. At Bukkasagaram (BS) the mean group size varied from 2.64±1.03 (winter, 1993-1994) and 2.97±1.13 (summer, 1991-1992). At Narayanpet (NP) it ranged between 2.37±1.04 (winter, 1993-1994) and 2.71±1.21 (monsoon, 1990-1991); at Purandaradas Temple (PT), it was between 2.29±1.08 (monsoon, 1992-1993) and 2.76±1.19 (winter, 1990-1991). While at sites Behind Hampi Temple (BHT) and Narahari Theertham (NT), the maximum mean group size was 2.46±1.14 (monsoon, 1990-1991) and 2.57±1.14 (monsoon, 1990-1991), while the minimum was 2.13±0.9 (summer, 1991-1992) and 2.11±0.89 (monsoon, 1993-1994) (Table 5). Excepting Behind Hampi Temple habitat (F - 10.39: *P*<0.001), no significant variation in mean group size of otters was noted. No significant variation in the overall mean group size of otters at Hampi was noted (Fig. 4).

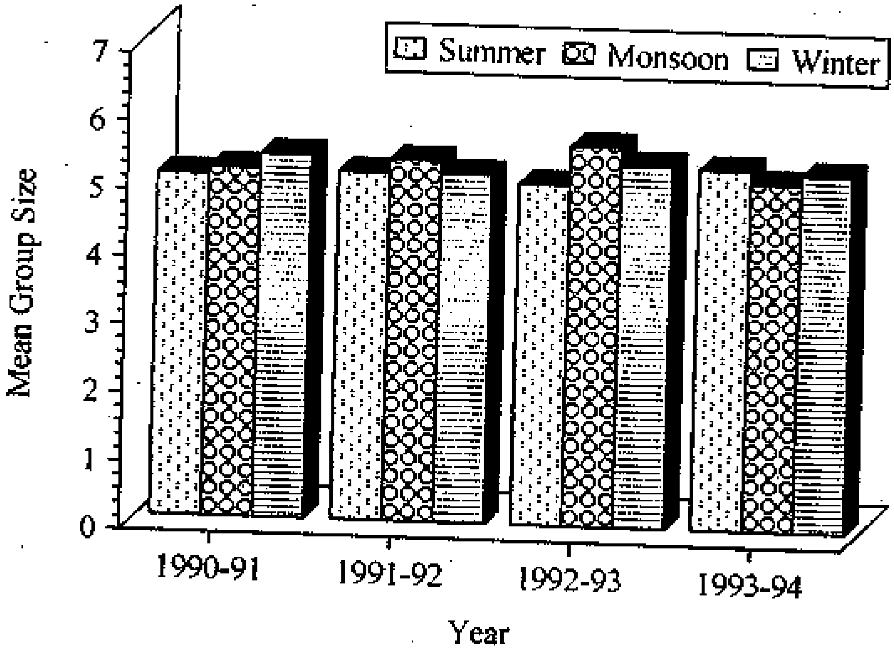

Figure 3. Seasonal variations in mean group size of otter at Coringa

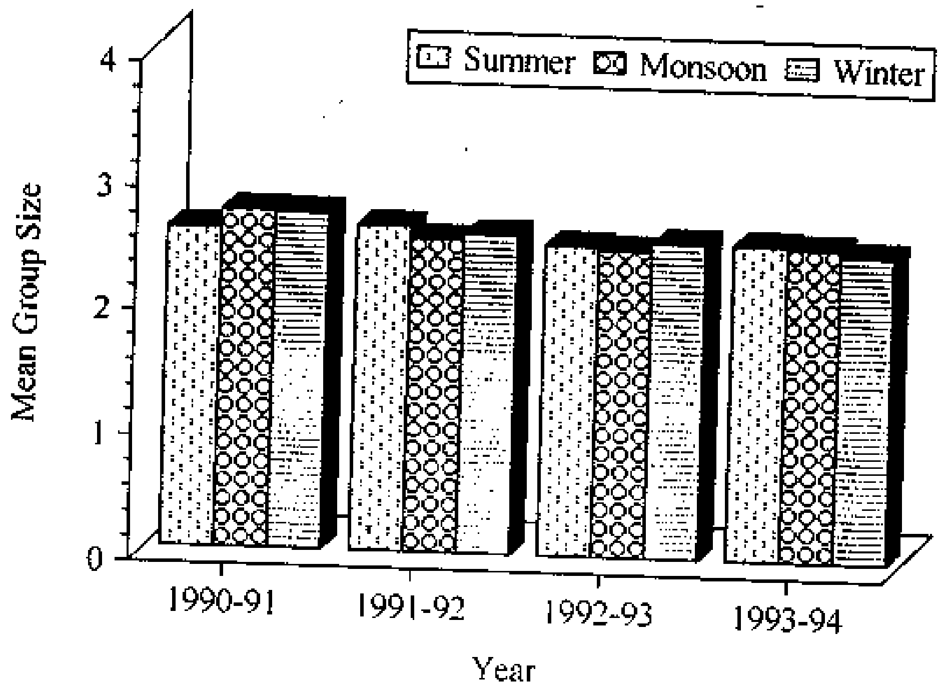

Figure 4. Seasonal variations in mean group size of otter at Hampi

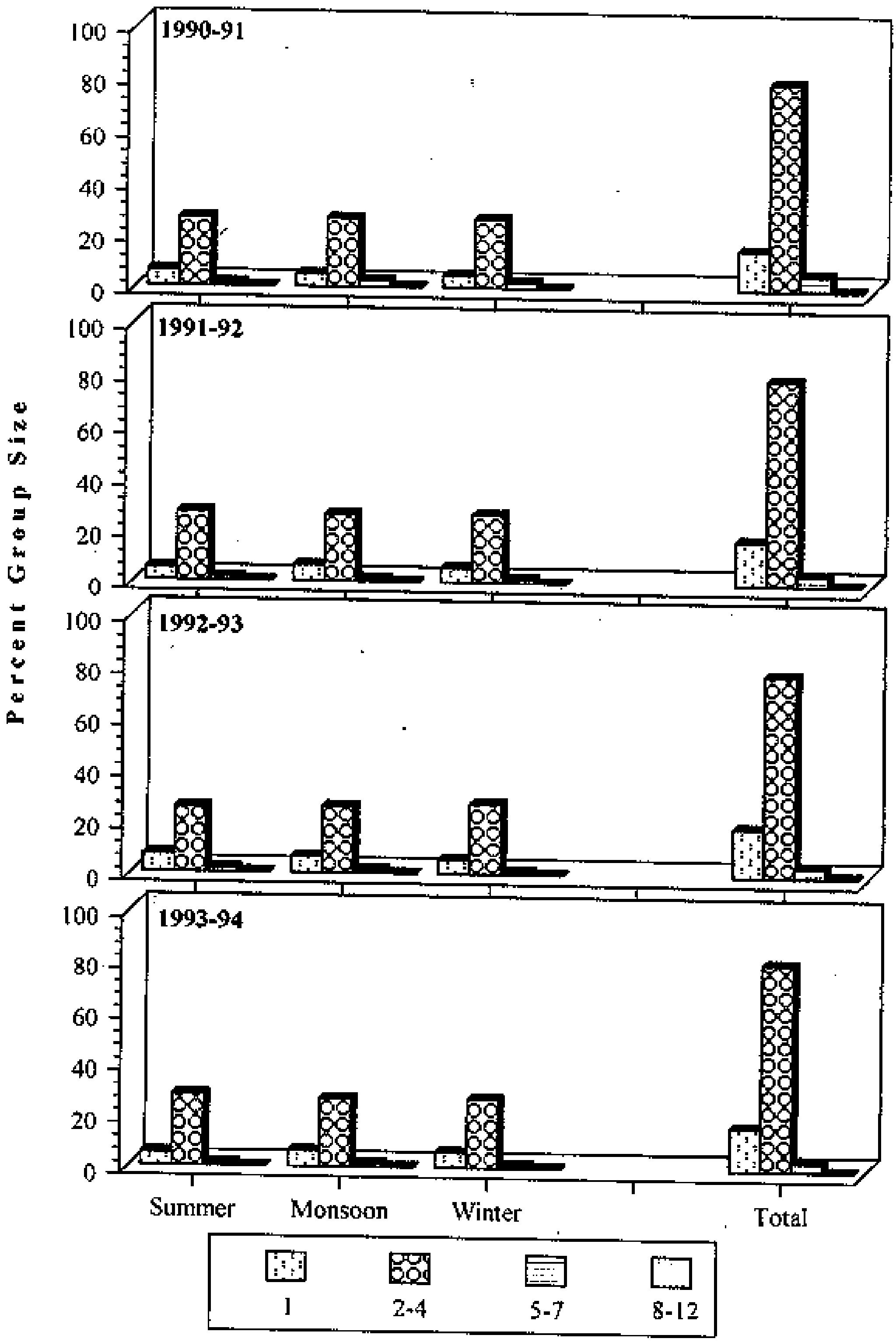

Figure 5. Percent sightings of otter in different group size at Coringa

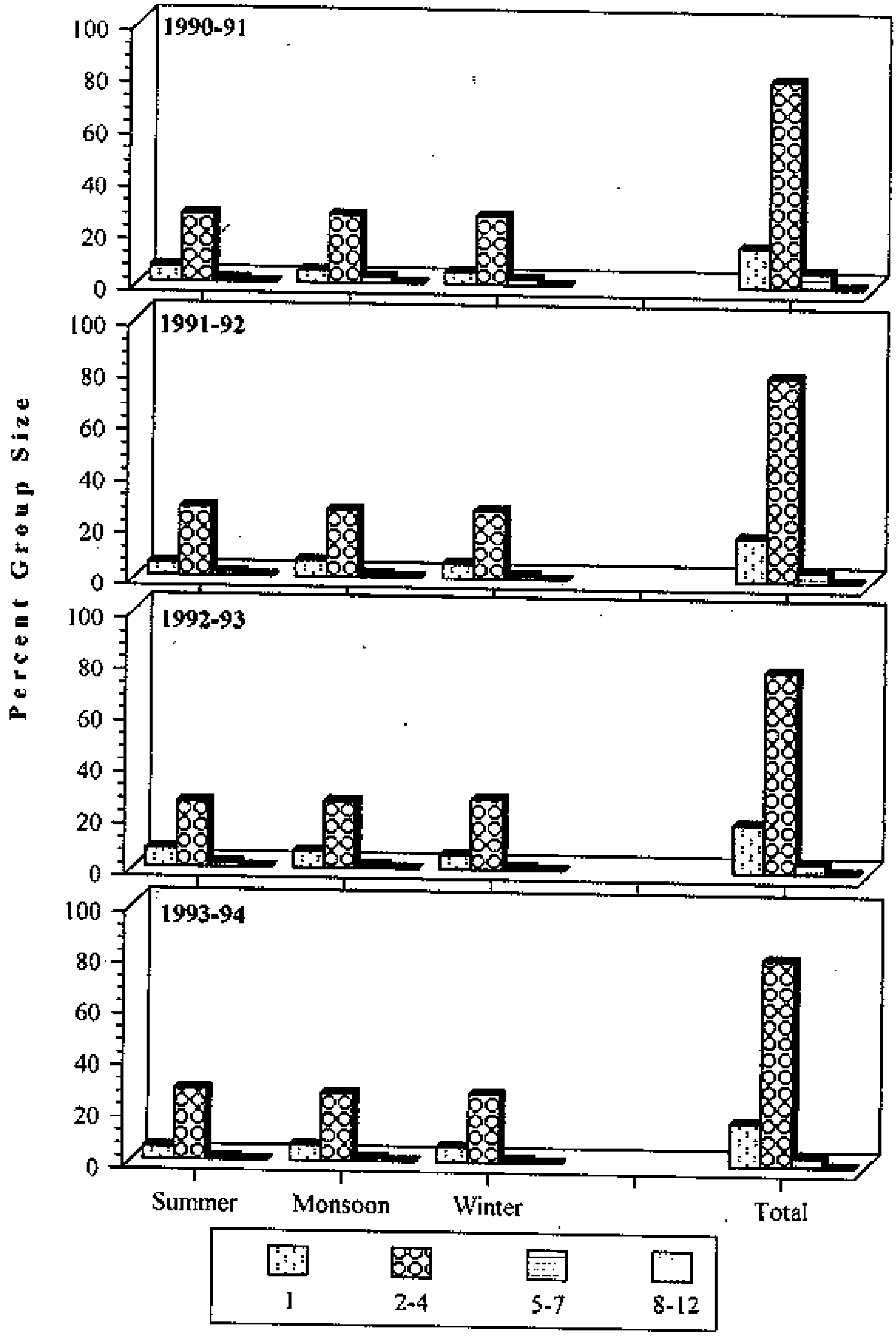

Figure 6. Percent sightings of otter in different group size at Hampi

The relation between the various group size classes and seasons showed variations at both the study areas (Table 6 and 7). At Coringa, groups of 5-7 animals was the most frequently recorded in all the years of the study. The maximum was observed during winter (17.5%) and the minimum during the monsoon (13.7%). Groups of 2-4 animals was the maximum recorded during the summer (12.5%) and minimum during the monsoon (8.85%). The incidence of sightings of lone individuals was the lowest and it was maximum during the monsoon (1.18%). Throughout the whole study period the percentage sightings of individual otters ranged between 1.6% - 2.63% (Fig. 5) However, no significant variation in sighting of otters in different group size structure with seasons throughout the study period was noted (χ^2_6 = 6.73: n.s.).

At Hampi, the group size class of 2-4 animals was dominant over other groups in all the years of the study. The maximum was recorded during the summer of 1993-1994 (27.5%), while the minimum was recorded during the summer of 1992-1993 (25%). Groups of 5-7 animals were low with percentages ranging between 0.88% (summer, 1993-1994) to 2.49% (monsoon, 1990-1991). The percentage sighting of single animals at Hampi was significantly high with the maximum incident of sightings being 18.5% during 1992-1993 (Fig. 6). As at Coringa, no significant variation in sighting of otters in different group size structure with seasons throughout the study period was noted (χ^2_4 = 3.72: n.s.).

The seasonal variation in the group size in both study areas was higher during the monsoon and in winter. In summer the group size was slightly lower. This variation can be attributed to the fact that otter sightings during the monsoon increase as otters tend to come out of the submerged dens which become flooded by the rain and compels the otter to seek higher areas. Observation during the rainy season usually shows good population of animals. By winter, the young ones born in the preceding breeding season are seen associated with their mothers busily feeding on the gamut the rains have brought a few months back. The observations of MELQUIST and HORNOCKER (1983) and HUSSAIN (1993, 1996) of seasonal variation in otter sightings do not agree with the present observation. This may be due to many reasons, a few of them being the difference in habitat conditions, change in reproductive pattern and the adaptation of animals to local conditions.

Unlike the Eurasian otter (*Lutra lutra*) and other otter species, the smooth-coated otter is a social animal that tends to live in groups of 2-7 animals. KANCAHANASAKA and BOONKIRD (1995) have observed smooth-coated otters leading a solitary life. However, in general, group size varies considerably depending on the habitat as well as availability of food. At Coringa, maximum sightings of otters were in groups of 5-7 individuals, while HUSSAIN (1993) recorded group sizes of 1-9 animals in Chambal National Park in North India. At Hampi, they were more often sighted in groups of 2-4. As FOSTER-TURLEY and SANTIAPILLAI (1990) observed, group sizes of otters tend to be larger at Coringa - the estuarine habitat, compared to that at Hampi - the riverine habitat.

Table 1. Ecological description of the study areas

S. No.	Parameter	Coringa	Hampi
1.	Location	$16^{O}42'$ N / $82^{O}15'$ E	$15^{O}17'$ N / $76^{O}23'$ E
2.	Area (km^2)	235.7	92
3.	Habitat	Mangrove	Riverine
4.	Climatic conditions		
	Temperature	19.3^{O}C – 41.3^{O}C	18.5^{O}C – 43.8^{O}C
	Rainfall	1600 mm	950 mm
5.	Flora	Halophytes & floating weeds	Herbs & shrubs
6.	Fauna	Marine & estuarine fishes, prawns crabs, mudskippers, otter, fishing cat, jackal, fox, and a variety of fishes	Freshwater fishes, Freshwater turtles, leopard, sloth bear, crocodile, otter, jackal, fox, and a variety of fishes
7.	Socio-economic status		
	Fishermen	Medium	Poor
	Export	High	Poor
	Land utilization	High	Medium
8.	Health and hygiene		
	Water pollution	Seasonal	Lesser extent
	Epidemics	Malaria, Filiariasis, Tuberculosis & Cholera	Small pox, Gastro-enteritis, Tuberculosis & Cholera
9.	Status of otter	Protected area, fairly good population	No protection, poaching significant

Table 2. Seasonal sightings of *Lutra perspicillata* at Coringa

Year	Season	Mean ± S.D.	Range
1990-91	Summer (n=40)	1.52 ± 2.1	1 – 9
	Monsoon (n=28)	1.00 ± 1.4	2 – 5
	Winter (n=25)	1.96 ± 2.1	2 – 6
1991-92	Summer (n=26)	1.88 ± 2.0	1 – 6
	Monsoon (n=26)	0.80 ± 1.4	2 – 5
	Winter (n=21)	2.57 ± 2.5	1 – 8
1992-93	Summer (n=55)	5.8 ± 2.6	1 – 12
	Monsoon (n=44)	3.1 ± 1.5	1 – 8
	Winter (n=47)	6.8 ± 3.1	2 – 14
1993-94	Summer (n=66)	5.0 ± 2.3	1 – 10
	Monsoon (n=48)	4.0 ± 1.7	2 – 8
	Winter (n=52)	7.8 ± 4.5	1 – 24

Value in parenthesis represents number of group sightings

Table 3. Seasonal sightings of *Lutra perspicillata* at Hampi

Year	Season	Mean ± S. D.	Range
1990-91	Summer (n=18)	1.44 ± 1.6	1 – 5
	Monsoon (n=12)	1.33 ± 1.3	1 – 3
	Winter (n=15)	1.73 ± 1.9	1 – 6
1991-92	Summer (n=14)	1.78 ± 1.8	1 – 5
	Monsoon (n=12)	1.00 ± 1.3	2 – 3
	Winter (n=16)	2.18 ± 2.0	1 – 5
1992-93	Summer (n=52)	4.0 ± 1.8	2 – 8
	Monsoon (n=46)	2.9 ± 1.4	1 – 6
	Winter (n=42)	4.5 ± 1.8	2 – 9
1993-94	Summer (n=55)	3.3 ± 1.6	1 – 7
	Monsoon (n=63)	2.8 ± 1.2	1 – 6
	Winter (n=55)	4.1 ± 1.8	1 – 8

Value in parenthesis represents number of group sightings

Table 4. Seasonal variation in sightings of *Lutra perspicillata* in different study sites at Coringa

Year / Season	TH	PL	DC	MP	SK	KK
1990-91						
Summer	2.8 ± 1.32 (range 1 – 6)	5.84 ± 2.05 (range 1 – 10)	7.18 ± 2.06 (range 3 – 12)	4.55 ± 1.72 (range 1 – 8)	4.84 ± 1.35 (range 2 – 8)	4.91 ± 1.39 (range 1 – 9)
Monsoon	3.01 ± 1.4 (range 1 – 6)	6.76 ± 1.92 (range 2 – 10)	7.34 ± 1.85 (range 3 – 12)	4.61 ± 1.58 (range 1 – 8)	4.47 ± 1.7 (range 1 – 8)	4.54 ± 1.84 (range 1 – 8)
Winter	3.32 ± 1.48 (range 1 – 6)	6.61 ± 1.77 (range 2 – 10)	7.0 ± 1.71 (range 4 – 12)	5.47 ± 1.53 (range 2 – 8)	4.88 ± 1.56 (range 2 – 8)	4.72 ± 1.55 (range 2 – 8)
1991-92						
Summer	2.99 ± 1.42 (range 1 – 6)	6.49 ± 1.76 (range 3 – 10)	7.42 ± 1.81 (range 3 – 12)	4.71 ± 1.71 (range 1 – 8)	4.24 ± 1.7 (range 1 – 8)	4.76 ± 1.5 (range 2 – 8)
Monsoon	3.24 ± 1.24 (range 1 – 6)	7.0 ± 1.61 (range 4 – 10)	7.2 ± 1.71 (range 4 – 12)	4.66 ± 1.65 (range 1 – 8)	4.82 ± 1.62 (range 1 – 8)	4.87 ± 1.75 (range 2 – 8)
Winter	2.91 ± 1.43 (range 1 – 6)	6.2 ± 1.62 (range 4 – 10)	7.69 ± 1.53 (range 2 – 15)	4.25 ± 1.76 (range 1 – 8)	4.42 ± 1.67 (range 2 – 8)	5.28 ± 1.38 (range 2 – 8)
1992-93						
Summer	2.96 ± 1.25 (range 1 – 5)	6.41 ± 1.71 (range 2 – 10)	6.89 ± 2.04 (range 2 – 12)	4.05 ± 1.74 (range 1 – 8)	4.87 ± 1.4 (range 2 – 8)	4.79 ± 1.32 (range 2 – 8)
Monsoon	3.49 ± 1.32 (range 1 – 6)	7.08 ± 1.6 (range 2 – 10)	7.82 ± 1.45 (range 5 – 12)	4.75 ± 1.52 (range 2 – 8)	5.21 ± 1.32 (range 2 – 8)	5.11 ± 1.34 (range 2 – 8)
Winter	1.44 ± 0.48 (range 1 – 6)	1.49 ± 0.23 (range 4 – 10)	1.68 ± 0.22 (range 4 – 12)	1.77 ± 0.38 (range 1 – 8)	1.65 ± 0.36 (range 1 – 8)	1.65 ± 0.35 (range 2 – 8)
1993-94						
Summer	3.51 ± 1.51 (range 1 – 7)	6.83 ± 1.56 (range 4 – 10)	7.11 ± 1.82 (range 4 – 12)	4.41 ± 1.78 (range 1 – 8)	5.17 ± 1.4 (range 2 – 8)	4.64 ± 1.54 (range 1 – 8)
Monsoon	3.37 ± 1.56 (range 1 – 7)	6.51 ± 1.43 (range 4 – 10)	7.09 ± 1.78 (range 5 – 12)	4.78 ± 1.53 (range 1 – 8)	4.86 ± 1.37 (range 2 – 8)	3.95 ± 1.61 (range 1 – 8)
Winter	3.04 ± 1.32 (range 1 – 7)	7.16 ± 1.38 (range 5 – 10)	7.37 ± 1.76 (range 4 – 12)	4.45 ± 1.86 (range 1 – 8)	4.83 ± 1.45 (range 2 – 8)	4.54 ± 1.63 (range 2 – 8)

Study Sites: TH, PL, DC, MP, SK, KK

Key: TH – Thalarevu; PL – Plantation; DC – Dindodivari Canal; MP – Metlapalem; SK – Sarihaddu Kaluva; KK – Kandikuppam;
Values are mean ± S. D.

Table 5. Seasonal variation in sightings of *Lutra perspicillata* in different study sites at Hampi

Year / Season	TH	PL	DC	MP	SK	KK
1990-91						
Summer	3.0 ± 1.01 (range 1 – 6)	2.91 ± 1.09 (range 1 – 5)	2.51 ± 1.18 (range 1 – 5)	2.38 ± 1.1 (range 1 – 5)	2.24 ± 0.95 (range 1 – 5)	2.3 ± 1.03 (range 1 – 5)
Monsoon	2.96 ± 1.04 (range 1 – 5)	2.88 ± 1.2 (range 1 – 6)	2.71 ± 1.21 (range 1 – 5)	2.66 ± 1.2 (range 1 – 6)	2.46 ± 1.14 (range 1 – 6)	2.57 ± 1.14 (range 1 – 5)
Winter	3.17 ± 1.04 (range 1 – 6)	2.91 ± 1.11 (range 1 – 5)	2.68 ± 1.15 (range 1 – 5)	2.76 ± 1.19 (range 1 – 5)	2.28 ± 1.05 (range 1 – 5)	2.37 ± 1.07 (range 1 – 5)
1991-92						
Summer	3.01 ± 1.08 (range 1 – 6)	2.97 ± 1.13 (range 1 – 5)	2.64 ± 1.08 (range 1 – 5)	2.46 ± 1.05 (range 1 – 5)	2.13 ± 0.9 (range 1 – 4)	2.46 ± 1.07 (range 1 – 5)
Monsoon	2.88 ± 1.01 (range 1 – 5)	2.71 ± 1.19 (range 1 – 5)	2.42 ± 1.13 (range 1 – 5)	2.42 ± 1.05 (range 1 – 5)	2.28 ± 0.96 (range 1 – 5)	2.33 ± 1.04 (range 1 – 5)
Winter	2.97 ± 1.05 (range 1 – 6)	2.8 ± 1.11 (range 1 – 5)	2.42 ± 1.12 (range 1 – 5)	2.47 ± 1.11 (range 1 – 5)	2.36 ± 1.02 (range 1 – 5)	2.36 ± 1.05 (range 1 – 5)
1992-93						
Summer	2.86 ± 1.09 (range 1 – 6)	2.64 ± 1.16 (range 1 – 5)	2.42 ± 1.25 (range 1 – 6)	2.47 ± 1.6 (range 1 – 12)	2.18 ± 0.87 (range 1 – 4)	2.36 ± 1.08 (range 1 – 5)
Monsoon	2.88 ± 0.89 (range 1 – 6)	2.67 ± 1.16 (range 1 – 5)	2.55 ± 1.06 (range 1 – 5)	2.29 ± 1.08 (range 1 – 5)	2.21 ± 0.94 (range 1 – 5)	2.13 ± 0.94 (range 1 – 4)
Winter	2.96 ± 0.89 (range 1 – 5)	2.68 ± 1.1 (range 1 – 5)	2.51 ± 1.14 (range 1 – 5)	2.41 ± 1.04 (range 1 – 5)	2.18 ± 0.98 (range 1 – 5)	2.41 ± 1.01 (range 1 – 5)
1993-94						
Summer	2.89 ± 1.45 (range 1 – 6)	2.7 ± 1.02 (range 1 – 5)	2.67 ± 1.01 (range 1 – 5)	2.36 ± 1.03 (range 1 – 5)	2.29 ± 0.92 (range 1 – 5)	2.26 ± 0.94 (range 1 – 5)
Monsoon	2.79 ± 1.45 (range 1 – 6)	2.72 ± 1.11 (range 1 – 5)	2.71 ± 1.21 (range 1 – 6)	2.38 ± 1.11 (range 1 – 5)	2.33 ± 0.91 (range 1 – 4)	2.11 ± 0.89 (range 1 – 5)
Winter	2.8 ± 1.01 (range 1 – 6)	2.64 ± 1.03 (range 1 – 5)	2.37 ± 1.04 (range 1 – 5)	2.22 ± 0.95 (range 1 – 5)	2.37 ± 0.99 (range 1 – 5)	2.37 ± 1.08 (range 1 – 5)

Key: TG – Thalavarigattu; BS – Bukkasagaram; NP – Narayanpet; PT – Purandaradas Temple; BHT – Behind Hampi Temple; NT – Narahari Theertham; Values are mean ± S. D.

Table 6. Seasonal variation in number of sightings of *Lutra perspicillata* in different group size class at Coringa

Year	Group Size	Season: Summer	Monsoon	Winter	Total
1990-91					
	1	12 (0.88)	16 (1.17)	8 (0.58)	36 (2.63)
	2 – 4	170 (12.43)	169 (12.35)	133 (9.72)	472 (34.5)
	5 – 7	208 (15.2)	188 (6.07)	239 (17.47)	635 (46.42)
	8 – 12	66 (4.82)	83 (6.07)	76 (5.56)	225 (16.45)
1991-92					
	1	12 (0.88)	11 (0.8)	12 (0.88)	35 (2.56)
	2 – 4	164 (11.99)	143 (10.45)	157 (11.48)	464 (33.92)
	5 – 7	205 (14.99)	223 (16.3)	205 (14.99)	633 (46.27)
	8 – 12	75 (5.48)	79 (5.77)	81 (5.92)	235 (17.18)
1992-93					
	1	7 (0.51)	4 (0.29)	12 (0.88)	23 (1.68)
	2 – 4	170 (12.43)	121 (8.85)	148 (10.82)	439 (32.09)
	5 – 7	214 (15.64)	239 (17.47)	214 (15.64)	667 (48.76)
	8 – 12	65 (4.75)	92 (6.73)	81 (5.92)	238 (17.4)
1993-94					
	1	11 (0.8)	13 (0.95)	8 (0.58)	32 (2.34)
	2 – 4	131 (9.58)	151 (11.04)	160 (11.7)	442 (32.31)
	5 – 7	242 (17.69)	226 (16.52)	203 (14.84)	671 (49.05)
	8 – 12	72 (5.26)	66 (4.82)	85 (6.21)	223 (16.3)

Value in parenthesis is relative percentage

Table 7. Seasonal variation in number of sightings of *Lutra perspicillata* in different group size class at Hampi

Year	Group Size	Season			
		Summer	Monsoon	Winter	Total
1990-91					
	1	80 (5.85)	63 (4.61)	65 (4.75)	208 (15.2)
	2 – 4	360 (26.32)	359 (26.24)	362 (26.46)	1081 (79.02)
	5 – 7	16 (1.17)	34 (2.49)	29 (2.12)	79 (5.77)
1991-92					
	1	69 (5.04)	86 (6.29)	77 (5.63)	232 (16.96)
	2 – 4	368 (26.9)	355 (25.95)	359 (26.24)	1082 (79.09)
	5 – 7	19 (1.39)	15 (1.1)	20 (1.46)	54 (3.95)
1992-93					
	1	94 (6.87)	85 (6.21)	74 (5.41)	253 (18.49)
	2 – 4	343 (25.07)	352 (25.73)	369 (26.97)	1064 (77.78)
	5 – 7	18 (1.32)	19 (1.39)	13 (0.95)	50 (3.65)
	8 – 12	1 (0.07)	0	0	1 (0.07)
1993-94					
	1	68 (4.97)	82 (5.99)	77 (5.63)	227 (16.59)
	2 – 4	376 (27.49)	357 (26.1)	363 (26.54)	1096 (80.12)
	5 – 7	12 (0.88)	17 (1.24)	16 (1.17)	45 (3.29)

Value in parenthesis is relative percentage

These observations agree with those of SHARIFF (1984) regarding the sightings of various group sizes in both study areas. SHARIFF (1984) had noted the presence of large groups and low incidence of solitary sightings in estuarine and coastal mangrove habitats, while at freshwater reported a high incidence of solitary sightings but absence of large groups.

The variation in the group sizes of otters - large groups in estuarine habitat and smaller groups at riverine habitat can be attributed to the fact that tidal fluctuations in coastal areas bring a relatively constant supply of a variety of inter-tidal fauna as prey. The same is not the case at the riverrine habitat, where water level changes due to upstream rains and drought conditions affect the prey availability. MELQUIST and HORNOCKER (1983) and FOSTER-Turley et al. (1990) highlighted similar observations.

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HABITAT USE BY *Lutra perspicillata* AT CORINGA AND HAMPI, TWO ECOLOGICALLY DIFFERENT OTTER HABITATS IN INDIA

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Abstract: The smooth-coated otter prefers to use habitats where food availability is plenty and anthropogenic disturbances are low. The different microhabitats were used mainly for the purpose of feeding, resting and other social activities. Males, females and sub adults at Coringa used more mudflats and mangroves, while at Hampi, rocky areas were more frequently used. The monthly variation of habitat use by male, female and sub adult otters and both the study sites differed significantly (Coringa $P>0.005$, Hampi $P>0.001$). A positive correlation between the degree of habitat use as assessed by direct observations and that appraised by spraint collections was recorded at Coringa, while a negative correlation was found at Hampi.

INTRODUCTION

Habitat use by animals depends upon factors such as the availability of preferred food, shelter and other factors for their safety and sustenance. These factors tend to control the greater use of certain microhabitats within a given area (MARTIN, 1977). The present paper deals with habitat use pattern of smooth-coated otter, *Lutra perspicillata* in two ecologically different habitats in India.

STUDY AREA

The two ecologically different habitats, namely Coringa and Hampi, have been selected for the present study. The former is an estuarine habitat on the East Coast of India (Fig. 1), while the later is a riverrine habitat (Fig. 2). A high density of both palnt and animal species have been recorded to occur in Coringa habitat (NAGULU et al., 1991, 2002).

MATERIALS AND METHOD

Habitat surveys were made at both study areas with the help of the available maps (1:50.000 scale) and all prominent places of otter occurrences were marked. Standardized field techniques (MASON and MACDONALD, 1986, 1987) were followed to identify otter potential sites. All observations were carried out with the aid of 8x40 and 7x50 binoculars. Monthly visits were made to the selected potential sites at both study areas and observations on the number of animals, positive sites and habitat type along with indirect signs of otter activity, i.e., spraints, footprints, holts and food remains were recorded. To determine the habitat use by otters methods outlined by JENKINS and

BURROWS (1980), KRUUK et al. (1986), JEFFERIES (1986), MASON and MACDONALD (1987) and ROWE-ROWE (1992) were followed.

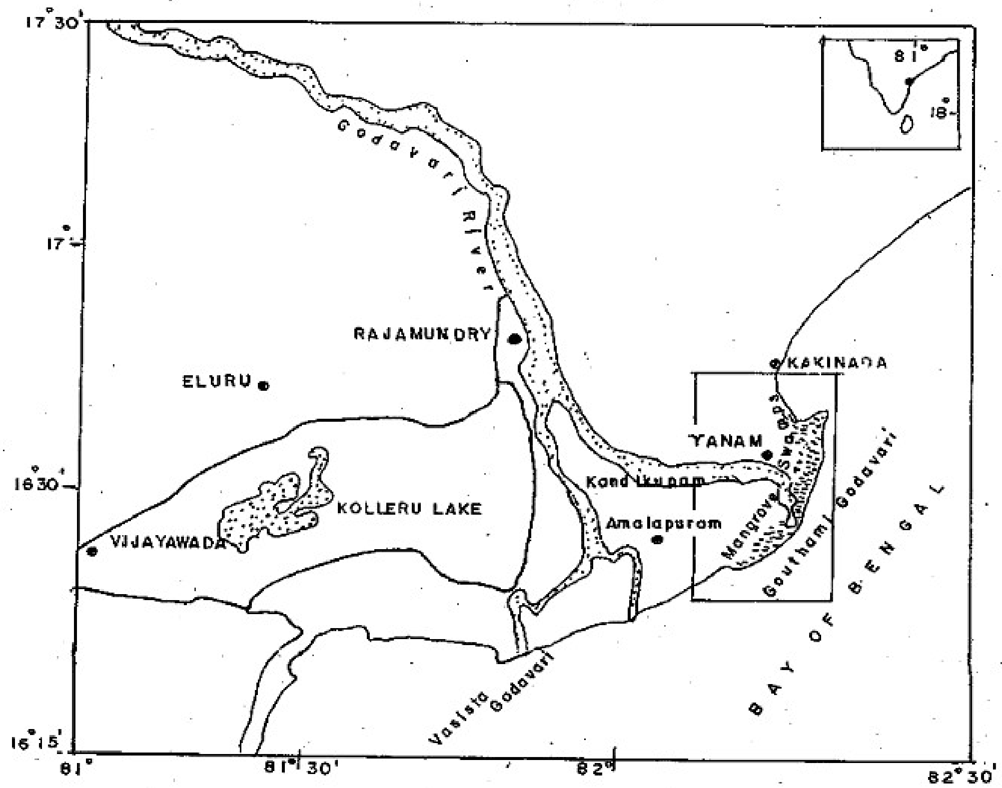

Figure 1. Study area: Coringa Wildlife Santuary – An estuarine habitat

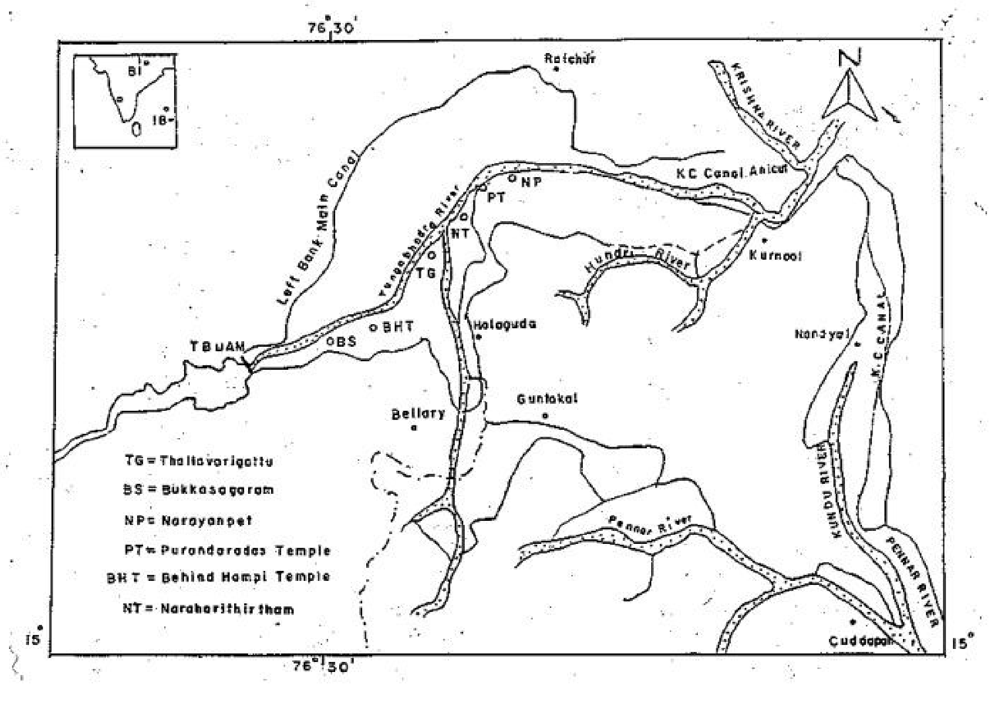

Figure 2. Study area: Hampi – a riverine habitat

Habitat characteristics were analyzed during the preliminary survey of the study areas and the habitat features were recorded on the respective study area maps as rocky areas (RA), sandy areas (SA) and open areas (OA) at Hampi and mudflats (MF), mangroves (M) and open areas (OA) at Coringa.

Habitat Use Index was calculated as follows:

$$\text{Habitat Use Index} = \frac{N_{HI}}{N_H} \times 100$$

Where, N_{HI} = Total number of sightings of individuals in one habitat (in a season or during the study period)
N_H = Total number of sightings of individuals in all habitats (in a season or during the study period)

Analysis of variance was done to assess the significance between the variables in different seasons.

RESULTS AND DISCUSSION

The mean sightings of otters in different seasons in different habitats at Coringa, is given in Table 1. Males, females and sub adults utilized more significantly (P<0.001) the mudflats and mangroves, than the open areas, in all the seasons during the study period. In summer, the mean sightings of males in mudflats ranged between 14.25±3.3 (1990-1991) and 21.5± 2.4 (1993-1994). In winter, it was between 12.75±2.5 (1990-1991) and 17.25±2.6 (1992-1993), while during monsoon it was between 7.25±3.3 and 13.25±3.3. Mangrove use by males was similar in all the seasons but with a maximum in summer (20.5±12), followed by 18±4.2 in winter. In the case of females, the most used habitat was the mangrove type with mean sightings of 20.75±3.4 (1993-1994) in summer, followed by winter (16.5±2.3) during the same year. While at mudflats, the mean sighting ranged between 7±4 (monsoon of 1990-1991) and 17.25±2.5 (summer of 1993-1994). While in other habitats, the mean sightings of females showed no significant variation (P<0.01). The sub adults followed a similar pattern with mean sightings ranging from 4.1±0.92 to 8±2.3 in both the mangrove and mudflats. All the three groups showed similar patterns in the use of open area habitat, with males showing higher incidence (P<0.005) of sightings in this habitat when compared to that of females and sub adults.

At Hampi, males tend to use more sandy areas during summer in all the years of study (Tab. 2), with mean sightings ranging between 13.25±5.5 (1992-1993) and 18.75±5.5 (1991-1992). An exception of maximum value of the mean sighting of otters in rocky areas (19.25±4.1) during the year 1991-1992 was due to increased foraging activities during the lean period. In winters, the use of rocky areas and the sandy areas by male otters did not differ significantly. A similar pattern was found during monsoons. Females

Table 1. Seasonal sightings of *Lutra perspicillata* in different habitats at Coringa

Group	Season	1990-91			1991-92			1992-93			1993-94		
		M	MF	OA	M	MF	OA	M	MF	OA	M	MF	OA
Males	Summer	17.25 ± 2.7	14.25 ± 3.3	2.5 ± 1.0	17.5 ± 3.7	17.0 ± 2.0	2.75 ± 0.9	15.0 ± 4.9	14.25 ± 5.7	4.25 ± 1.5	20.5 ± 1.2	21.5 ± 2.4	4.0 ± 1.4
	Monsoon	9.5 ± 5.6	7.25 ± 3.3	2.75 ± 2.2	10.75 ± 6.6	11.0 ± 6.0	2.25 ± 0.5	12.0 ± 6.0	11.5 ± 5.9	4.25 ± 0.9	15.7 ± 4.3	13.25 ± 3.3	4.25 ± 0.96
	Winter	13.5 ± 4.4	12.75 ± 2.5	3.5 ± 1.9	14.5 ± 3.0	13.0 ± 7.4	3.5 ± 2.0	17.25 ± 2.5	17.25 ± 2.6	4.5 ± 1.0	18.0 ± 4.2	17.25 ± 3.5	4.0 ± 1.8
Females	Summer	13.0 ± 5.35	9.75 ± 2.8	2.4 ± 0.58	16.25 ± 1.7	16.0 ± 2.1	2.75 ± 0.9	14.0 ± 5.7	13.25 ± 4.1	2.75 ± 2.1	20.75 ± 3.4	17.25 ± 2.5	3.75 ± 1.7
	Monsoon	7.0 ± 3.37	7.0 ± 4.0	2.0 ± 1.8	8.75 ± 4.9	8.25 ± 4.3	2.0 ± 0.8	12.25 ± 4.6	13.0 ± 6.1	3.75 ± 0.5	13.75 ± 3.5	13.25 ± 4.9	3.5 ± 1.7
	Winter	13.0 ± 4.0	11.5 ± 2.6	3.0 ± 0.0	13.0 ± 2.5	12.75 ± 3.7	3.5 ± 5.0	16.25 ± 3.86	14.0 ± 1.8	4.0 ± 0.8	12.5 ± 2.3	16.0 ± 3.4	3.5 ± 0.5
Sub adults	Summer	7.75 ± 3.10	5.75 ± 2.91	1.5 ± 0.68	5.5 ± 2.1	4.25 ± 0.6	2.25 ± 0.5	6.0 ± 1.2	4.75 ± 0.9	2.5 ± 1.0	8.0 ± 2.3	5.5 ± 2.3	1.5 ± 0.5
	Monsoon	5.25 ± 0.96	4.0 ± 4.2	2.5 ± 0.58	6.5 ± 2.38	5.75 ± 2.2	2.0 ± 0.8	6.25 ± 2.7	5.5 ± 1.7	2.75 ± 0.9	7.25 ± 2.6	4.5 ± 1.29	1.5 ± 0.5
	Winter	5.75 ± 2.2	5.0 ± 1.8	2.25 ± 0.96	5.5 ± 1.9	5.0 ± 1.8	2.0 ± 0.8	5.5 ± 2.5	4.75 ± 1.7	2.5 ± 0.5	8.0 ± 1.0	8.0 ± 2.9	2.75 ± 1.2

Key: M – Mangrove; MF – Mudflat; OA – Open Areas

Table 2. Seasonal sightings of *Lutra perspicillata* in different habitats at Hampi

Group	Season	1990-91			1991-92			1992-93			1993-94		
		RA	SA	OA	RA	SA	OA	RA	SA	OA	RA	SA	OA
Males	Summer	15.75 ± 5.97	15.7 ± 6.7	3.0 ± 0.8	19.25 ± 4.11	18.75 ± 5.5	3.5 ± 1.3	13.25 ± 5.6	13.25 ± 5.5	3.5 ± 1.0	16.25 ± 2.5	16.5 ± 3.0	2.5 ± 0.58
	Monsoon	11.25 ± 4.6	11.5 ± 4.2	3.75 ± 1.3	11.25 ± 2.5	13.25 ± 3.2	3.75 ± 2.3	14.5 ± 1.7	13.5 ± 2.5	2.25 ± 1.3	15.75 ± 4.35	13.25 ± 3.3	4.25 ± 0.96
	Winter	16.5 ± 1.7	17.7 ± 1.5	4.25 ± 1.5	17.5 ± 2.5	16.25 ± 2.2	4.25 ± 1.5	19.5 ± 3.0	18.0 ± 1.4	3.0 ± 0.8	16.5 ± 4.4	16.0 ± 1.8	3.55 ± 0.9
Females	Summer	14.25 ± 4.7	13.5 ± 6.2	3.75 ± 0.96	17.25 ± 4.5	18.0 ± 2.7	4.5 ± 1.3	13.5 ± 5.8	13.25 ± 5.6	2.5 ± 1.0	19.0 ± 7.3	15.5 ± 2.6	2.25 ± 0.5
	Monsoon	10.0 ± 1.4	10.7 ± 3.1	3.25 ± 1.4	11.5 ± 3.0	11.0 ± 1.8	3.25 ± 0.9	12.25 ± 4.3	10.5 ± 2.3	2.75 ± 0.5	13.75 ± 3.5	13.25 ± 4.9	3.5 ± 1.7
	Winter	16.75 ± 3.9	14.5 ± 2.4	3.75 ± 1.26	15.0 ± 2.45	15.25 ± 3.1	5.0 ± 0.8	16.25 ± 2.1	16.0 ± 2.2	3.25 ± 0.9	16.0 ± 2.5	12.75 ± 2.2	3.75 ± 2.2
Sub adults	Summer	6.75 ± 0.5	5.0 ± 2.2	2.25 ± 0.5	4.75 ± 0.5	4.25 ± 0.96	2.0 ± 0.4	7.25 ± 3.17	6.75 ± 4.3	2.0 ± 0.8	8.0 ± 2.3	5.5 ± 2.4	1.5 ± 0.5
	Monsoon	4.75 ± 0.96	4.25 ± 0.5	1.75 ± 0.5	5.25 ± 1.26	5.25 ± 0.96	1.5 ± 0.58	6.75 ± 2.9	5.75 ± 2.5	1.5 ± 0.5	7.25 ± 2.6	4.5 ± 1.3	1.5 ± 0.5
	Winter	4.5 ± 0.5	4.75 ± 1.3	1.25 ± 0.5	6.75 ± 1.7	6.5 ± 1.8	3.0 ± 0.8	10.75 ± 2.5	8.0 ± 4.24	2.5 ± 0.6	8.25 ± 2.9	6.75 ± 3.86	2.5 ± 1.3

Key: RA – Rocky Areas; SA – Sandy Areas; OA – Open Areas utilized more of rocky areas than the other two habitats during summer ($P<0.005$). The mean sightings of females in rocky areas ranged between 13.5±5.8 (1992-1993) and 19±7.3 (1993-1994), while in sandy areas, the values ranged between 13.5±6.2 (1990-1991) and 18±2.7 (1991-1992). In winters, the mean sightings of females were significantly similar ($P<0.005$) in all the years of study and ranged between 15±2.4 to 16.75±3.9, in rocky areas, while in sandy areas it ranged between 12.75±2.2 and 16.25±2.1. During the monsoon a similar trend was followed, the mean sightings ranging between 10±1.4 and 13.75±3.5 in rocky areas, it was between 10.5±2.3 and 13.25±4.9 in sandy areas. The sub adults were seen to utilize all the habitats similar to that of males and females, though their mean sightings in all the seasons were considerably lower ($P<0.001$) compared to that of adult males and females. An exceptionally high value of mean sighting of sub adult otters (10.75±2.5), was recorded during winter 1992-1993. This increase in mean sightings of sub adults, along with that of adult males (19.5±3) may be due to the possible immigration of small populations of otters form other adjoining areas.

The observations showed that otters prefer to use habitats where food is plentiful and anthropogenic disturbances low. In general the habitat used by otters is mainly for the purpose of feeding, resting and other social interactions.

The seasonal variations in habitat use of male, female and sub adult otters at Coringa and Hampi are shown in Figures 3 and 4. At Coringa, the sighting of males in mangrove habitat was highest during March (11.2%), followed by May (10.06%) and October (10.1%) and lowest in July (4.3%). The percent sightings of males in mangrove showed bimodal pattern of habitat use with decreased use during the months of July and August. In the mudflat habitat, greatest use was observed between March and June with a sharp drop in July followed by a gradual increase. While, in the open areas the maximum use was at the onset of winter season and in January, when the highest percent of 13.53% was recorded.

In the case of females and subadults, the monthly variation in habitat use was also significant ($P<0.005$). The females used mangroves and mudflats significantly more during the months of October to May. At mangroves, the maximum percentage use was during March (11.25%) and February (10.65%), while on the mudflats it was in January (10.69%). In open area habitats, the maximum use was in May (10.81%). During the rest of the months the use of mangroves and mudflats showed similar variations (Fig. 3). The sub adults were seen to utilize more of open areas (in the months of October, November and January). The percent utilization of different habitats by sub adults does not show any significant variation.

At Hampi, a significant variation in monthly use of habitats was recorded among all the three social groups (Fig. 4). In case of males, the use of rocky areas was greatest during the months of November to January, and March to May with a sharp decrease in February. Least use was in July (5.47%). In sandy areas, the utilization was maximum during April (10.75%) and there was also high use between October and March. The open area utilization by males was relatively greater than those at other areas and showed little

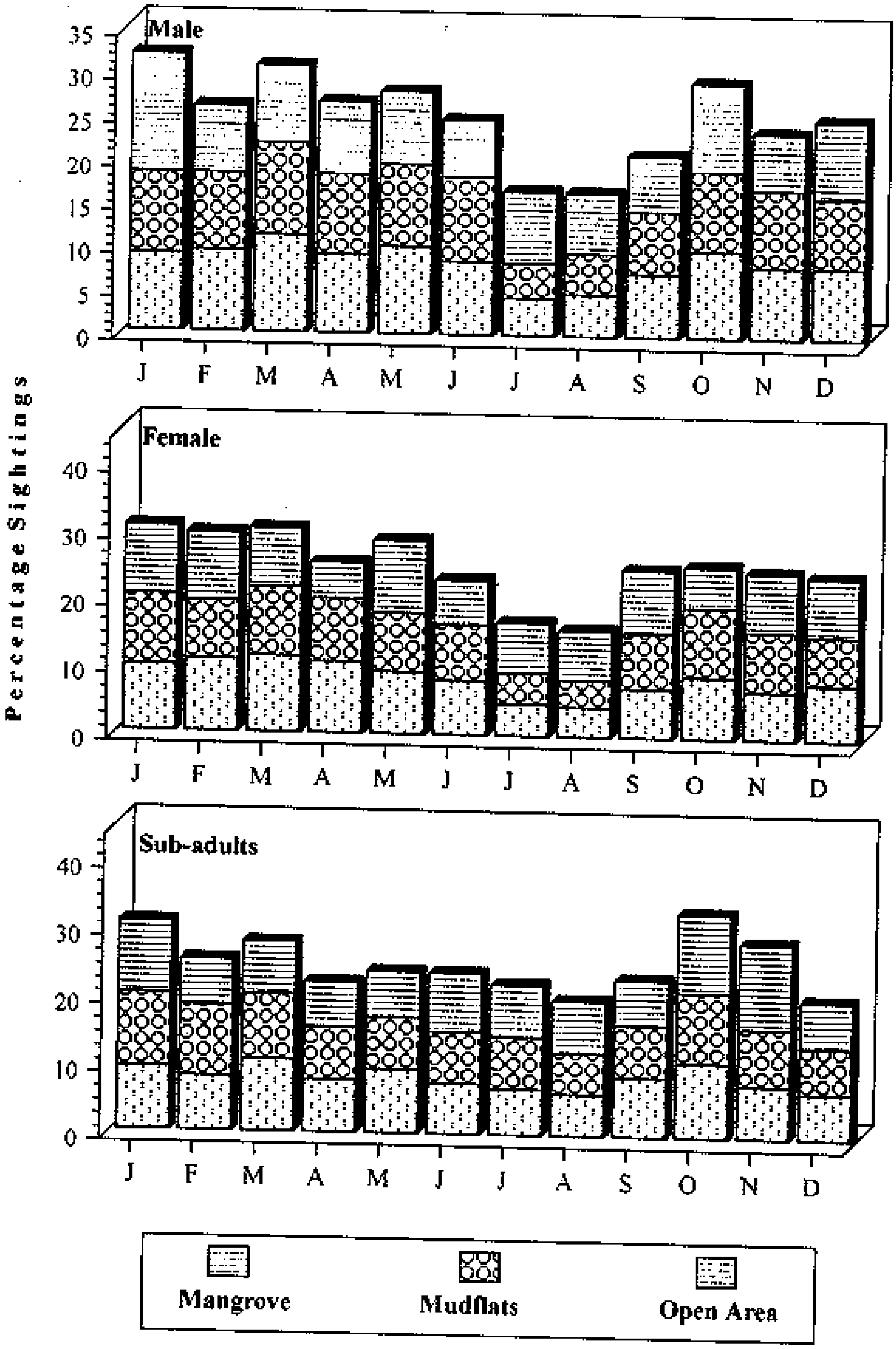

Figure 3. Monthly variations in habitat use of otter at Coringa

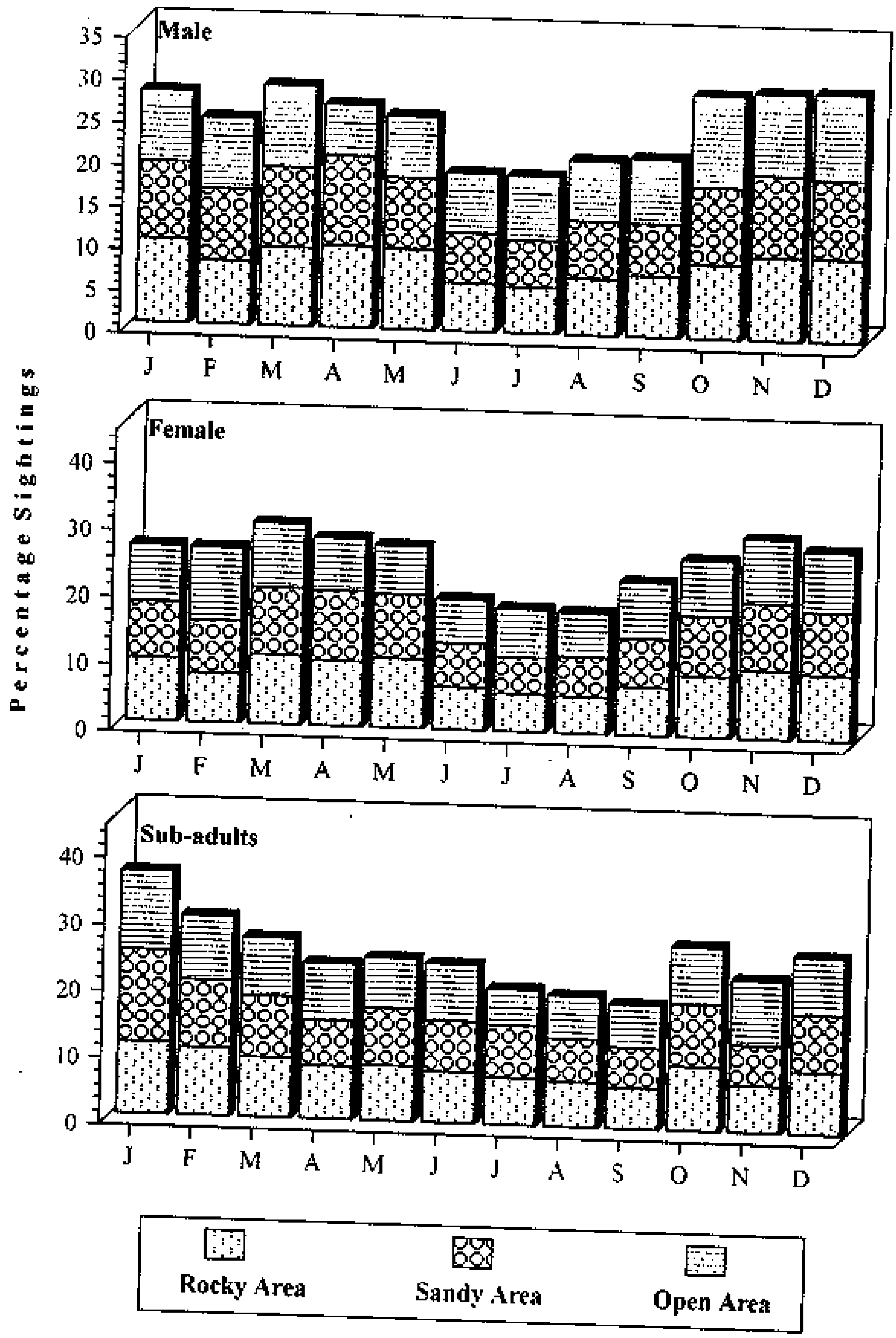

Figure 4. Monthly variations in habitat use of otter at Hampi

monthly variations, ranging 7.19% and 10.78%, but with a sharp decline during April (5.99%).

Female otters at Hampi were observed to use rocky areas with a significant monthly variation ($P<0.005$). The use of this habitat (above 9.5%) was observed in January, March to May, November and December, while the least use was in August (5.41%). In sandy areas, the use of habitat, above 9.5%, was recorded only between March and May, November and December. In open areas, the mean percentage variation of habitat use ranged between 6.63% (June and August) and 10.84% (February). In case of sub adults, the monthly variation in habitat use of rocky areas showed a gradual decrease from January to December, while in the sandy area habitat, the tendency remained same, with the highest value recorded in January (13.81%), followed by February (10.07%) and March (9.33%). The minimum use was recorded in September and November (5.97), and in August (6.34%). The variation in use of open areas was between 5.38% (July) and 11.83% (January) (Fig. 4).

At Coringa, the percentage sighting of males in all habitats during the three seasons tended to be greater than the females and subadults. The same was observed at Hampi. During summer, the mangrove habitat utilization by males ranged between 19.5% to 23.2%, while the range was between 12.69% to 14.14%, and 1.71% to 2.9% in mudflat and open area habitats, respectively. During the monsoon, the mangrove habitat was used more (16.84% to 20.45%), while the mudflats (10.51% to 13.2%) and open areas (2.2% to 3.2%) were used less. In winter a similar pattern was observed. The same was also observed in females and subadults (Fig. 5).

At Hampi, the otters were observed to use more of rocky areas followed by sandy areas in all the seasons. The use of rocky areas in case of females ranged between 17.5% and 20.5% during the monsoon. While the females habitat use value ranged between 16.3% (monsoon) and 21.8% (summer) (Fig. 6).

Indirect evidence, such as occurrence of footprints and spraints were also considered to give an indication for habitat utilization of otters at both study areas. At Coringa, spraint collections showed the habitat use pattern similar to that which had been shown by direct observations in different habitats. The seasonal percent occurrence of spraints in different habitats is shown in Figure 7. During summer, the percent of spraints were collected from mudflats ranging between 15.2% to 20.9%, while it was between 10.1% to 16.9% at mangroves. During the months of the monsoon the highest occurrence of spraints were observed in open areas which were dry and provided better sprainting sites, ranging between 8.2% to 13.8%. In winter the occurrence of spraints were more or less similar in both the mangrove (13.72% to 16.9%) and the mudflat (13.8% to 16.3%) habitats (Fig. 7). The total occurrence of spraints in different habitats showed high incidence of occurrence in mudflats, followed by open areas and mangroves during the study period (Fig. 8).

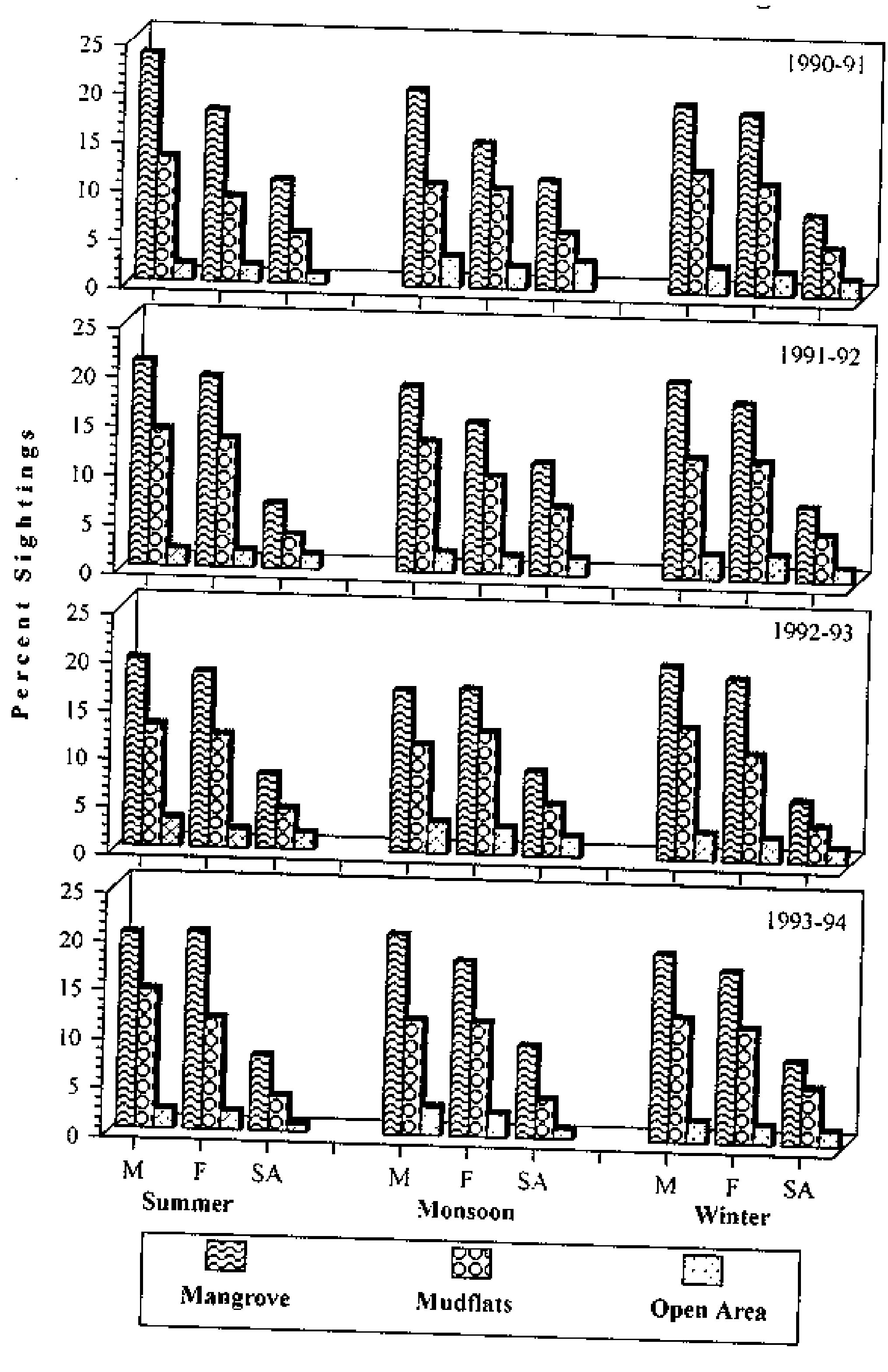

Figure 5. Percent sightings of otter in different habitats at Coringa

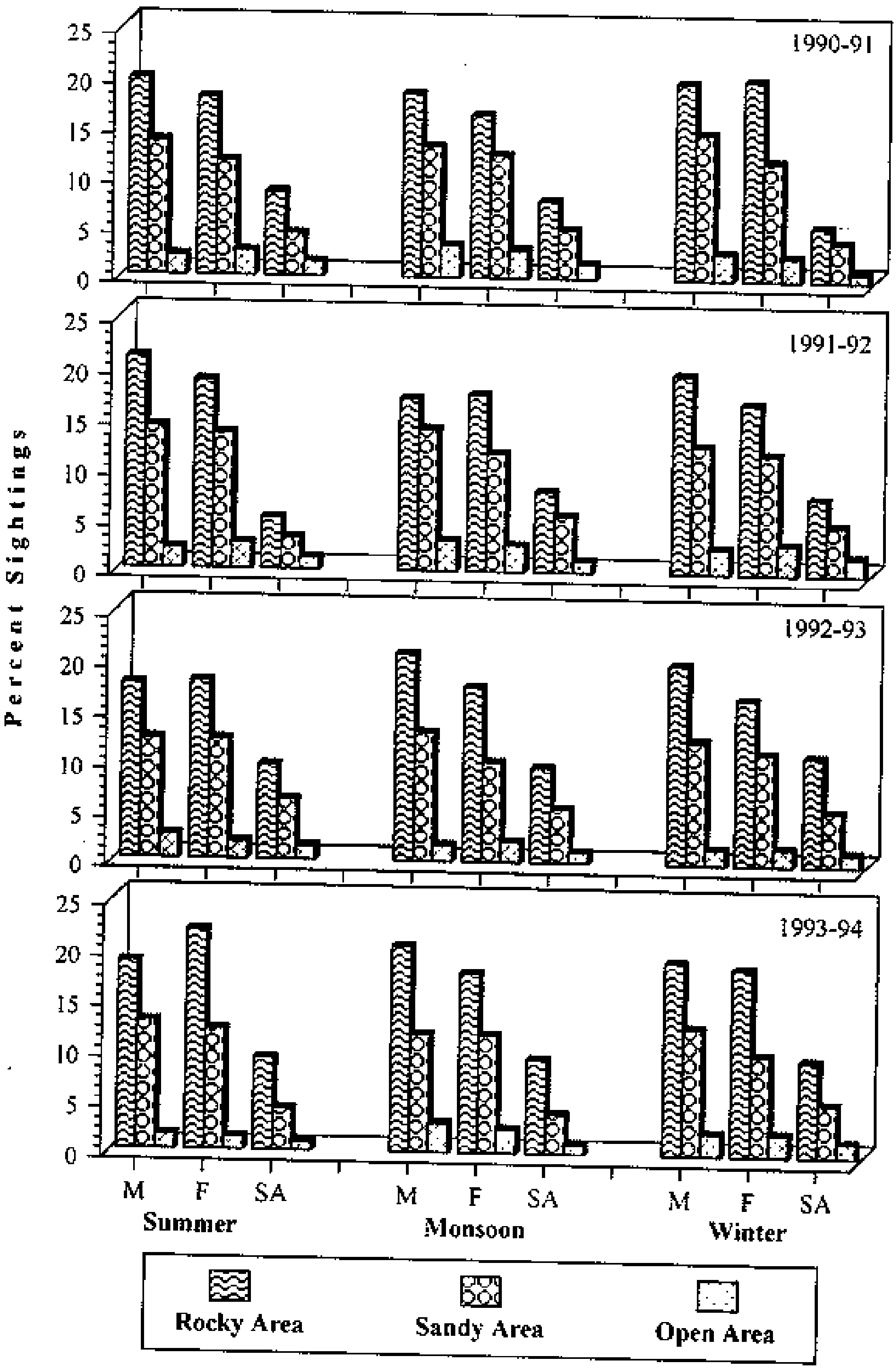

Figure 6. Percent sightings of otter in different habitats at Hampi

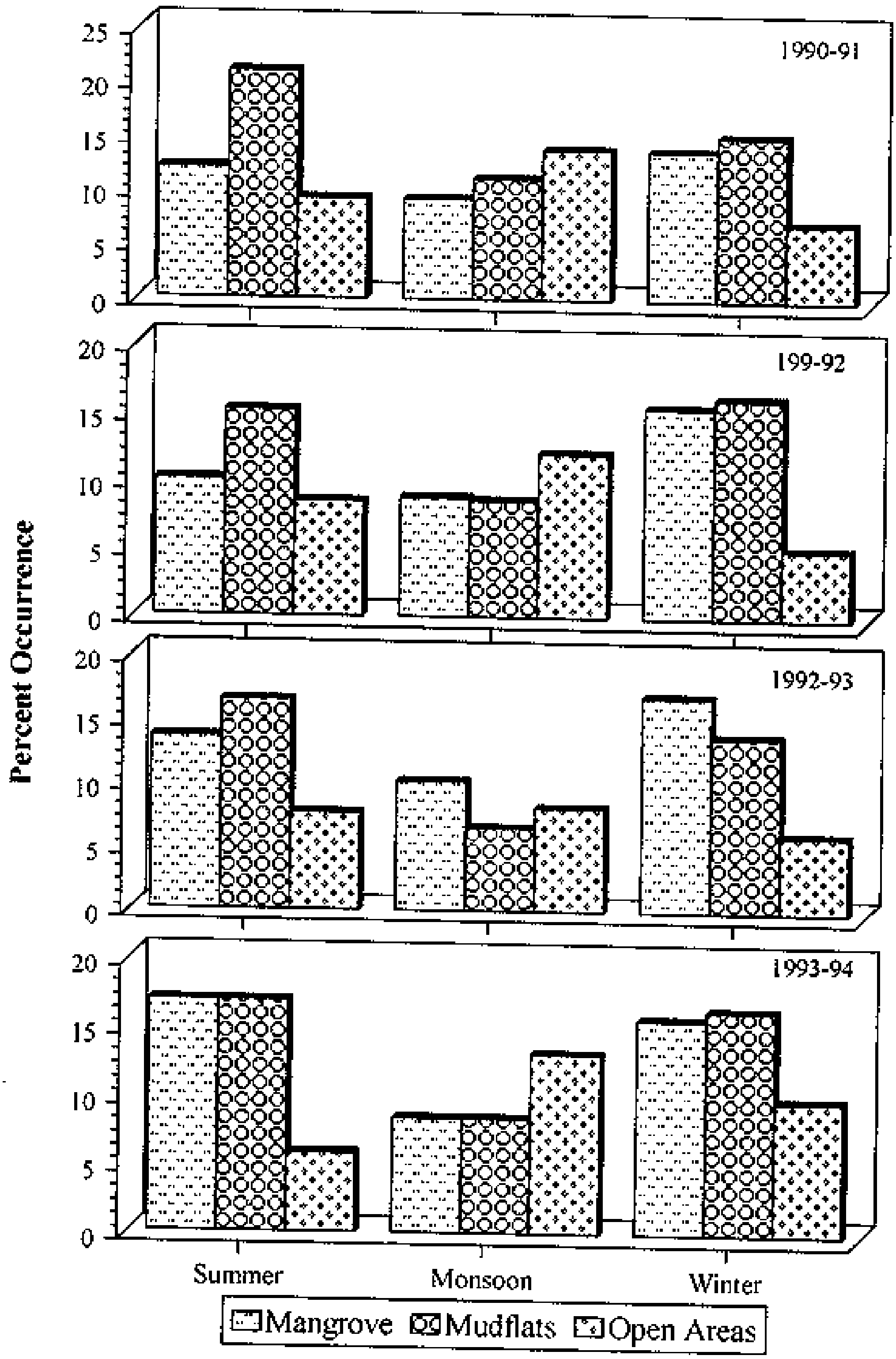

Figure 7. Seasonal percent spraints collected in different habitats at Coringa

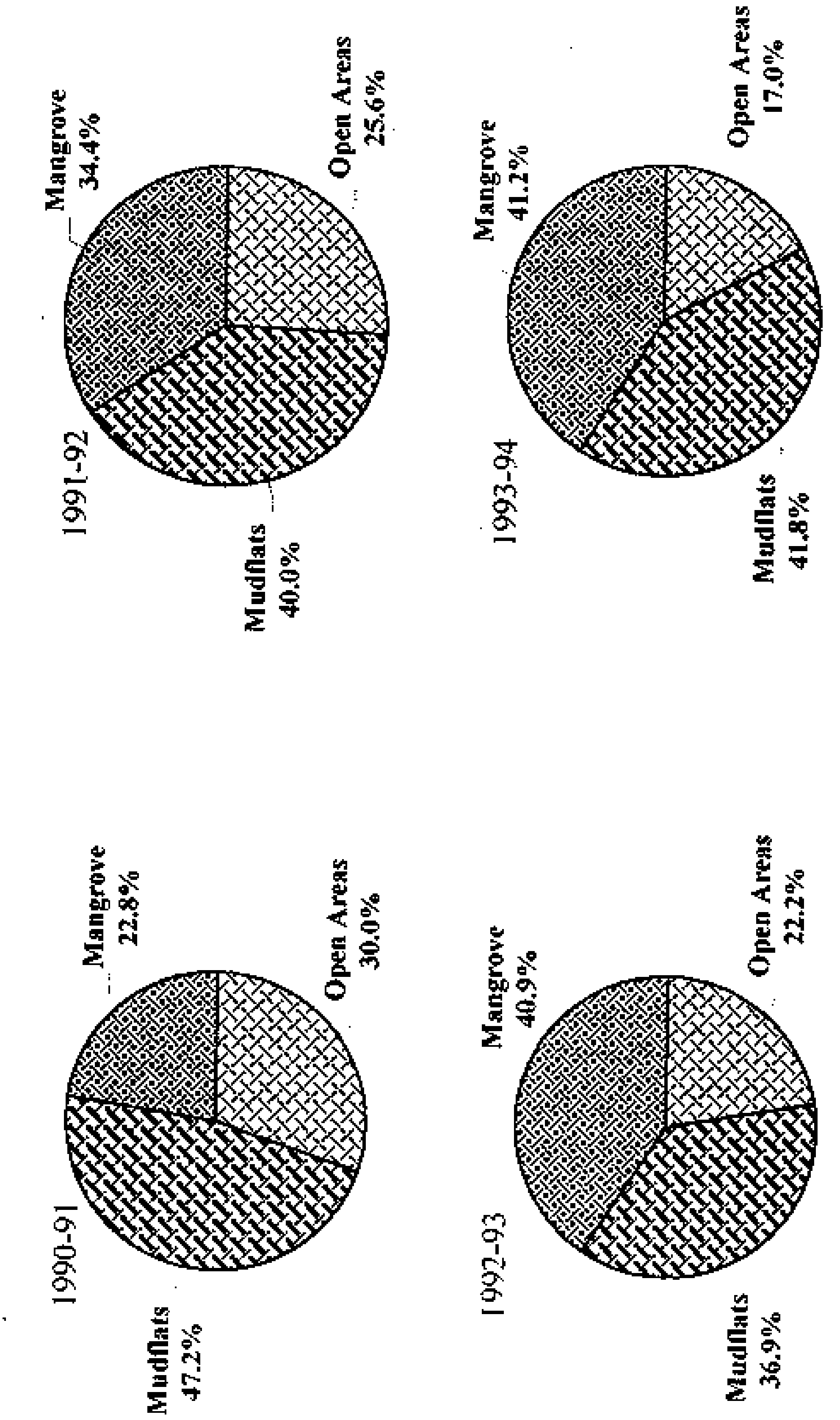

Figure 8. Percent spraints collected in different habitats at Coringa

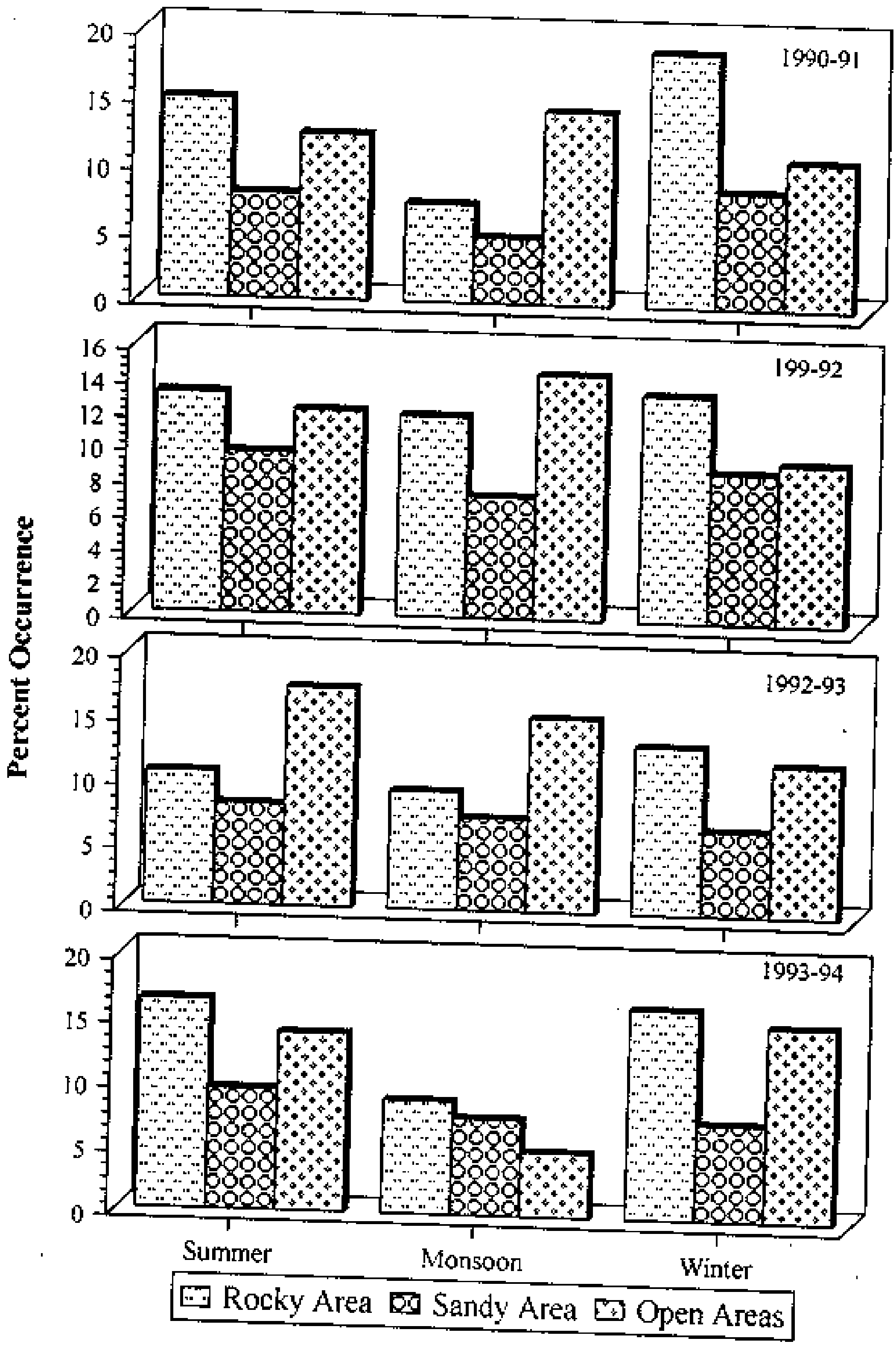

Figure 9. Seasonal percent spraints collected in different habitats at Hampi

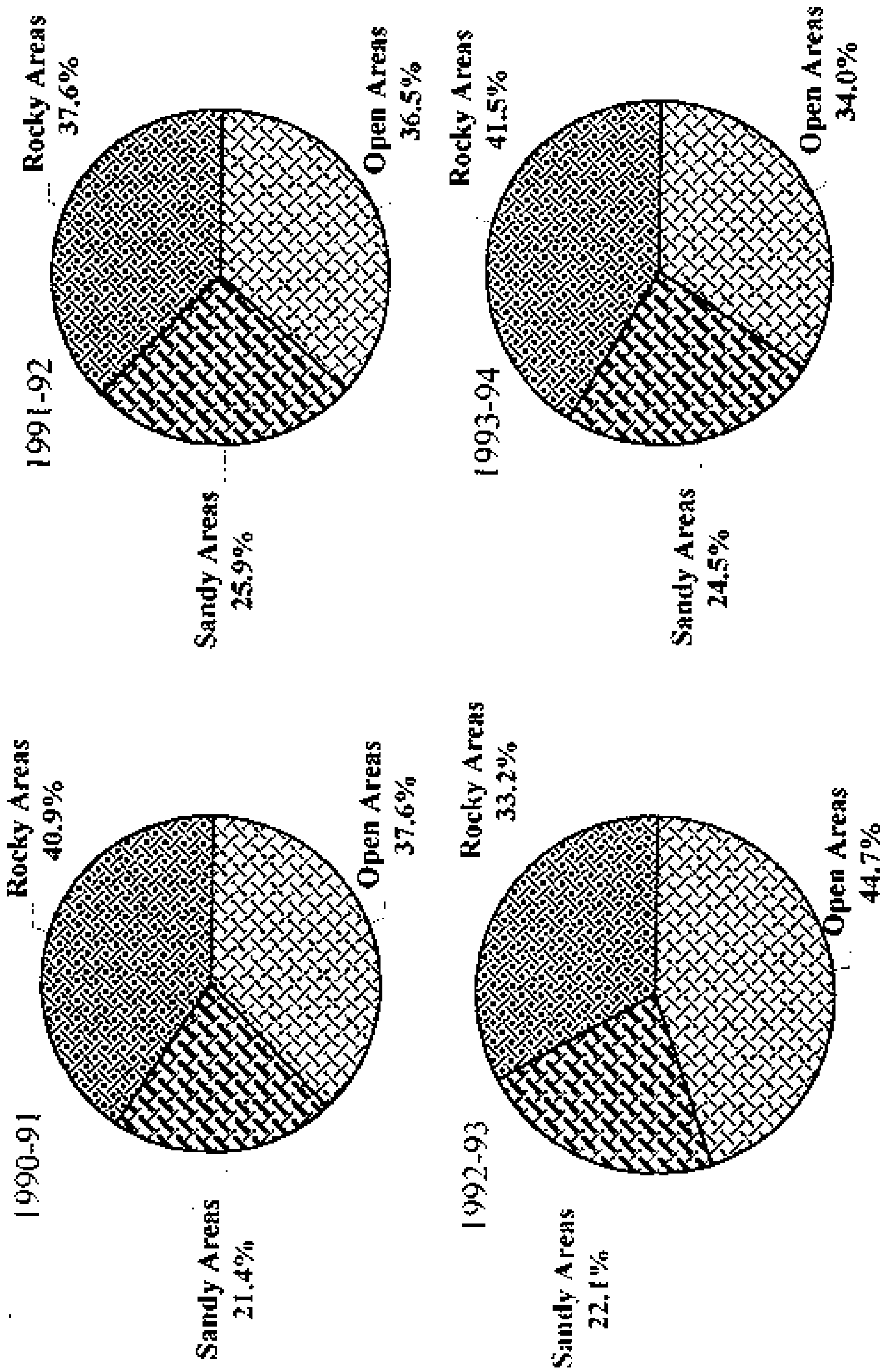

Figure 10. Percent spraints collected in different habitats at Hampi

At Hampi, the presence of spraints in summer was high in open areas, ranging from 12.1% to 17.3%, followed by rocky areas (10.5% to 16.3%). In sandy areas, the presence of spraints was low, ranging between 7.8% and 9.5%. During the monsoon and winter months, a similar pattern was observed (Fig. 9). Throughout the study period the percent occurrence of spraints in sandy area habitat was low ranging between 4.9% to 9.5%. The total percent of spraints in different habitats showed high incidence of occurrence of both the open and rocky area habitats during the study period (Fig. 10).

In the estuarine habitat of Coringa, use of mudflats and mangrove was greater when compared to that of open areas for two reasons, mangroves associated with other tree species provide good cover and escape routes, while mudflats provides ample foraging grounds during the inter-tidal periods. The otters at Coringa tended to rest more on the exposed mudflats. Most of the den sites were also located in the mangroves. These two factors seemed to govern the habitat use at Coringa. However, at Hampi - the riverine habitat, similar influencing factors played important role in determining the habitat use pattern. The rocky area habitat provides good vantage points from where the otters can locate shoals of fishes swimming in the river, as well as natural den sites. Similar observations were reported by MACDONALD et al. (1978), MELQUIST and HORNOCKER (1983), MACDONALD and MASON (1985), HUSSAIN (1993) and NEWMAN and GRIFFIN (1994).

During the present study an attempt to check the feasibility of using spraints to assess habitat utilization by otters seemed appropriate only in the case of Coringa habitat. Here a positive correlation was found between direct sightings and indirect evidence (Correlation = 0.735). While at Hampi, a negative correlation was found (Correlation = 0.124). Many authors have found no relationship between the sprainting sites and habitat use (KRUUK et al., 1986), while there are many other works, which suggest that the spraints can be used as a tool for studying habitat utilization by otters. MASON and MACDONALD (1987) suggested that positive relationship between spraint numbers and habitat utilization exist basing on the findings of other authors. Our observations revealed that indirect evidence for determination of the degree of utilization of a given habitat by otters vary from region to region.

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THE STATUS OF OTTERS IN AFRICA: AN ASSESSMENT

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Abstract: The occurrence, distribution, numerical status, degree of legal protection and threats to survival of otters in Africa are described and discussed. For the majority of African countries wherein otters occur such data are sparse and sometimes contradictory. This makes a valid assessment of the current status of especially the distribution and numbers of most species in nearly every country difficult and probably worthless. It also highlights the urgent need for research both on the occurrence of suitable habitat, e.g. the large but virtually unknown wetlands in some countries, as well as on particular otter species by trained researchers that can differentiate between species. The current survey, however, indicates that no otter species have gone extinct in a particular country, nor have any expanded their range into previously uninhabited countries. Current research indicates that at least in some countries otters may be more widely distributed than previously suspected: *Aonyx capensis* occurs widely in the arid interior of South Africa and Namibia. On the other hand some species now have more restricted ranges, e.g. *Lutra maculicollis* in South Africa; some have declined in numbers due to habitat deterioration, e.g. *L. lutra* in Algeria; while some have been heavily hunted for food during civil wars, e.g. any of *A. congica, A. capensis* and *L. maculicollis* in the Democratic Republic of Congo.

INTRODUCTION

The otters of Africa comprise three endemic sub-Saharan species: the Cape clawless otter *Aonyx capensis,* the Congo clawless otter *A. congicus,* and the spotted-necked otter *Lutra maculicollis.* North of the Sahara, in the rivers and wetlands flowing from the Atlas mountains in Morocco, Tunisia and Algeria, a fourth species occurs: the Eurasian otter *Lutra lutra*, separated from the "true" African species for an unknown length of time by the waterless Sahara. Of the African otters, the Cape clawless has the widest distribution and penetrates furthest into arid zones, e.g. Eritrea and Senegal. Contrary to previous accounts (ROWE-ROWE, 1990; 1991) it occurs in extremely arid areas as long as pools of freshwater persists; in South Africa, for example, in the middle reaches of the Doring River (unpubl. data) where the mean annual rainfall is <30 mm (J. HOUGH, pers. comm.). It is also the only species occurring on offshore islands, e.g. the Bijago archipelago off Guinea-Bissau (N.G. DIAS, in litt.). This otter is mainly a crab eater (e.g. ROWE-ROWE, 1977a; SKINNER and SMITHERS, 1990; PURVES et al., 1994; CARUGATI, 1995; SOMERS and PURVES, 1996; ROWE-ROWE and SOMERS, 1998) and also occurs along the South African coasts (e.g. van der ZEE, 1981; van NIEKERK et al., 1998; SOMERS, 2000a). It is the best-studied otter species in Africa (e.g. ROWE-ROWE 1977a,b; van der ZEE, 1981, 1982; ARDEN-CLARKE, 1983; BUTLER and DU TOIT, 1994; CARRUGATI, 1995; SOMERS and PURVES, 1996; ROWE-ROWE and SOMERS, 1998).

The spotted-necked otter is less widely distributed than the Cape clawless otter, perhaps because it needs larger, and cleaner bodies of water (ROWE-ROWE, 1991). It is also more of a fish-eater (ROWE-ROWE, 1977a; KRUUK and

GOUDSWAARD, 1990; LEJEUNE, 1989, 1990; CARUGATI, 1995; SOMERS and PURVES, 1996; ROWE-ROWE and SOMERS, 1998). Few ecological studies have been undertaken on this species.

The Congo clawless otter is the least-known of the three species, and to our knowledge no detailed ecological study on this species has been published. It also has the most restricted range, being most common in the lowland Congo basin. It is perhaps more of a fish-eater, although KINGDON (1977) suggests a varied diet.

Otters have not yet been recorded in Djibouti, Egypt, Libya, Mauritania, Somalia and Western Sahara. Of these, Egypt and Mauritania could well have populations of *A. capensis:* this species had not been recorded in Sudan as recently as 1956 (SETZER, 1956), but is now known to occur locally in the southern parts (ROWE-ROWE, 1995). Although the Egyptian Nile would appear to offer adequate habitat they have not been recorded here. Mauritania contains large wetlands (SCOTT and JONES, 1995), connected to the Senegal River delta (HOWARD-WILLIAMS and THOMPSON, 1985) wherein *A. capensis* might occur, and may thus also harbour otters. The other countries are probably too arid to support viable otter populations.

The occurrence of otters in specific African countries have been given by COETZEE (1971), MEESTER et al. (1986), and WOZENCRAFT (1993). These taxonomic works provide the only substantiated distribution records. Although we attempt here to summarize the extent of the distribution of each species and their numerical status in particular countries, we stress that these data may be inaccurate for the following reasons: virtually no-one in Africa is studying otters; very few untrained persons can distinguish between species, which aggravates the inaccuracy of sight records where species are sympatric; very few people actually *see* otters, because of their secretive and often nocturnal habits; and few can identify their spoor or spraints. Those that can are usually subsistence hunters, and unless carefully questioned cannot pass on their knowledge to scientists. Keeping in mind the array and extent of wetland and river systems in Africa (e.g. HOWARD-WILLIAMS and THOMPSON, 1985; SCOTT and JONES, 1995) that could provide suitable habitat, studies by trained persons directed at distribution and status could well yield new and valuable information. Also of concern is the few data available on the biology of the main prey species of African otters such as freshwater crabs *Potamonautes* spp (SOMERS and NEL, 1998). Although there are some data on distribution of freshwater fishes (SKELTON, 1993) there are no data available on productivity or biomass of these organisms.

METHODS

Biologists and Nature Conservators, through the IUCN Regional Offices in Africa, in as many countries as possible throughout the distribution range of all four species were contacted. As research on African otters is virtually non-existent, mammalogists specializing in other taxa but working in Africa were also consulted. Recent literature (e.g. MEESTER et al., 1986; ROWE-ROWE 1990, 1991; WOZENCRAFT, 1993) were also consulted. Correspondents were asked to provide information on the species occurring and their distribution (widespread, localised, restricted) in suitable habitat within each country;

numbers or density (common, fairly common, rare, very rare) of each species; degree of legal protection (total, partial, nil); and threats to survival (habitat destruction, hunting, pollution, disturbance by man). Comparing this information with previous surveys (ROWE-ROWE, 1991, 1995), or when specifically remarked on, we estimated whether the distribution and especially numbers of a species in a particular country was stable, or declining.

RESULTS

The Cape clawless otter is the most widely distributed otter species in Africa (Fig. 1). It occurs in 35 countries, is common or fairly common in 19 (but could be rare in parts of a country), and rare to very rare in 12. It seems that the distribution range and/or population size is stable in 29 countries, while declining in 6. No data on the situation in Eritrea, Mali, Togo and Gambia are available.

The spotted-necked otter has a somewhat more restricted range than the Cape clawless (Fig. 2). It definitely occurs in 31 countries, and possibly in a further 3, and is common to fairly common in 17, while rare to very rare in 9. For 4 countries data are lacking. Populations/distribution is stable in 24 countries, but seems to be declining in 7. For example, during the past 20 years this species has disappeared from a number of rivers in the Eastern Cape Province, South Africa (SOMERS and NEL 1996).

The Congo clawless otter occurs in 11 countries, mainly in the tropical lowlands of Africa (Fig. 3). It is fairly common in 4, and rare or very rare in 7. Populations/distribution seems stable in 6 countries, but declining in 5.

The Eurasian otter occurs only in Morocco, Algeria and Tunisia (Fig. 4). Apart from Tunisia where it can be locally common it has become rare, more localized or restricted in its distribution, while all correspondents stressed that populations are declining. In Morocco it perhaps no longer occurs on the coastal plains NW of the Atlas mountains (M. THÉVENOT, in litt.).

Legal protection varies greatly between countries (Tables 1 and 2). Total protection is afforded in only 9 countries; partial (i.e. National Parks, Nature Reserves or parts of a country) in a further 24, while no data are available for 6. However, even for some countries where partial protection is on the lawbooks in effect no protection is given, due to civil unrest or - wars.

Threats to otters continent-wide are habitat destruction, which range from bush-clearing and deforestation to water extraction or desertification in North African countries. Subsistence hunting prevalent in Africa, a continent with a fast-increasing human population without a concomitant rise in food production. In addition, civil wars have raged for many years in a number of countries; marauding armies have forced inhabitants into the bush, where "bush-meat", including otters in at least the Democratic Republic of Congo, and the Congo (D. MUSIBONO, pers. comm.) are heavily utilized. Pollution, however, has not been reported as being a major threat in most countries (Tables 1 and 2). Only for a very few countries (e.g. Ethiopia) have hunting for the fur trade been stated as being significant.

Table 1. Distribution and status of *Aonyx capensis, A congicus* and *Lutra maculicollis* in subsaharan Africa. Species: *A.cap. = A. capensis; A. con. = A. congica; L. mac. - L. maculicollis.* Distribution: W = widespread (in suitable habitats); L = localised; R = restricted, e.g. to a part of a country. Status: C = common in distributional area; FC - fairly common; Ra = rare; VRa = very rare. Protection: T = total (full legal protection countrywide); P = partial (usually in National Parks or Nature Reserves); N = none;? = no information;* donates existing legislation not being enforced, e.g. due to civil war. Threats: Hab = habitat destruction; Hu = hunting (meat or skins); Pol = pollution; Dist. = human disturbance. Fo = declining food supply. Change: S = stable distribution/status since 1990[1]; D = decline.

Country	Species	Distribution	Status	Protection	Threats	Change
Angola	*A.cap*.	W	Ra-FC	?	Hab; Hu	S
	A.con.	L	FC	?	Hab; Hu	S
	L.mac.	W	FC	?	Hab; Hu	S
Benin	*A.cap.*	?L	Ra	P	Hab; Hu	?S
	L.mac.	?L	Ra	P	Hab; Hu	?S
Botswana	*A.cap.*	W	FC	T	?	S
	L.mac.	W	FC-Ra	T	?	S
Burkina Faso	*A.cap*.	L	?Ra	P	?	S
	L.mac.	L	?Ra	P	?	S
Burundi	*A.con.*	?R	?Ra	N	?	?D
	L.mac.	?R	?Ra	N	?	?D
Cameroon	*A.cap*.	?W	?Ra	?	?	?
	A.con.	?W	?Ra	?	?	?
	L.mac.	?W	?Ra	?	?	?
Central African Republic	*A.cap.*	W	FC-Ra	P*	Hu	?D
	A.con.	W	FC	P*	Hu	?D
	L.mac.	W	FC-Ra	P*	Hu	?D
Chad	*A.cap.*	L	FC	P	Hab; Hu	?D
	L.mac.	L	FC	P	Hab; Hu	?D
Congo	*A.con.*	W-L	FC-Ra	P*	Hu	?D
	L.mac.	W	FC-?	P*	Hu	?D
Democratic Republic of Congo	*A.cap.*	L	FC	P*	Hu	D
	A.con.	W	Ra	P*	Hu	D
	L.mac.	W-L	FC	P*	Hu	D
Equatorial Guinea	*A.con.*	?	?	?	?	?
	L.mac.	?	?	?	?	?
Eritrea[2]	*A.cap.*	?	?	?	?	?
Ethiopia	*A.cap.*	L	Ra	T	Hab; Hu	?
	L.mac.	L	FC-Ra	T	Hab; Hu	?
Gabon	*A.con.*	?W	FC-Ra	P-N	Hu	?
	L.mac.	?W	Ra	P-N	Hu	?
Gambia	*A.cap.*	?	?	?	?	?
Ghana	*A.cap*	?W	?FC-Ra	P	?	?S
	L.mac.	?W	?FC	P	?	?S
Guinea	*A.cap.*	W	FC	P	Hu	S
Guinea-Bissau	*A.cap.*	W	FC	N	Hu	S
Ivory Coast	*A.cap.*	W	FC	P	?Hab	S
	L. mac	?L	?	P	?Hab	S
Kenya	*A.cap.*	L	Ra	T	Hab;Hu;	S
	L.mac.	L	Ra-FC	T	Pol	S
Lesotho	*A.cap.*	R	Ra	P	Hab; Hu	?D
	?L.mac.	?	?	P	Hab; Hu	?D
Liberia	*A.cap.*	W	FC	P*	? Hu	S
	L.mac.	W	FC	P*	? Hu	S
Malawi	*A. cap*.	W	C	P	?	S
	L. mac.	L	FC-Ra	P	?	S
Mali	*A.cap.*	?	?	?	?	?
	L.mac.	?	?	?	?	?

Mozambique	*A.cap.*	W	FC	P*	Hu	?
	L.mac.	L	Ra	P*	Hu	?
Namibia	*A.cap.*	W	FC	T	Hab	S
	L.mac.	R	Ra	T	Hab	S
Niger	*A.cap.*	R	Ra	T	Hab	S
	L.mac.	R	Ra	T	Hab	S
Nigeria	*A.cap.*	?W	FC-Ra	P	?	?S
	A.con.	R	?	P	?	?S
	L.mac.	R	FC-Ra	P	?	?S
Rwanda	*A.cap.*	L	Ra	P	Hab; Hu	?D
	A. con.	L	Ra	P	Hab; Hu	?D
	L. mac.	L	Ra	P	Hab; Hu	?D
Senegal	*A. cap.*	R	C	P	?	S
Sierra Leone	*A.cap.*	L	Ra	P	Hab	S
	L.mac.	?L	VRa	P	Hab	S
South Africa	*A.cap.*	W	C	T	Hab; Pol.	S
	L.mac.	L	FC-Ra	T	Hab; Pol	S
Sudan	*A.cap.*	R	Ra	P	Dist.	S
	L.mac.	L	FC	P	Dist	S
Swaziland	*A.cap*	W	Ra	P	Hab	S
	?L.mac.	?	?	P	Hab.	?
Tanzania	*A.cap.*	W	FC	P	Dist; Hab.	S
	L.mac.	L	FC	P	Dist; Hab.	S
Togo	*A.cap.*	?	?	?	?	?
	L.mac.	?	?	?	?	?
Uganda	*A.cap.*	W	FC	P	Hab; Hu	S
	A.con.	R	FC	P	Hab; Hu	S
	L.mac.	W	FC	P	Hab; Hu	S
Zambia	*A.cap.*	W	FC	P	Hu	S
	L.mac.	L	FC	P	Hu	S
Zimbabwe	*A.cap.*	W	FC	P	?	S
	L.mac.	?	?	P	?	?

[1] Recent information was compared with that in ROWE-ROWE (1990) and NEL (1998); [2] by extrapolation from map in YALDEN et al. (1980).

Table 2. Distribution and status of *Lutra lutra* in North Africa. For abbreviations, see legend to Table 1.

Country	Distribution	Status	Protection	Threats	Change
Algeria	L - R	Ra	T	Hab;Hu;Pol.	D
Morocco	L	Ra	T	Hab; Pol.	D
Tunisia	L	C - VRa	T	Hab; Hu	D

DISCUSSION

The distribution and population size of a species in a given locality - or for a country as a whole - effectively mirrors the availability of suitable habitat, food, and shelter; the amount of competition; the effects of predation (including hunting, if applicable) and more subtly, that of pollution. For otters, fresh water is a *sine qua non;* if not for foraging, then for drinking or washing salts from the pelage (KRUUK and BALHARRY, 1990). How widely an otter species is distributed in a given country obviously would reflect not only the availability of freshwater sources, but also its quality, the amount of available prey, shelter, and predation or hunting pressure. For Africa, the direct or indirect threats of pollution seems less serious than elsewhere, perhaps because of the low level of industrialization in most countries. This situation could, of course, change rapidly.

Figure 1. Distribution of the Cape clawless otter *Aonyx capensis*. Stable populations are indicated by solid circles; declining populations by open circles.

Figure 2. Distribution of the spotted-necked otter *Lutra maculicollis.* Stable populations are indicated by solid circles; declining populations by open circles.

Figure 3. Distribution of the Congo clawless otter *Aonyx congicus*. Stable populations are indicated by solid circles; declining populations by open circles.

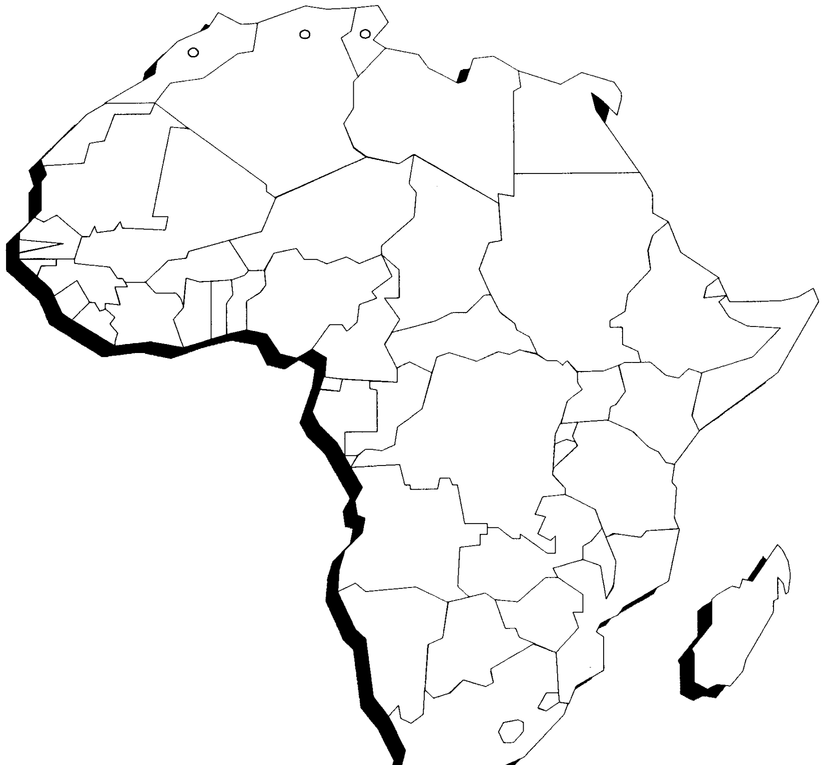

Figure 4. Distribution of the Eurasian otter *Lutra lutra* in Africa. Stable populations are indicated by solid circles; declining populations by open circles.

Of the sub-Saharan otters, only the Cape clawless is known to utilize coastal food resources (van der ZEE, 1981; SOMERS, 2000b) in South Africa, and probably also in Guinea-Bissau (DIAS, in litt.). In addition, these otters also inhabit very arid areas (unpubl. data) so it is not surprising that it is widespread in Africa. The other species, spotted-necked and Congo clawless, have smaller distribution ranges perhaps because of less plasticity in habitat requirements, or more specialized food requirements.

The distribution and status of the otter species in the various countries as described here rely on estimates which obviously vary in degree of accuracy. For most countries they are therefore of dubious value or even worthless, due primarily to a nearly complete lack of reliable data on these aspects, accumulated by trained researchers.

Protection for otters in most African countries is woefully inadequate, and in many probably not enforced fully, if at all. As elsewhere, and for other animal taxa as well, destruction of habitat seems to be the most serious threat, with hunting as a subsidiary threat in a number of countries. Distribution and pollution, often localized, do not at this stage pose a major threat.

Our ignorance of many facets affecting the viability of otters in Africa is immense. But despite the documented negative effects of an increasing human population in nearly all countries the available habitat that remains is enormous. The potential for viable populations of at least the sub-Saharan species to survive, in most or all of the countries where they occur at present, therefore seems promising.

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CRANIAL AND DENTAL ANOMALIES IN THE NORTH AMERICAN RIVER OTTER: A COMPARISON OF A NORTHERN AND SOUTHERN POPULATION

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INTRODUCTION

Genetic and environmental factors contribute to the incidence of cranial and dental anomalies (BEAVER et al., 1981). They in turn affect dental and occlusion and ultimately the condition of the animal. Few studies of the dental and cranial anomalies of otters are available, and these have tended to be based on small sample sizes (e.g., BURT 1954; BJOTVEDT and TURNER, 1976). Researchers using adequate sample size have emphasized only one anomaly (ADDISON et al., 1988, ROEST, 1992) or examined one population (BEAVER et al., 1981, TUMLISON et al., 1985). No publications cite frequencies of occurrence of a suite of cranial and dental anomalies of specimens from two different populations. We examined a large sample of skulls derived from two different North American river otter (*Lutra canadensis*) populations: a northern one from Alaska and a southern one from Arkansas and contiguous states. We tested two hypotheses. 1) All other factors being equal over their lives, populations living in northern latitudes are subject to colder climates, higher energy expenditures/feeding rates (COSTA and KOOYMAN, 1984; ESTES et al., 1986), and greater amounts of wear on their dentition than their southern counterparts. 2) One of the two populations may have undergone a bottle neck and exhibited genetic drift such as in the case of the musk ox (*Ovibos moschatus*) (HENRICHENSEN, 1989) and sea otter (*Enhydra lutris*) (ROEST, 1993).

MATERIALS AND METHODS

We examined skulls (n=507) of river otters housed in the following museums: Arkansas State University Museum of Zoology, College Station (ASUMZ); Field Museum of Natural History, Chicago (FMNH); Oklahoma State University Museum of Natural History, Stillwater (OSUM); University of Oklahoma, Stovall Museum, Norman (OUM); Memphis State University, Museum of Zoology, Memphis (MSUMZ); Southern Illinois University, Zoology Department, Carbondale (SIUZD) University of Alaska Museum, Fairbanks (UAM); University of Arkansas, Department of Zoology, Fayetteville (UADZ), and University of Southwestern Louisiana, Lafayette (USL). Specimens with missing or badly-broken craniums were not included in the analysis. The descriptions of BEAVER et al. (1981), HOOPER and OSTENSON (1949), TUMLISON et al. (1985), and POLECHA (1987) were used as a list of potential anomalies (Table 1). These or any other peculiarity were recorded and tabulated as a frequency of occurrence.

RESULTS AND DISCUSSION

The frequencies of occurrence of dental and cranial anomalies of river otters from a northern population (i.e., AK: n=184) and a southern population (AR: n=283) and nearby states (n=40) are listed in Table 1. The frequencies of occurrence for the states neighboring Arkansas are more variable than the Arkansas or Alaskan specimens due to the small sample size. All eleven anomalies occurred in at least one individual. Southern and Arkansas (*sensu strictum*) specimens possessed all of the eleven anomalies except bregmatic bones. Northern specimens possessed all of the eleven anomalies except dental caries.

Alveolar thinning had the consistently highest frequency (17.4 and 18.7% for AK and AR specimens respectively) of occurrence of any anomaly. The next most common, congenital agenesis (embryonically "missing" teeth, genetically determined phenotype), occurred in 13 and 9.5% of the AK and AR specimens respectively. The frequencies for these two populations of otters are low compared to the high values for the small reintroduced founder population of muskox (*Ovibos moschatus*) in Alaska (HENRICHSEN, 1989). Worn dentition was more prevalent in the AK sample than AR sample (6.5% v 1.1%). All other anomalies occurred in frequencies < 3%. These results compare favorably with the results of BEAVER et al. (1981) from Maryland. These southern populations plus the AK sample were freer of dental and cranial anomalies than Michigan otters (HOOPER and OSTENSON, 1949).

In the present study, two cases of dental caries provided the only possible evidence for a cranial or dental anomaly that would have an immediate detrimental impact on the otters at the time of collection. Decay of dental tissue to the point of erosion of the socket and destruction of periodontal tissue and cementum, which occurs in dental caries, might lower the fitness of these individuals (LYUBASHENKO, 1983). Specimens that possessed an anomaly that were especially severe included: a) AR specimen (PJP 1230) with an exostosis (i.e., abnormal local outgrowth) making the surface rough rather than smooth; b) AK specimen (UAM 15522) with a combination of congenital agenesis on three molars, alveolar thinning, and Skrjabingylus infection, and c) an AK specimen with congenital agenesis on a total of seven premolars and molars, and irregular placement.

Anomalies not described by BEAVER et al. (1981) and TUMLISON et al. (1985) included the presence of peg-like cheek teeth from and AK specimen (UAM 15419) believed to be atavistic in nature. Extra foramina, near the infraorbital foramen, were noted in 2.7 % (n=5); the first time for otters (sensu Lutrinae). A bilateral bulging of the pars temporalis of the frontal bone and concomitant discoloration of the bone plus holes (ADDISON et al., 1988) were noted in both AR and AK specimens. The frequency of occurrence of this apparent infection by Skrjabingylus (Nematoda: Metastrongyloidea) was tabulated for the AK specimens only at 10.9% (n=20). This agrees favorably with the results of ADDISON et al. (1988) for Ontario.

Table 1. Frequency of occurrence of dental and cranial anomalies in river otters in Arkansas and other states. Data collected by author except where noted. For museum abbreviations, see text.

State		Total AR (UADZ & ASUMZ)	IL (SIUZD)	LA (USL & OSUM)	OK (OSUM & OUMDZ)	TN (MSUMZ)	AK (UAM,USNM & FMNH)
Anomalies	Description						
Dental:							
Alveolar thinning	-exposure to the buccal tooth roots*	18.7	37.5	60.0	0	16.7	17.4
Congenital agenesis	-reduced dental complement ducts, teeth that failed to develop	9.5	37.5	20.0	0	5.6	13.0
Irregular placement	-teeth in positions other than the normal pattern*	1.1	0	0	0	0	0.5
Supernumerary teeth	-those in excess of normal pattern*	0.4	0	10.0	0	0	0.5
Worn dentition	-crown erosion to gun line	1.1	0	10.0	0	0	6.5
Caries	-decay of dental tissue*	0.7	0	0	0	0	0
Cranial:							
Plaglocephaly	-asymetrical cranial growth due to premature closure of one frontal-parietal surface	1.4	0	0	0	5.6	0.5
Bregmatic bones	-extra bones derived from accessory ossification in any of the fontanelle*	0	0	0	0	0	1.1
Heterotopic bones	-small accessory bones*	1.8	0	10.0	0	0	1.1
Exostosis	-abnormal local outgrowth**	0.4	0	0	0	0	1.6
Porus bone	-erosion of bone to form many small pinholes	2.5	0	0	0	0	4.3
Total Anomalies:		29.3	50.0	70.0	0	22.2	
Sample Size (n)		283	8	10	4	18	184

*Source: BEAVER et al. (1981); **Source: HOOPER and OSTENSON (1949); ***Source: TUMLISON et al. (1985)

CONCLUSION

Alveolar thinning and congenital agenesis were the two most commonly occurring anomalies. Worn dentition, indicative a high forage rate was more prevalent in the Alaskan population. Caries occurred only in the AR population while bregmatic bone only occurred in the AK population. Only four individuals (1 AR and 3 AK) had severe anomalies that would immediately lower their fitness. Anomalies that had not been described for otters include peg-like teeth and extra foramina. Infections by *Skrjabingylus* were noted in 10.9 % the AR specimens.

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CONTINENTAL REPORT ON THE SITUATION OF THE NORTH AMERICAN RIVER OTTER

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Abstract: The status and management of the North American river otter was compared over time. Their has been ten continental and regional papers published on the species. Conservation priorities listed in I.U.C.N.'s Otter Specialist Group Action Plan. These include: 1) status determination across their historical range; 2) studies of the Sonoran river otter; 3) carcass analysis; 4) establishment and implementation of reintroduction criteria; 5) otter-friendly beaver management plan; 6) collaborative studies with aquatic biologists; 7) cooperative watershed studies; 8) encouragement of publication and dissemination of knowledge; 9) symposium on ecology and management. The progress and/orshortcomings on each of these priorities will be discussed. Highlights of this analysis include the following assessments. The status of the otter in 1994 was reported as declining in part of one state, stable in 14 (plus part of one), increasing in 24, and unknown in 10. This is statistically significant change from a 1989 study. Of concern is the Southwestern States, Rocky Mountains, Great Plains, and Midwest. The number of reintroduction programmess increased by more than one and a half times between 1987 and1994. Population modeling is needed to estimate population trends within confidence limits. Since 1976, the passage of the CITES treaty, the number of publications on the river otter increased more than eight fold.

INTRODUCTION

There are a number of reports on the status of the North American (i.e., Nearctic) river otter (*Lutra canadensis*). The problem is that they rarely compare the changes in numbers over time outline steps for changes or chart the progress made. Papers with a continental coverage include those written by DEEMS and PURSLEY (1978, 1983), TOWEILL and TABOR (1982), JENKINS (1983), MELQUIST and DRONKERT (1987), NOWAK et al. (1987), POLECHA (1991), and REED-SMITH (1994, 1995). Papers with a continental coverage include those by HILL (1978), HAMILTON and FOX (1987), and NOWAK et al. (1987). The purpose of this paper is to report the recent status of North American river otter tracing any change through time.

MATERIAL AND METHODS

The IUCN's North American river otter "Action Plan" (POLECHLA, 1991) was produced in 1989 and included a questionnaire to all geo-political areas (g.p.a.s, i.e., states of the US and provinces, territories, and islands in Canada). A similar study, was conducted by telephone interview, in 1994 (REED-SMITH, 1994/1995). The responses to the status question (i.e. declining, stable, increasing, or unknown) were compared statistically with the

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1989 data using a Chi-square test using the earlier data as theexpected and the 1994 data as the observed values. A literature review used the following sources: HEIDT, TUMLISON and SHALAWAY (DATRE), MELQUIST and DRONKERT (DATE), REED-SMITH (DATE). *Wildlife Review*, a Biosis (a computer literature search engine), the literature cited in Otter Bulletins. To determine if the signing and implementation of the CITES treaty had an impact on the publication of scientific research papers, the number of papers on the North American river otter (the river otter) were divided into two groups (i.e. before and after the 1976 signing of the CITES treaty) and compared. The performance is evaluated on the basis of the IUCN North American Otter Action Plan (POLECHA, 1991).

RESULTS AND DISCUSSION

1) Status across their Range

The results of the analysis of the status from 1989 to 1994 revealed a significant difference between the two periods was statistically significant (Chi-square = 8.65; df=3; $0.05>P>0.02$). The number of geo-political areas with increasing populations rose from 20 to 24. The status of the otter in 1994 was reported as declining in part of one state, stable in 14 and unknown in ten (and increase from five). The types of data and the techniques of gathering status determination vary in quality between g.p.a.s. The types of data collected (in order of ascending quality) include those from harvest (from states that have a legal harvest), questionnaires, track and scat, age structure, natality, recruitment, and population density. Collection of harvest data include fur dealer records, trapper questionnaires and pelt tagging. Field personnel and amateur naturalists have been questioned about the sightings and abundance of otters. The examination of areas for tracks and scats at: random points in a wetland, scent post stations and bridge crossings yields useful information and has the added advantage of determining diet. Both carcass analysis (and subsequent cementum annuli analysis from a random sample of otters) and radio-telemetry techniques have been used to determine if the age structure is indicative of an increasing, decreasing or stable population. Radio-telemetry is the least intrusive of the two techniques, however carcass analysis can reveal more details about the demography of the population. The same techniques can be used to determine birth rates although the reproductive tract of the carcass is examined and radio-telemetry is used as a tool to observe pups following adults and to find natal dens. Accurate density estimates can only be obtained with radio-telemetry. All g.p.a.'s gather and analyze some level of data except Prince Edward Island where the species is considered extirpated. A concerted effort should be made to obtain and analyze the highest quality data. Annual status assessment is needed every year in all g.p.a.'s in their historical range.

The best assessment of status is to combine several techniques. Population modeling is severely modeling to project different outcomes in worst and best case scenario for an otter population.

2) Studies of the Sonoran River Otter

Studies of the Sonoran River Otter have been initiated in northern New Mexico, and complete in northern Nevada in northern Utah. More studies are needed in the Colorado River Drainage of southern California, southern Nevada, northern Arizona, and southern New Mexico.

3) Carcass Analysis

In g.p.a.s.' that have a sufficient population to allow a harvest, carcass collection and analysis for age structure, reproductive status, dietary analysis, relative health at the time of death should be mandatory. In addition, otters could be better salvaged from accidental deaths (e.g., drowning in fish nets and "road kills") and yield good data.

4) Establishment and Implementation of Reintroduction Criteria

Prior to the decision of whether or not to reintroduce river otters and where has been made the following criteria should be met: a) passage of a water quality assessment, b) adequate cover and prey, c) determination of the genetic relation of the original population to the one considered for translocation. If these criteria are not met then the managing agency should not attempt a reintroduction until the habitat is rehabilitated.

Since 1987, the number of g.p.a.'s involved with otter reintroduction/translocation/stocking have grown from 13 in 1987 (MELQUIST and DRONKERT, 1987), to 17 in 1989 (POLECHA, 1991), to 21 in 1994 (REED-SMITH, 1994/1995), a 162% increase. Most of the reintroduction programmes have been in the interior of the continent in the Great Plains of south central Canada and Midwestern U.S. Many of these projects have met with a fair to excellent margin of success. Missouri's has been the most ambition with a release of about 800 otters.

5) Otter-Friendly Beaver Management Plan

Since river otters and beavers have a facultative commensal relationship, the two species often occur together in the same microhabitat. Otters often benefit from the damming and lodge-building behavior of the beaver by having more pools to in which to fish and dens to inhabit. Some river otters are trapped while trappers are trying to catch beavers. Beavers are often at odds with human interests (e.g., farming, irrigation, fruit growing, forestry management). In areas that the otter population is vulnerable, laws for using swivelled snares or soft-catch traps instead of killer Conibear@ traps should be used. Public education should be also used targeting land owners. The presence of an adequate beaver population has been used as a criteria for reintroduction.

6) Collaborative Studies with Aquatic Biologists

In the past, holistic studies on examining a suite of factors potentially affecting otters and their semi-aquatic habitat has been lacking. Exceptions appeared when radio-telemetry technology was available. This area needs to be developed further.

7) Cooperative Watershed Studies

Since river otters do not adhere to arbitrary and imaginary geo-political boundary lines and that a different g.p.a. occurs on either side of a river (e.g., Illinois and Iowa), we must collaborate with agencies from adjacent g.p.a.'s to conduct studies that make biological sense. Also an added benefit of cooperative studies in an entire watershed is research monies can be pooled and leveraged.

8) Encouragement of Publication and Dissemination of Knowledge

The River Otter Alliance publishes a newsletter to educate the public concerning river otter conservation. Several films have been produced and aired on river otters (by "Nature" television programme) and their habitat (by Misssouri Conservation Department and Rio Grande Restoration). Two otter films are being planned (by National Geographic) on the river otter and otters of the world. These films can reach a wide audience. There are three internet World Wide Web Sites that inform computer users about otters. This is a growing audience and should be developed for this species and others. Plans (by the Museum of Southwestern Biology, University of New Mexico) are under way to publish the proceedings of the First *"Nearctic River Otter Symposium".*

9) Symposium on the Ecology and Management of River Otter

The last symposium held on *L. canadensis* was held in conjunction with The Wildlife Society's First Annual Conference, Albuquerque, NM 1994. Prior to that a conference was hosted by the Missouri Conservation Department in 1984 in Columbia, MO. These should be held more often, every five years. These meetings are useful in sharing information, planning conservation plans within a watershed, and stimulating more interest in research.

CONCLUSION

The status of the North America river otter is stable or increasing where wetlands are abundant. Due to reintroduction efforts in the Midwestern and Great Plains regions, the promise of these populations is great but untested. The same threats to otter populations persist; decline of habitat quality due to pollution and quantity (due to the destruction of wetlands). Safeguards against the possibility of overharvest should be continued with vigor and rigor. Refinement of data collection and initiation of population modeling must be initiated to increase the diagnostic and predictive power. Plans to increase public awareness of the plight of the otter and their "interconnectedness" with humans long-terms sustainable interests should be undertaken in a concerted manner.

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HUSBANDRY AND CAPTIVE BREEDING OF OTTERS (LUTRINAE) IN NORTH AND LATIN AMERICA: A SYNOPSIS OF CURRENT PROGRESS

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Abstract: This paper summarizes the husbandry and captive breeding of four species of Lutrinae in North and Latin American zoological facilities over the last ten years. Information on current methods of exhibition, management for captive breeding and vaccination programmes will be presented for the North American river otter, Asian small-clawed otter, and Cape clawless otter. The information available will be presented for the Neotropical otter.

INTRODUCTION

There are a number of excellent general reviews of the captive maintenance of Lutrinae species, including DUPLAIX-HALL (1975), FOSTER-TURLEY (1990), and REUTHER (1991). This paper will concentrate on selected captive management issues; focusing on the success of North American zoological facilities to meet the standards set out in these reviews and their success in breeding these species in captivity. The information presented is taken from an ongoing analysis of records and information being compiled for the publication of husbandry guidelines by the American Association of Zoos and Aquariums (AZA) Small Carnivore Taxonomic Advisory Group (SCTAG), Asian small-clawed otter Species Survival Plan (SSP), and Latin American Zoological facilities.

MATERIALS AND METHODS

Data were collected from the International Species Inventory System (ISIS) North American data base, 41 Latin American facilities enumerated in a zoos and aquaria of the world listing (POLECHLA, GALLO-REYNOSO and MEINECKE, in litt.), the North American River Otter Husbandry Notebook (Reed-Smith, 1994), Central Park Wildlife Center North American. River Otter Enrichment Survey (n=47: zoos), John Ball Zoo North American River Otter Breeding (n=23) and Husbandry Surveys (n=55), Asian small-clawed otter SSP survey (n=25), a literature survey, site visits to institutions housing otters in India, Germany, Mexico and the United States (n=35), and personal communications with representatives from ten other facilities.

RESULTS AND DISCUSSION

The totals of North American and Latin American facilities housing each species are as follows: North American river otter (*Lutra canadensis*) - 97, Asian small-clawed otter (*Aonyx cinerea*) - 25, Neotropical otter (*L.*

longicaudis) - 11, and Cape clawless otter (*A. capensis*) - 4. The results of these enquires and surveys include exhibition (e.g., display size, land:water ratio, fixtures, physical environment, and nest boxes), some health concerns (diseases and vaccinations), and captive breeding concerns (e.g., copulation, estrous, pregnancy determination, gestation, pseudopregnancy, contraception, paring, sex ratios, and liter size).

EXHIBITS AND MANAGEMENT

Exhibit size minimums have been given by a number of sources: 150.m^2 for two North American river otters (DUPLAIX-HALL, 1975); 10.98m^2 of floor space for one otter (Lutrinae) and 12.8m^2 for a pair with a height of 1.22m (WALLACH and BOEVER, 1983). A review of exhibit size currently being used is as follows: 4.86m^2 (for a pair) to 37,160m^2 (for an extended family) for the Asian small-clawed otter (n=15); 20.8m^2 (for one animal) to 418.1m^2 (for four animals) for the North American river otter (n=26); and from 1.7m^2 to 314m^2 for the Neotropical otter (n=5). Containment barriers are generally at least 1.5m tall for the three larger otter species but only 1.07m to 1.22m has been used for a portion of the containment barrier for the smaller Asian small-clawed otters.

DUPLAIX-HALL (1975) states an ideal land:water ratio of 4:1. A review of our data reveal a 1:1 to 400:1 for the Asian small-clawed otter and 3:1 to 12:1 for the larger species. The land:water ratio for the Neotropical otter (a medium-sized species) was found to be from 10:90 to 2:1. For health, stress, and behavioral reasons we advocate the larger land:water ratios.

Previous authors (DUPLAIX-HALL, 1975; FOSTER-TURLEY, 1990) made note of the importance of exhibit substrate and complexity to the animals' health. All institutions surveyed report a wide range of materials used to floor and enrich the otters' environment including; gunite, concrete, grass, soil, sand, bushes, trees, logs, nest boxes, sticks, rocks, tunnels, and waterfalls. In addition to the exhibit 'furniture', many facilities provide a wide variety of enrichment items for the animals to explore, manipulate, play with or hunt for.

Otters can be diggers and climbers so exhibits must be designed with this in mind. The Cape clawless otter is particulary notorious for its digging with one facility reporting holes up to 1.25m deep. An easy remedy for extreme digging is the placement of wire mesh under the top several centimeters of soil.

Water treatment techniques vary from simple daily dump/fill routines to elaborate sand and ozone filter systems. Some institutions heat the pool water to 21.1^{0}C for the Asian small-clawed otter and feel this stimulates more swimming.

Ambient temperature is an issue for the tropical species. Most North American facilities house the Asian small-clawed otter in climate controlled environments with an ambient temperature of 21 to 23º C. Northern institutions exhibiting their animals out of doors, heat the holding facilities and keep the animals inside during the winter.

Photoperiod manipulation is not an issue for most facilities because the animals have access to natural light or outdoor areas 24 hours a day. Those facilities that house their animals indoors, or lock them inside at night, vary the photoperiod with the use of light timers.

Nestboxes, or protected sleeping spots, should be provided for every animal in the group. Although most otters seem to like to sleep in piles, a safe area for each animal can help in times of stress. The Cape clawless otter appears to be slightly less social than the other species, with three of four institutions reporting that their animals generally elect to sleep alone.

HEALTH CONCERNS

The Asian small-clawed otter Species Survival Plan (SSP) survey (n=19: zoos) elicited the following list of common ailments: dental problems (e.g. tarter and gingivitis) (n=17), renal calculi (n=15), abscesses (inn 11), lameness (n=8), cystic calculi (n=7), and diarrhea/vomiting (n=7). Dental problems (e.g. occlusion and abscesses) are the most common health problems reported for the North American river otter. Facilities housing the Cape clawless (n=4) and Neotropical otter reported only footpad abrasions. These abrasions are generally the result of behavioral problems and may be resolved with the provision of a varied substrate and bedding materials year-round.

Surveyed institutions annually vaccinated their otters with feline FVRCP (viral rhinotracheitis, calicivirus, and panleukopenia) and canine DH2LPP (distemper, hepatitis, parainfluenza, parvovirus, adenovirus type 2, and leptospirosis). Some vaccinate for rabies using killed vaccine only.

Urogenital infections appear to be a potential problem in female North American river otters. HOVER and TYLER (1980) reported urogenital infection in 40% of wild-caught females (n=10). A subsequent preliminary survey revealed 12 cases of urogenital infections; a few were fatal. A female Cape clawless otter is reported to have chronic, reoccurring vaginitis. Renal and cystic calculi occur in Asian small-clawed otter. CALLE (1988) cites genetics and diet may be contributing factors.

CAPTIVE BREEDING

Copulation - The Cape clawless otter has only been observed copulating in the water. Apparently the Asian small-clawed otter and North American river otter copulate both on land and in the water; however the latter species copulate in the water more frequently. The dorsal/ventral position is most common for all three species but the ventro/ventral position has been observed in the Asian small-clawed and North American river otters. Copulation bouts can last from one to 45 minutes and occur several times a day. Although no successful breeding has occurred, the Jardin Zoologico de Barrnquilla in Columbia has seen their Neotropical otter pair play and court.

Oestrous cycle - Cape clawless otters bred in November, December, January, and April for four of the five litters produced (at one institution). Receptivity in this species lasted one day. Asian small-clawed otters breed year-round and have an oestrous cycle of 30-37 days with a one to ten day oestrus. North American river otters exhibit latitudinal variation in conception and parturition (POLECHLA, 1987; current survey). Breeding occurs in the early winter in southern latitudes and in spring in northern latitudes. (However, collected breeding/parturition dates from the southern state of Arkansas coincide with those from the northern latitudes). Breeding occurs in early winter in southern latitudes and in spring in northern latitudes. The oestrous cycle is 42-46 days until successful mating occurs with receptivity peaks about six days apart.

Pregnancy determination - Determination of pregnancy is usually based on breeding observations, weight gain, physiological and/or behavioral changes. Weight gain has been noticed in three species, the Asian small-clawed, Cape clawless, and North American river otters. It is most visible in the Cape clawless otter in the fold between the forearm and body. In the North American river otter, the mammae may begin to protrude from the coat a few weeks before parturition. Behavioral changes include anorexia, increased rubbing, increased nesting behavior, holing up in the nest box, and changes in attitude toward to the male, other exhibit mates, or keepers. SOBEL (1996) and GROSS (1992) successfully used fecal steroid monitoring of Asian small-clawed otters to determine pregnancy. Dr. Gross has also conducted some preliminary work with this technique in North American river otters.

Gestation - There are two records of gestation for the Cape clawless otter; 80 and 100 days. Gestation length ranges from 62 to 86 days for the Asian small-clawed otter and gestation plus delayed development of the blastocyst ranges from 285 to 380 days for the North American river otter (LIERS 1951; this study, n = 12 litters).

Litter size and pup sex ratio - Litter size (mean, range, mode, median, and sample size) of the species surveyed were as follows: Cape clawless otter (1.2, 1-2, 1, 1, n=5), Asian small-clawed otter (3.5, 1-7, 3, 3, n=28), and North American river otter (2.4, 1-5, 3, 3, n=46). The observed pup sex ratios were not statistically ($P<0.05$) different from an expected 1:1 ratio for any of these species.

Pseudopregnancy - Several facilities housing North American river otters reported what appeared to be pseudopregnancies. Females showed signs of impending parturition including swollen mammae, increased nesting behavior, holing up in nesting boxes, anorexia, and intolerance to conspecific males and keepers. A 13 month old subadult was video taped mating with a female that showed signs of psueopregnancy the following spring. This and one other similar case substantiate HUTCHINS et. al. (1996) conjecture that pseudopregnancy is related to sterile matings in induced ovulators. Cases of pseudopregnancy have also been reported in the Asian small-clawed otter.

Contraception - Melengestrol acetate (MGA), a synthetic progestin, implants have been used in female Asian small-clawed and North American river otters. Porcine zonae pellucidae (PZP) offers a promising immunocontraceptive approach to fertility control for mammals in general and has been effectively used in one female North American river otter.

Pairing - The Cape clawless otter has successfully bred at only one facility. Due to excessive harassment by the male, the one male/two female combination was kept together during the day, but the male was housed alone at night. The one discernible clue that a female was in oestrus was by the male’s response to her. Generally the day before she was receptive (day 1), the male would start following her closely and there would be a great deal of play behavior between the pair. The next day (day 2), the pair would be observed mating repeatedly throughout the day. The third day would see a resumption of day 1 behavior. Day four brought a return to non-breeding behavior. One female produced two litters, the other three. Six of the ten animals currently housed in North American zoos are offspring of one male. Although the current captive population is small, several facilities are interested in displaying this species and developing captive management techniques.

The Asian small-clawed otter population housed in North American zoos is managed by an AZA SSP. A species coordinator working with a governing committee directs this plan. At this time, the captive population comprises of 125 individuals (63 males: 62 females) with an addition of six pups born in 1996. Unlike the other three species, these otters live in social groups, and appear to do better when left in the family group. One facility reported spontaneous lactation in a 13 months old female after she showed great interest in her mother's subsequent litter. Currently the SSP masterplan is under review and the committee is interested in fostering global communication on the captive care of this species and supporting *in situ* conservation efforts.

The North American river otter is a species recommended for management by the AZA SCTAG. Zoos in North America have been more successful breeding this species in the 1990s with 24 litters born between 1990 and 1998 compared to 7 litters born between 1980 and 1989. The majority (n=51) of facilities housing this species exhibit one pair. Successful breeding appears to be dependent on pair compatibility. This leads to the conclusion that pair manipulation or multiple mate selection as proposed by DAVIS (1985) may be the answer to more consistent success. The Minnesota Zoo has had the greatest number of litters born; seven from two females. Several other facilities housing only a pair have had three or four litters born to the same pair as of 1998. Some facilities have had annual breeding while others see no sign of the post-partum oestrus; their females breed bi-annually.

CONCLUSION

North and Latin American zoological facilities have improved their knowledge and care of their otters over the last ten years. Significant strides have been made in the areas of exhibit design, veterinary care, and management for captive breeding. The ongoing study of management practices promise future refinements in the husbandry of otters.

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THE OTTER (*Lutra lutra*) IN EUROPE RECENT DEVELOPMENTS AND FUTURE NEEDS

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Abstract: The number of distribution surveys using the IUCN/SSC Otter Specialist Group Method is increasing. In some countries surveys have been repeated on more than one occasion. As a result of these surveys it is believed there is a trend towards the recovery of otter populations in many European regions. Although the number of studies on *Lutra lutra* is increasing, the true reasons for the decline in otter numbers and its distribution throughout much of Europe between 1900 and 1970 are still unknown. In most European countries the otter and its habitats are protected by the Berne Convention. The most important future needs in otter research and protection are: a better standardization of the survey method; the establishment of a system of regularly repeated standardized surveys; the development of reliable methods to count otter populations; the development of deterrents and methods of preventing otter damage to fish production facilities; the definition of the fundamental aims of otter protection.

INTRODUCTION

This paper summarises the development of research and protection activities targeting the otter in Europe since the International Otter Colloquium held in September 1993 at Pietermaritzburg, South Africa (REUTHER and ROWE-ROWE, 1995). It also introduces areas of otter research and protection believed to require immediate attention in the future.

RECENT DEVELOPMENTS

Distribution

Only one species of otter exists naturally in Europe – the Eurasian Otter (*Lutra lutra*). So far no one has obtained an accurate count, or an estimate, of surviving numbers of *L. lutra* in Europe. A continuing problem in obtaining accurate distribution and population figures is the use of different survey methods. This leads to survey results that are largely non-comparable and thus of limited value. As a result, until recently, our knowledge of population density and distribution has remained fragmentary.

In the last few years, however, more surveys have been undertaken (Table 1, Figure 1) by the so called British or standard, or as I prefer to call it, the IUCN/SSC Otter Specialist Group method (MACDONALD, 1990). It should be noted that because the methodology involved in several of these surveys was modified from the standard form the results should be compared with great caution (ROMANOWSKI and BRZEZINSKI, 1997). This is particularly true when comparing surveys done on a national or regional basis (Table 1) or when comparing the results of the total number of sites surveyed compared with identical sites surveyed in repeated surveys (Table 2).

Happily, during this time, surveys using the same methodology have been repeated more than once in some countries. This has allowed for a comparison of data within and between some countries. It is clear from these studies that there is a trend towards recovery by the otter over much of its former range (Figure 2). In Great Britain for instance, STRACHAN and JEFFERIES (1996) calculated an approximate otter population recovery curve for England from which it appears possible that the otter will recover to 75 % of its former range (site occupation) by the year 2025 – starting with a 5.8 % as shown in a 1977 to 1979 survey (Figure 3).

The extent of this recovery has varied from region to region and required different time spans as was shown by HAMMERSHØJ et al. (1996) for Denmark (Figure 4). Further, recent information from Central Europe points out a clear expansion tendency of the otters range in that region. This expansion does not necessarily mean there has been an increase in population density and caution must be exercised when making assumptions about animal numbers. Nevertheless there are many indications that a population increase is occurring.

Research

What research progress has been made on *Lutra lutra* over the last four years depends on the viewers expectations. There is still no conclusive answer to the question - why did the otters' distribution over much of Central Europe decrease within the first seven decades of this century?

On the positive side there have been an increasing number of studies focused on the biology and ecology of this species. Also, great steps forward were made in the understanding of the predator/prey relationship (CARSS, 1995; KRUUK, 1995), the contamination with toxic substances (SMIT et al., 1996; LEONARDS, 1997) or the demography of individual casualties e.g. by traffic accidents (KÖRBEL, 1994; MADSEN, 1996; ANSORGE et al., 1997).

It seems that there is an increasing interest in studies focused on the morphology, physiology and genetics of the otter, as well as in telemetry studies or the testing of new methods like non-invasive monitoring of hormones.

Protection

Most European countries have signed the Berne Convention of the Council of Europe, which guarantees *Lutra lutra* and its habitats the highest protection level – at least on paper. So far only Russia, Belarus, the Ukraine, Slovenia, Croatia, Bosnia-Hercegovina, Yugoslavia and Macedonia have not signed this convention (Figure 5). With the exception of Albania and the Czech-Republic, in all signatory countries the protections afforded by the Berne Convention have become national laws.

In several countries specific conservation programmes for the otter have also been initiated. Some, especially those, which are focused on habitat management, are supported by the European Union, for example**,** by the LIFE-Programme or the New Hanse Interregio Programme. The efforts to establish an Otter Habitat Network Europe (REUTHER, 1995) have been intensified (Figure 6).

Table 1. Results of otter distribution surveys done by the IUCN/SSC Otter Specialist Group method (from: REUTHER, 1993).

Country/Region	Year(s) of Survey	Number of Sites	Portion of positive Sites	Authors
National or Federal States Surveys				
England	1977-79	2,940	5.8 %	LENTON et al., 1980
	1984-86	3,188	8.9 %	STRACHAN et al., 1990
	1991-94	3,188	22.2 %	STRACHAN and JEFFERIES, 1996
Wales	1977/78	1,030	20 %	CRAWFORD et al., 1979
	1984/85	1,097	38 %	ANDREWS and CRAWFORD, 1986
	1991	1,097	52 %	ANDREWS et al., 1993
Scottland	1977-79	4,636	73 %	GREEN and GREEN, 1980
	1984/85	2,650	65 %	GREEN and GREEN, 1987
	1991-94	3,706	88 %	GREEN and GREEN, 1997
Denmark	1984/86	1,154	9.2 %	MADSEN and NIELSEN, 1986
	1991	767	26.1 %	MADSEN et al., 1992
	1996	1,235	21.5 %	HAMMERSHOJ et al., 1996
Spain	1984/85	3,966	33.5 %	DELIBES, 1990
	1994/96	4,049	48.8 %	RUIZ-OLMO and DELIBES, 1998
Ireland	1980/81	2,373	91.7 %	CHAPMAN and CHAPMAN, 1982
Italy	1984/85	1,300	6.2 %	CASSOLA, 1986
Poland	1991-94	2,083	79.5 %	BRZEZINSKI et al., 1996
Portugal	1995	1,008	86 %	TRINDADE et al., 1998
Germany				
Schleswig-Holstein	1986/87	356	2.2 %	HEIDEMANN and RIECKEN 1988
	1998	316	1.9 %	INSTITUT BIOGEOGR., unpubl.
N-Niedersachsen	1991/92	938	1.9 %	BINNER et al. 1996
Mecklenburg-Vorpommern	1992/94	844	61.4 %	BINNER, 1997
Brandenburg	1995/97	1,372	81.9 %	DOLCH and TEUBNER, 1997
Austria				
Steiermark	1993/94	1,016	25.2 %	SACKL et al., 1996
Burgenland	1996/97	446	37.5 %	JAHRL and KRAUS 1998, KRAUS and JAHRL, unpubl.
Regional Surveys				
Central Portugal	1980	90	70 %	MACDONALD and MASON, 1982b
Spain	1981	176	40 %	ELLIOT, 1983
Western France	1980	315	15 %	GREEN and GREEN, 1981
Southern Italy	1982	188	8.5 %	MACDONALD and MASON, 1983a
Austria				
Steiermark)	1986	225	11.1 %	KRAUS, 1986
Hohe Tauern region	1993	242	0.4 %	JAHRL, 1995
Mühl-, Waldviertel	1994	266	44.7 %	KRANZ, 1995
Southeastern region	1997	284	2.5 %	JAHRL, unpubl.
Western Hungary	1988/89	300	32.7 %	NECHAY et al., 1990
Hungary	1987/88	369	52 %	KEMENES, 1991
Western Greece	1985/86	106	66 %	GAETHLICH, 1988
Greece	1981	200	62 %	MACDONALD and MASON, 1982a
Yugoslavia	1982	129	44 %	LILES and JENKINS, 1984
Albania	1985	31	51.5 %	PRIGIONI et. al., 1986
Morocco	1983	78	46 %	MACDONALD and MASON, 1984
Algeria	1984	52	19 %	MACDONALD et al.,1985
Tunesia	1982	75	40 %	MACDONALD and MASON, 1983b

Table 2. Like the results of the repeated surveys from England, Scotland and especially Denmark show a comparison of the percentage of the positive sites should be based on the number of the identical sites and not on the total number of sites surveyed.

		England		**Wales**		**Scotland**		**Denmark**	
		total sites	identical sites	total sites	identical sites	total sites	identical sites	total sites	identical sites
1st survey	n sites surveyed	2,940	2,940	1,030	1,008	4,636	2,650	1,154	633
	% positive sites	5.8 %	5.8 %	20 %	20 %	73 %	57 %	9.2 %	15.2 %
2nd survey	n sites surveyed	3,188	2,940	1,097	1,008	2,650	2,650	767	633
	% positive sites	8.9 %	9.7 %	38 %	38 %	65 %	65 %	26.1 %	24.1 %
3rd survey	n sites surveyed	3,188	2,940	1,097	1,008	3,706	2,650	1,235	633
	% positive sites	22.2 %	23.4 %	53.0 %	53 %	88 %	83 %	21.5 %	35.5 %

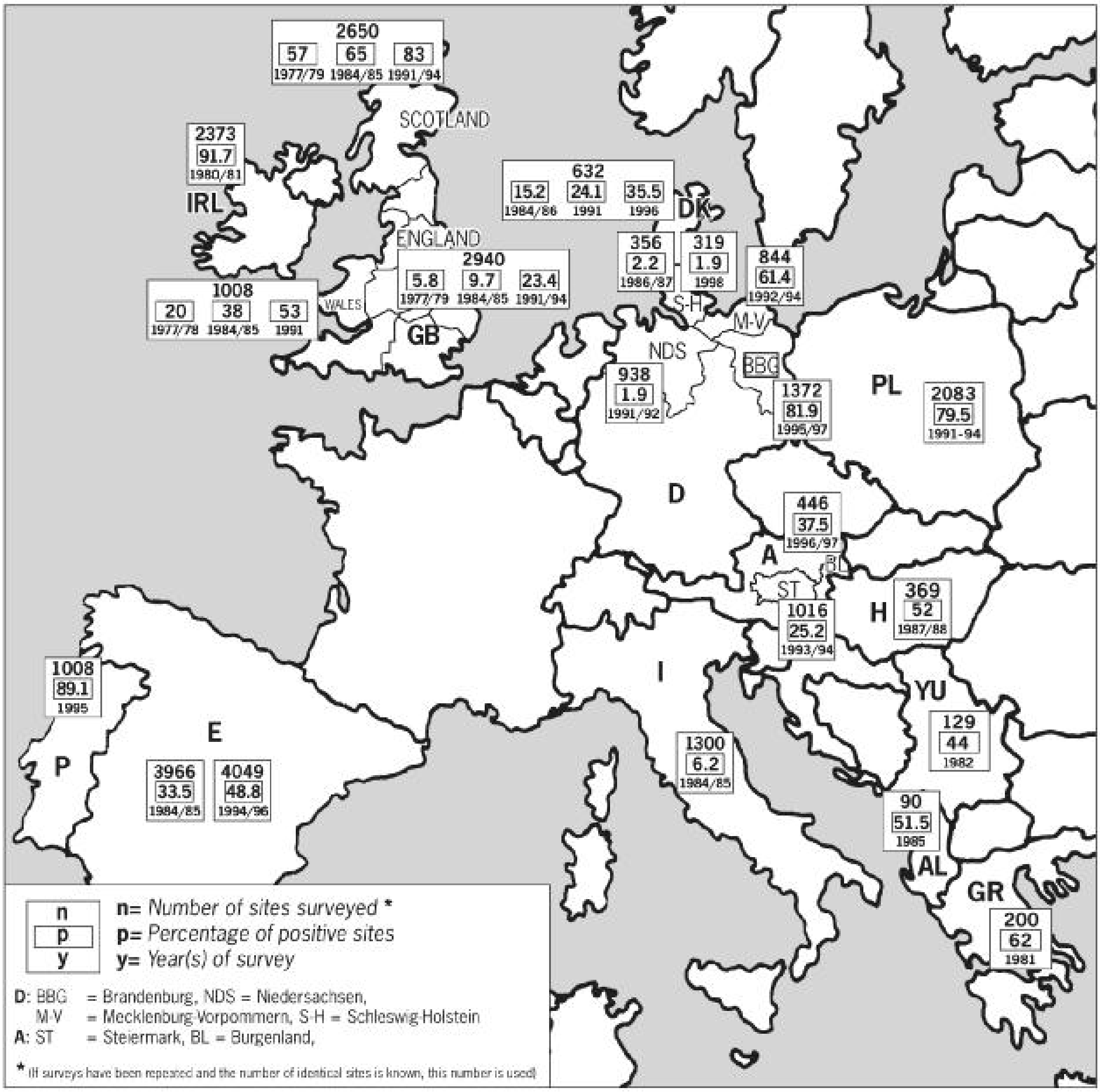

Figure 1. For an increasing number of European countries results of surveys done by the IUCN/SSC Otter Specialist Group method are available. Fortunately these surveys have been repeated once or twice in some countries.

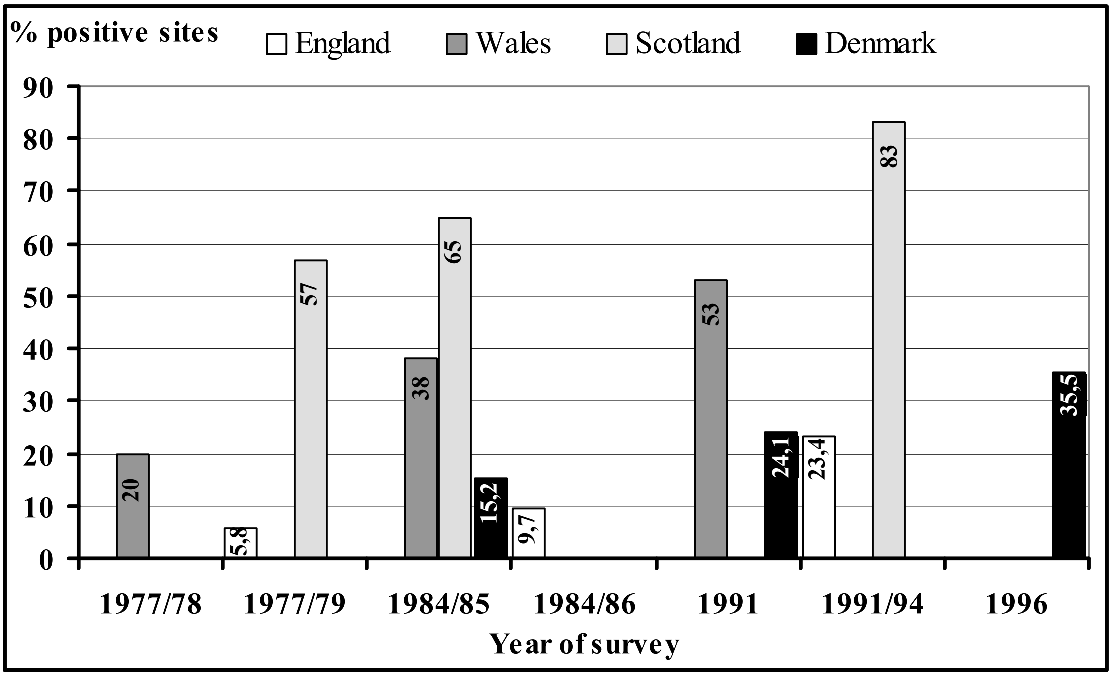

Figure 2. A comparison of the survey results in those countries where the surveys have been repeated (based on identical survey sites) show a clear trend towards recovery by the otter of much of its former distribution range.

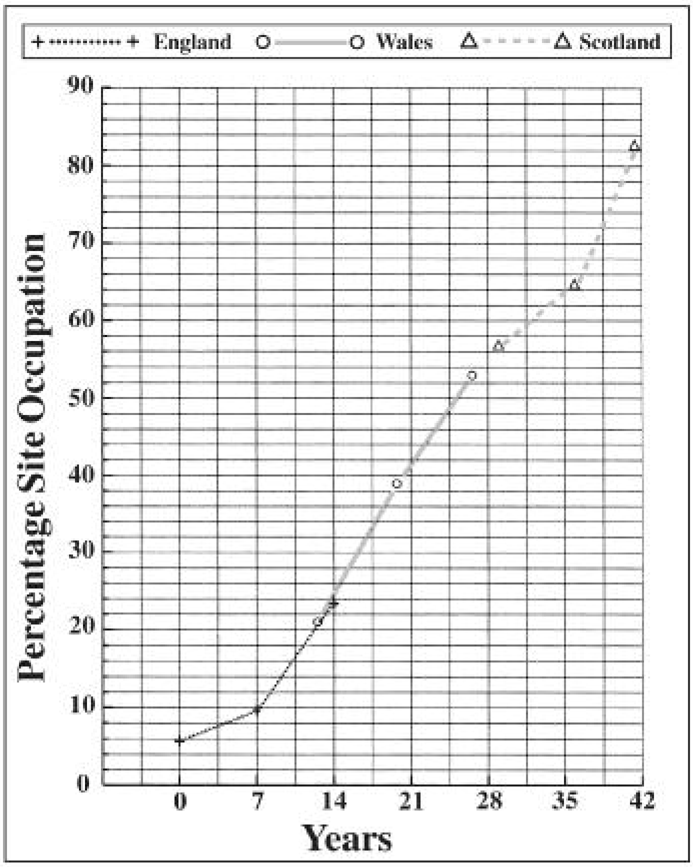

Figure 3. STRACHAN and JEFFERIES (1996) calculated the approximate shape of the otter population recovery curve for Britain on the base of the results for overall percentage site occupation at the twice repeated surveys of England, Wales and Scotland.

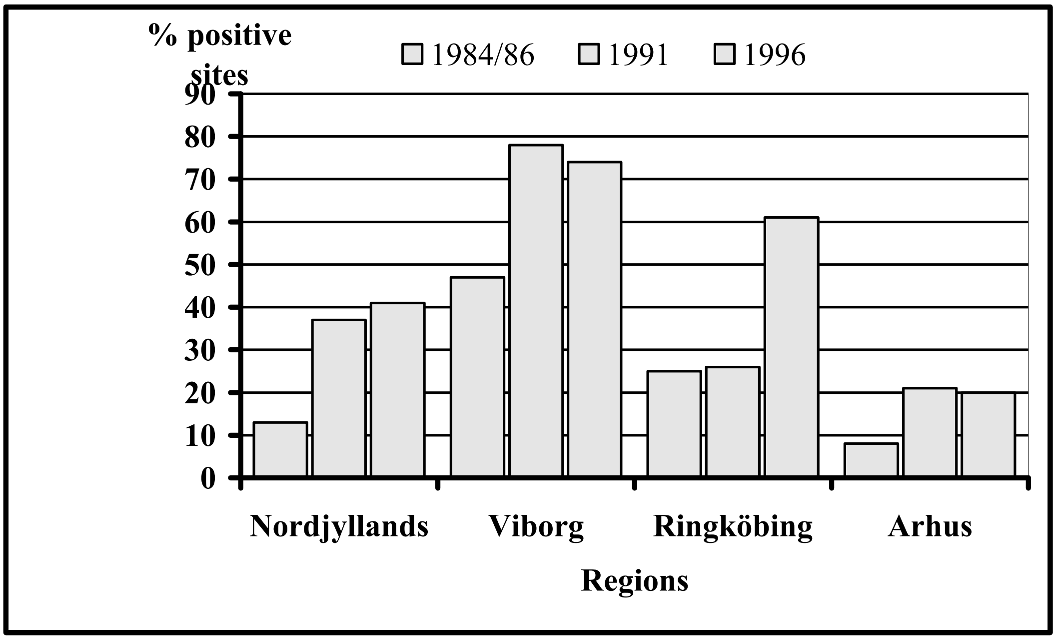

Figure 4. The extent of the recovery varies from region to region and requires different time spans as is shown by a comparison of the results of a twice reapeated survey of four regions in Danmark (from: HAMMERSH∅J et al. 1996).

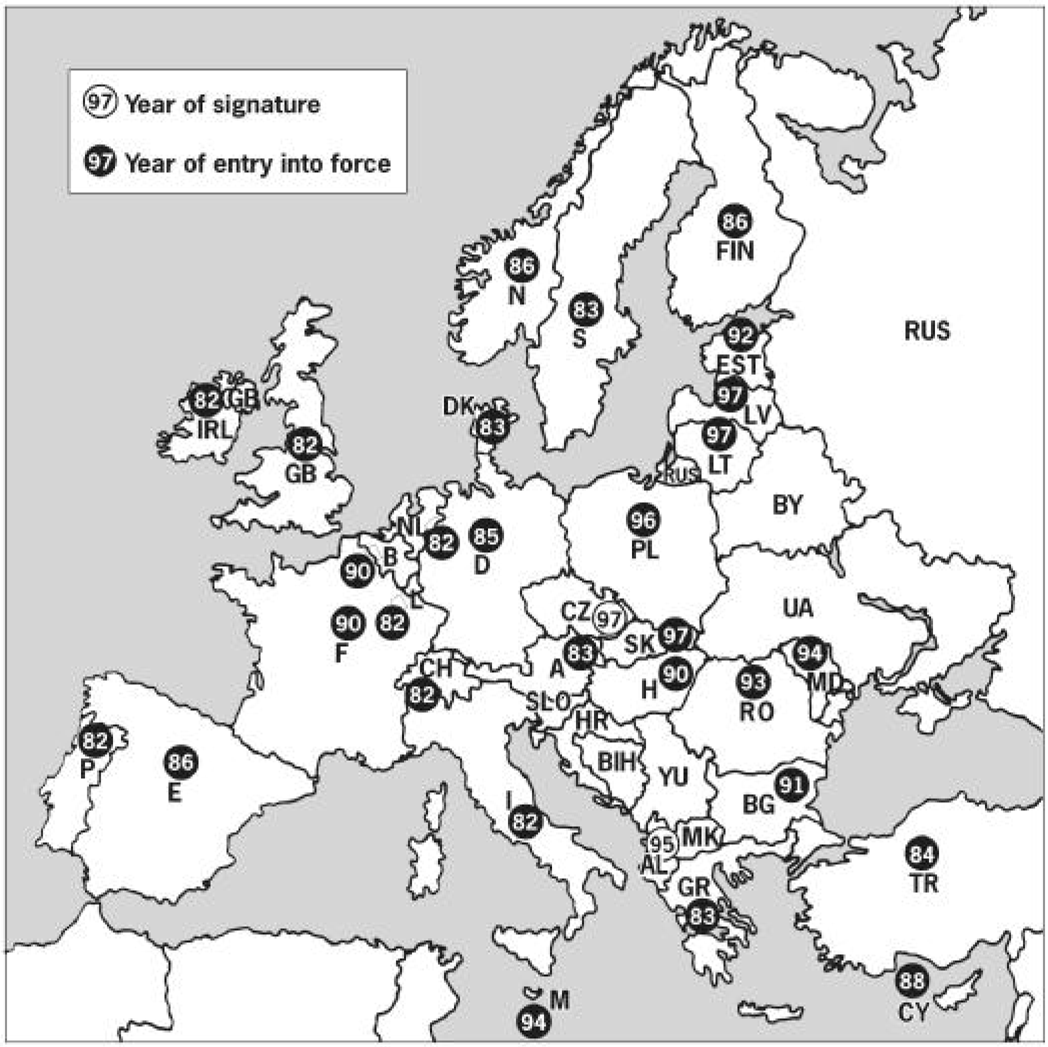

Figure 5. Most European countries have signed the Berne Convention and with the exception of Albania and the Czech Republic all signatory states have already implemented this convention into national laws.

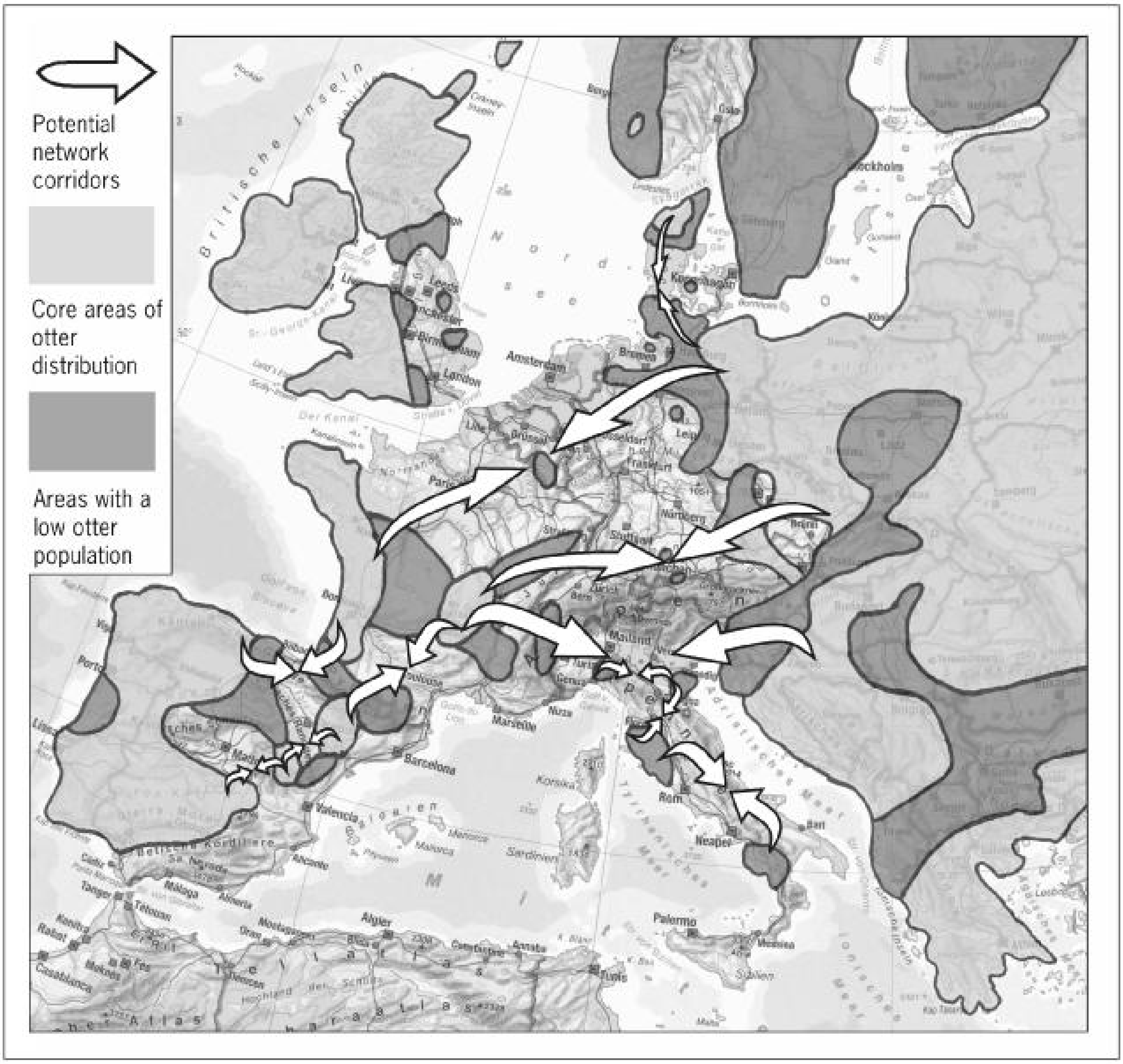

Figure 6. One of the main tasks for the near future is the development of a European Otter Habitat Network (OHNE) to re-connect the isolated and drifting apart otter occurences.

In most European countries there are private, governmental or university groups, or organisations, which initiate or co-ordinate regional or national activities for otter protection. These activities also promote public awareness of the factors causing the endangering of the otter and the need for the protection of its habitats. As a result, the otter is now one of the most popular mammal species throughout Europe, especially in Western Europe.

Reintroduction, translocation or supplementation projects have been started in Great Britain, Sweden, Italy and Spain. Additional projects are planned or being discussed in countries like France, the Netherlands and the Czech Republic. Now, as before, the need for this kind of artificial intervention is controversial (REUTHER, 1992).

The efforts to optimise the management of the captive population of *Lutra lutra* have been intensified. *Lutra lutra* is part of the European Endangered Species Programmes (EEP) and the studbook for this species is working well. A draft of the husbandry guidelines is currently being revised and will be published soon (MELISSEN, 1997).

FUTURE NEEDS

Distribution

It is necessary to increase our knowledge of the otters' distribution and population status development. This has to be done by comparable survey methods like that of the IUCN/SSC Otter Specialist Group. Those European countries which still have not done these surveys on a nation wide basis should be encouraged to do so. Those countries which have done initial, status quo surveys, should be encouraged to repeat these surveys at intervals of five to ten years as a maximum.

An important precondition to making the survey results more comparable is an improved standardisation of the methodology. Some of the regulations have to be defined more clearly and the methods of presentation adapted to a uniform system.

To what extent regional based survey results can improve our understanding of the causes of the otters' decline has to be evaluated. However regional surveys offer a greater opportunity to compare changes in the otters' distribution and in environmental factors affecting this distribution. Therefore, surveys of both types, national and regional, should be conducted. National surveys will allow monitoring of distribution trends over the entire range of *Lutra lutra*. Regional surveys will facilitate the monitoring and evaluation of more localized factors which may be influencing these national trends.

A future scientific challenge of great importance is the development of methods to count, or to estimate, the number of otters. Without this data base all ratings of threat levels, estimations of population developments, studies on the reasons of decline or evaluations of the success of protection measures will be speculative.

Research

The number of otters in a given area is not the only key to the understanding of population developments. More information on the social system and territoriality of *Lutra lutra* is also needed. For this more telemetry studies are necessary. But, it is not enough to do this with some single animals and over short periods of time (weeks or months).

Looking at the recovery of the otter in many European regions it is predictable that a problem will come to the fore which is locally restricted at the moment: the conflict between otters and fish production. It would be naive to wait until the fish industry exerts widespread international pressure to develop solutions to this growing problem. It also would be foolish to expect legislative regulations such as the Berne Convention, or idealistic arguments based on the otters' role as a natural fish predator to reduce this burgeoning conflict. What we need immediately are studies to find, and test, technical measures that can avoid, or greatly reduce, damages by otters in fish production facilities.

There are many other fields of research that should be intensified. For instance, more effortshould be made to study possible effects of contaminants, rather than simply adding more and more chemical data on tissue concentrations. In addition, the development of non-invasive methods of studying contaminant concentrations is encouraged.

However, looking at the limited personal and financial resources available, priority should be given to those studies, which can improve our understanding of the causes of population decline and possible methods of increasing the current recovery trend. The success of these efforts can be dramatically improved as more research is done in a co-operative way.

Protection

This is also true for our efforts in the field of protection, especially for border-crossing habitat management activities. This leads to the question - what are the basic aims of otter protection? And this cannot be answered from a local, regional or national point of view. It is not enough to look only on the regional or national species list or red data book and to check off the otter as a resident.

We have to look at the species as a whole. That means our primary goals should be to,

1. enable the otter to recover completely its former species range;
2. avoid isolated, small and non viable island-populations;
3. guarantee the genetic diversity of the species.

We also should keep in mind the important role of the otter as a flagship-species. Not for nothing the VI. International Otter Colloquium was entitled "otter conservation is not only about otters". For habitat management strategies as well as for public awareness campaigns the species is an important instrument. If we want to change the policy of water (rivers, lakes and wetlands) management from one of technically dominated solutions to an ecologically oriented approach and if we want to guarantee, or to increase biodiversity in our rivers, lakes and wetlands we have to use the tool ”otter” very carefully. It can fulfil this function only if we make the need of an ecological orientated paradigm shift clear to policy, administration and the general public. When we send the signal that it does not matter how society proceeds because conservationists will be able to repair the damages to nature by technical measures (like captive breeding programmes, re-introductions, gene-manipulation, etc.) we let slip the opportunity otter conservation represents for nature conservation as a whole.

This might sound too philosophical for the protection strategy of a single species. But we should be aware that it is not enough to lament the increasing number of threats, to constantly issue new demands for more legislative regulations, to develop technical protection measures against traffic casualties and drowning in fish-nets, or to publish recommendations how to build artificial holts, and how to rebuild canalised rivers or how to plant riparian vegetation. These are just instruments to be used in reaching our goal only. But what is our goal when we talk about otter conservation? To define an answer to this question is one of the most important future needs for scientists and conservationists engaged in otter protection in Europe – and I believe, not only in Europe.

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REINTRODUCTION OF THE EURASIAN OTTER (*Lutra lutra*) IN NORTHEAST SPAIN

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INTRODUCTION

The otter disappeared from Girona province (Catalonia, NE Spain) 20 years ago. In 1993, a project was started in order to restore the disappeared population.

STUDY AREA

The reintroduction project is being carried out in the Muga and Fluvià River basins, a territory which includes approximately 200,000 hectares. The Aiguamolls de l'Empordà wetlands lie between the mouths of both rivers, with 4,800 ha protected as Natural Park and 800 ha as Integral Reserve (Figure 1).

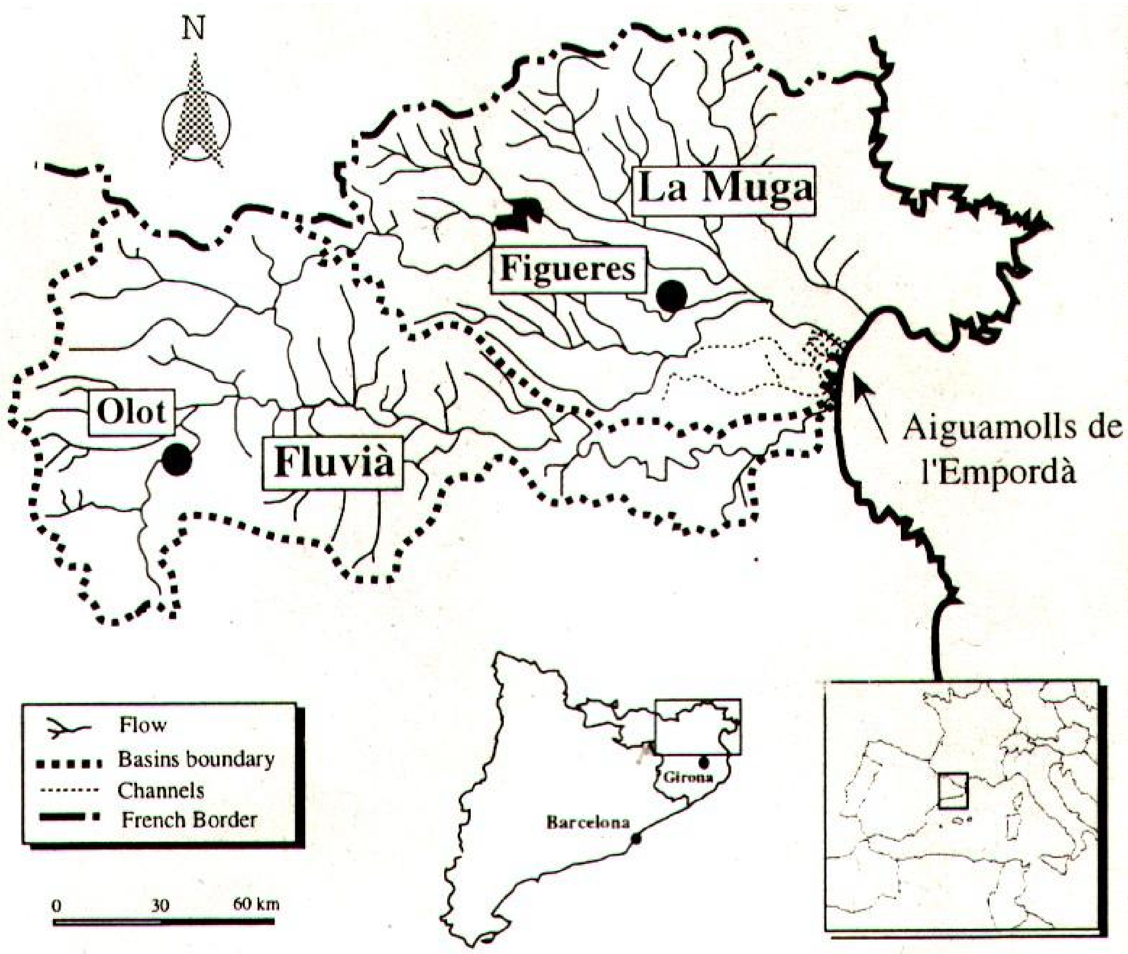

Figure 1. Study area

OBJECTIVES

The Otter Project has two main objectives:

* The restoration of an erradicated population.
* The promotion of river and wetland conservation through an emblematic species.

VIABILITY STUDY

In 1994, a study was carried out (SAAVEDRA, 1995) in order to determine if the Otter Project observed the guidelines for reintroductions proposed by the International Union for the Conservation of Nature (IUCN, 1987). The conclusions were the following:

1. The Eurasian otter (*Lutra lutra*) is classified as vulnerable for its total distribution and as endangered in Catalonia.
2. The reintroduction has been proposed in the original area of distribution.
3. The causes of extinction were persecution (hunting, trapping), pollution (mainly DDTs) and habitat destruction.
4. Extinction in the study area has been complete and spontaneous recolonization is unlikely to occur because the nearest populations live at a distance of hundreds of kilometers.
5. The proposed donor populations (from Extremadura, Galicia, Asturias and Portugal) are healthy and increasing in number (TRINDADE et al., 1998; RUIZ-OLMO and DELIBES ,1998).
6. There are no significant genetic differences (subspecies, race) between the Iberian populations of otter.
7. There is enough available habitat (200,000 ha).
8. The habitat is in good condition regarding water and fish pollution, fish biomass and riverbank and wetland conservation (ZAMORA et al., 1996; MATEO et al., 1999).
9. The human local population is mainly in favour of the reintroduction, because the otter does not negatively affect the interests of any economic group in the area. It’s a fully protected species from 1973.

REINTRODUCTION PROTOCOL

1. Identification of suitable places to set the traps.
2. Trapping using leghold traps (1.5 Softcatch Traps, Woodstream Corporation, USA).

Every time an otter was captured:

3. Anesthesia, trap removal, sex determination, wound inspection and treatment, antibiotic injection and body condition calculation. The strongest individuals (high body condition, RUIZ-OLMO, 1995), those prepared to resist the stress of handling and implanting, were chosen and any old individuals, pregnant or lactating females or animals in poor conditions were immediately released.

4. Neuroleptic injections (Haloperidol and Trilafon) and introduction into the transport cage.
5. Transport to Barcelona Zoo by car during the night.
6. Two-three weeks stay in Barcelona Zoo. Veterinary evaluation and implantation of a transmitter.
7. Release in the study area.
8. Radiotracking.

RESULTS

The implantation of transmitters in most of the otters released (91%, n=23) has been essential for supplying knowledge about the new population's adaptation and movements. The individuals are radiolocalised at least once every two weeks until the animal is lost or found dead (2-588 days, n=23). A total of 23 otters have been released, and there are at least two newborns (SAAVEDRA and SARGATAL, 1998). Post-release mortality has been caused (n=5) mainly as a result of road traffic accidents and illegal fike nets (RUIZ-OLMO et al., 1997). Ocuppation of the territory has been faster than expected and two years after the release of the first individual, the otters have visited most of Aiguamolls Natural Park, most of Fluvià and Muga Rivers and many tributaries. Some animals have travelled from one basin to the other using Aiguamolls wetlands as a corridor.

The first studies of feeding habits have shown that otters main prey are fish and crayfish (*Procambarus clarkii*).

Table 1. Dispersal of the new population

Period	nº of days	nº of released otters	kilometers of river	hectares of wetland
14/11/95-31/12/95	47	3	0	500
14/11/95-31/12/96	412	18	135	940
14/11/95-28/02/98	837	23	290	2200

ENVIRONMENTAL EDUCATION PROGRAMME

The Environmental Education Programme is essential for the achievement of the Otter Project's second objective: the promotion of the conservation of rivers and wetlands using an emblematic species. The programme began with the creation of a tale for children (*The Return of the Otter*, SAAVEDRA et al., 1995) along with other pedagogical tools.

Since the end of 1996, we have been visiting the local schools, bringing the message of river and wetlands conservation using the otter and the following reasoning: "*If the otter can live in this river, it is surely in good enough condition for the other animals, for the plants and for the people. But people need work in order to have their rivers clean and healthy again*".

For this reason we are promoting the creation of local groups (in every village in the area) called "Otter Groups", which will act voluntarily to conserve and restore their nearest stretch of river, removing rubbish, planting trees, preparing exhibitions and events about nature protection and so on. All these activities have the economic support of private sponsorship.

We have also made other promotional products such as T-shirts, pins, stickers and leaflets. A special version of the tale in Spanish will be sent to Extremadura, to promote the conservation of the Otter Project's donor populations.

PLANS FOR THE FUTURE

In the next months the release of otters will continue, until a total of 50 individuals, all implanted with transmitters. The creation of Otter Groups will continue and so the restoration activities in rivers, lakes and marshes.

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DISTRIBUTION AND FOOD HABITS OF THE EURASIAN OTTER (*Lutra lutra*) IN SOUTH KOREA

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ABSTRACT: The distribution of the Eurasian otter in South Korea was studied by checking spraints and footprints along rivers and coasts nation-wide from 1992 to 1996. Positive sites were found in most areas except for Kyonggi-Do District, which included the metropolitan area of Seoul. Otter density was relatively high on southern coasts, south flowing rivers and in the north-eastern hilly areas. Their habitats, however, have been lost very rapidly by reclamation of coastal areas, bank protection work and river water pollution. Food habits of otters from the Yoncho Reservoir were studied from 1995 to 1996 by analyzing 343 spraints. Their main food were fishes, birds, shrimps and frogs. High occurrence of waterfowl was a characteristic of the winter.

INTRODUCTION

In South Korea, only one species of otter occurs, the Eurasian otter (*Lutra lutra*). The species was designated as a natural monument in 1982 and its hunting prohibited by law. The designation, however, was not based upon scientific population surveys. There have been very few otter studies other than brief reports by ANDO et al. (1985) and ASAHI et al. (1986). In 1997, the South Korean Ministry of Environment conducted the first intensive study of the otter at Seom-Jing Gang with the assistance of the Ministry of Environment (1977). Unfortunately there is still no information on the nationwide status of the otter. Because of the rapid economic growth of the country, otter habitats are apparently being lost or degraded. Judging from the case of neighbouring Japan, where there has been no reliable evidence of otter presence for more than ten years (ANDO, 1997), there is an urgent need for Korea to formulate effective otter conservation plans to save the species from the threat of extinction. As basis for a conservation plan, the distribution of otters was surveyed from 1992 to 1996. From 1995 to 1996, the food habits of the otter were studied at the Yoncho Reservoir in Koje Island, Kyongsagnam-Do District.

STUDY AREAS AND METHODS

Distribution

One hundred fifty-two sites where otter were thought likely to occur and covering all nine districts of South Korea were selected and visited from 1992 to 1996 through the year. At each site, the presence of spraints and footprints was monitored over a distance of a few hundreds meters when signs were found, and over one kilometre when no signs were found. Each site was visited more than twice. In cases when field signs were confirmed in only one visit, or density of signs was less than one per kilometer in any visit, the population was considered to be unstable. When both signs were found in two or more visits and the density of signs was more than one per kilometer at least in one visit, the population was considered to be stable.

Food habits

Food habits of the otter were studied at the Yoncho Reservoir (1.5 km by 1.5 km) on Koje Island (about 150 sq. km) of Kyongsagnam-Do District (Fig. 1). The island is about 500 m from the mainland, and the reservoir is located 5 km from the mouth of a small river. The reservoir was constructed about twenty years ago, and has been used for drinking water. Human access and fishing in and around the reservoir are prohibited to protect the water quality. From November 1995 to October 1996, spraints were collected along the reservoir shore once every month. They were washed using 0.5 mm mesh sieve and the remains were sorted into 12 categories. Occurrence frequencies as well as bulk of food items were recorded. The bulk percentage of each food item in one spraint was estimated by eye into one of five ranks (0, 25, 50, 75, 100%) (modified from JENKINS et al., 1979).

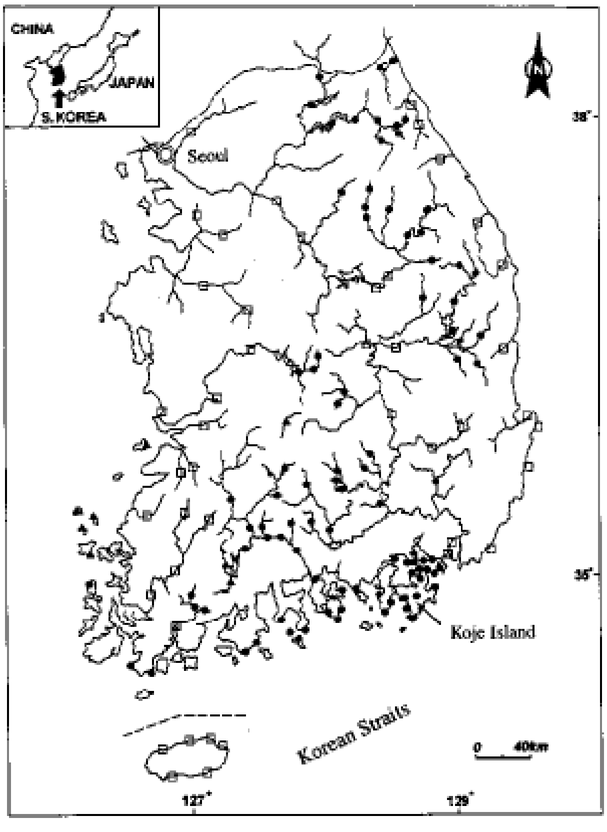

Figure 1. Distribution of Eurasian otters in South Korea.
□; no otter, • ; unstable populations, ●; stable populations

RESULTS

Distribution

Out of 152 survey sites, evidence of otters was found at 106 (70%). Of the positive sites, populations were classified as stable at 92 and as unstable at

14 sites (Fig. 1). In rivers flowing south into the Korean Straits, 79% (38 out of 48) of the sites were positive. In west flowing rivers, 61% (28 out of 46) were positive, and they were found only on the upper stream. East flowing bound rivers are mostly short, and positive sites occurred at only 25% (2 out of 8). A survey along the southern half of the west coast recorded 86% (6 out of 7) positive sites. Along the southern coast, facing the Korean Straits, otters occurred in most places -94%(32 out of 34) sites. Along the east coast, no positive sites were found (0 out of 3). In Cheju Island (1,200 sq. km), 90 km south of the mainland, surveys were made only along the coasts and no positive sites were found (0 out of 6).

Food habits

A total of 343 spraints were collected. Most were found within several metres of the reservoiris edge, only a few were found on the actual river system. Seasonal changes in frequency occurrence of food items in the spraints are shown in Table 1. Fish were the most important prey item for otters throughout the year. Birds and shrimps were frequently eaten in winter. During the field survey in winter, an otter chasing waterfowl on the reservoir was observed. The otter preyed amphibia mainly in spring and summer. Fig. 2 shows the average bulk percentage and occurrence frequencies of each food item. In bulk percentage, fish, the most important prey item, occupied 82%; birds were the second most important food source. Although appearing frequently in spraints, shrimps were not an important food resource. Remaining food items in spraints were mainly bones and scales of fishes, feather for birds, bones for amphibia, and carapace for shrimps. Table 2 shows identified food species by remains.

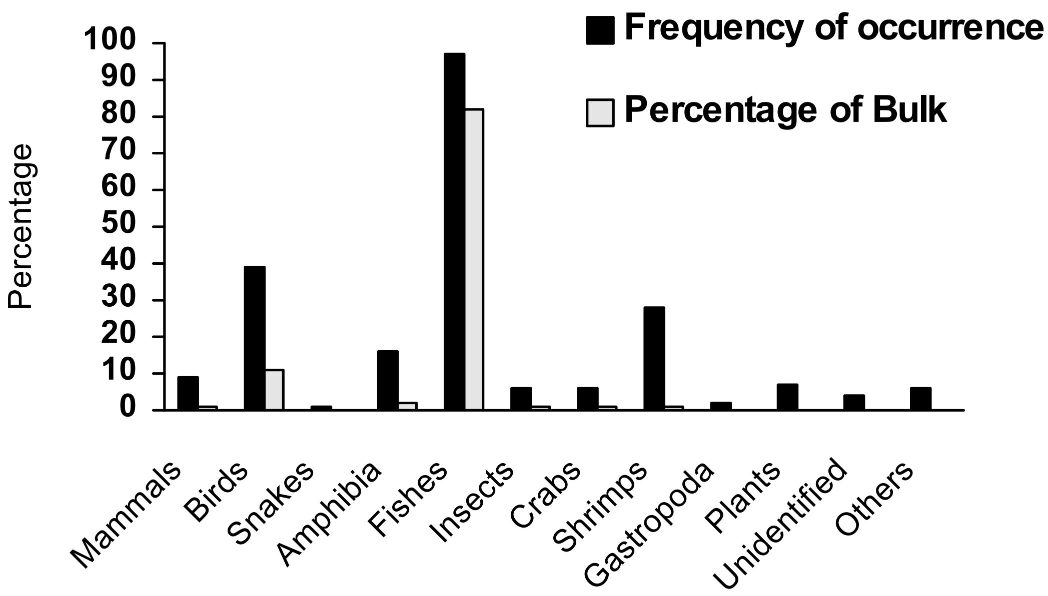

Figure 2. Average frequencies of occurrences and percentages of bulks of food items in otter spraints at the Yoncho Reservoir on Koje Island in South Korea.

Table 1. Seasonal changes of occurrence frequencies (%) of food items in spraints at the Yoncho Reservoir on Koje Island in South Korea.

	1995 Nov.	Dec.	1996 Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Average
Mammals	0	0	26	12	12	3	3	9	0	14	22	10	9
Birds	43	50	59	64	50	37	22	25	40	28	26	21	39
Snakes	0	0	0	0	0	0	0	0	0	10	0	0	1
Amphibia	7	0	7	3	15	30	32	22	24	21	17	7	16
Fishes	93	92	100	91	100	100	97	100	96	100	100	100	97
Insects	7	13	7	6	0	0	8	9	4	0	9	10	6
Crabs	0	0	22	0	0	0	0	25	8	0	0	21	6
Shrimps	29	46	48	27	27	27	27	22	28	28	13	17	28
Gastropoda	7	0	0	0	0	0	0	0	8	10	0	0	2
Plants	14	13	7	3	0	0	11	19	12	10	0	0	7
Unidentified	7	0	0	0	0	7	11	9	0	0	4	7	4
Others	0	0	11	9	8	10	11	16	0	3	4	0	6
No. of spraints	28	24	27	33	26	30	37	32	25	29	23	29	343

Table 2. Identified food items in otter spraints at the Yoncho Reservoir on Koje Island in South Korea. The group "others" include items like plastic sponges, parts of fishing nets and small stones.

Mammals	Striped field mouse *Apodemus agrarius coreae*
Birds	Gadwall *Anas strepera*
	Chinese little bittern *Ixobrychus sinensis*
	Little egret *Egretta garzetta*
Snakes	Short-tailed viper snake *Agkistrodon saxatilis*
Amphibia	Frog
Fishes	Crucian carp *Carassius carassius*
	Pale chub *Zacco platypus*
	Carp *Cyprimus carpio*
	Eel *Anguilla japonica*
	Dark chub *Jacco temminck*
	Oriental weatherfish *Misgurnus anguillicaudatus*
Insects	Coleoptera
	Hymenoptera
	Orthoptera
Gastropoda	Assimineidae

DISCUSSION

Distribution

Positive sites were found mainly along big rivers flowing to the south and the upper stream of rivers flowing to the west (Fig. 1). As Eurasian otters usually have big home ranges along rivers (ERLINGE, 1967), the otter population in South Korea may not yet be fragmented although habitats of the north-western plains, with many large cities including Seoul, were destroyed. Otters occur mainly in less human-populated hilly areas although there are rural living local people even in these areas. Thebig rivers in South Korea generally flow through urban, rural and mountain areas. Otters may use hilly parts of a river as core areas and urban parts for traveling routes.

On coastal areas, a high ratio of positive sites was recorded in the south and southwest coast. Those areas have complicated coastlines, and such topography provides the otter with long linear and diverse habitats including rocky points where fish are more abundant than along sandy beaches.

Along rivers and coasts, otter habitats have been destroyed by human interference sucf as road construction, land reclamation and water pollution. In many parts of South Korea where coastlines are complicated, roads between coastal towns are designed mainly to cross over a headland rather than follow the coastline. Although the design is not intended for nature protection, it helps protect the natural coastlines. The western coast of South Korea is characterized by very large tidal ranges extending over several metres, with quite broad tidal flats at low tide. In view of the distribution of positive sites, such tidal flat do not appear to be a favoured habitat of the otter, presumably because less fish are found on such coasts. Otters are found on the east coast at low density as observations of spraints were occasionally reported.

Food habits

Otters at the reservoir seem to use it as a core area and are mostly dependent on food items available at that place. Although the occurrence frequency and percentage of bulk might not be an exact reflection of the amount of food actually consumed, there is no doubt that fish are the most important item in the diet. A high percentage of waterfowl in their diet is a also characteristic of this study area. Seasonal change of birds in diets seems to reflect migratory waterfowl increase such as *Anas strepera*. Seasonal increase of frogs is also reported in ANDO et al. (1985). The presence of field mice remains in spraints may mean that the otter also hunts in the forest.

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HABITAT REQUIREMENTS OF GIANT OTTER (*Pteronura brasiliensis*) IN PERU

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ABSTRACT: A two-step approach was used to analyse habitat requirements of endangered giant otters in southeastern Peru. Step one consisted of a large-scale comparison of river characteristics and giant otter distribution (macro-habitat analysis); step two involved correlating different otter activity data (direct animal count, number of dens and marking places) with the main habitat factors of the oxbow lakes, the otter's preferred environment (micro-habitat analysis). Of 14 habitat factors (e.g. size of open-water surface, flooding vegetation, swamp areas, shoreline characteristics, lake volume and bottom profile, conductivity, visibility in the water and fish density), only the size of the oxbow lake showed a significant correlation with giant otter presence. This indicates that the size and distribution of oxbow lakes are a key factor for giant otter conservation and management in southeastern Peru.

INTRODUCTION

A top predator in the neotropical rainforest and a highly endangered species, the giant otter nonetheless remains largely unstudied (FORSTER-TURLEY et al., 1990). In July 1990 a project was initiated by the Frankfurt Zoological Society with the goal of broadening the knowledge about these rare animals and developing a plan for their conservation (SCHENCK and STAIB, 1995; SCHENCK, 1995; STAIB, 1995; SCHENCK et al., 1997). The project includes studies of current distribution of the giant otter (*Pteronura brasiliensis*), their population dynamics, predator-prey relationships and human impact. Essential for the conservation plan, habitat analysis forms a main focus. Following two and a half years of continuous fieldwork, the project has been followed up by annual, two-month fieldwork periods, which include a monitoring programme and public relations work in the non-fieldwork period. The study area is located in southeastern Peru in the Department of Madre de Dios (Fig. 1).

The area is defined by the Andes and the Brazilian and Bolivian borders and represents an area of 85,000 km^2. The Madre de Dios basin is characterised by several major rivers about 200 or more metres wide and a network of medium-sized and small streams. Water volumes vary greatly in the rainy and dry seasons. Most rivers are white-water rivers with low visibility, sandy beaches and many bends, which eventually erode to form oxbow lakes. The lake environment differs significantly from that of the original river, especially for an aquatic hunter. For one, the visibility is better as a consequence of sediment deposition. Due to the dense vegetation cover at the shoreline and the nutrient trap situation of the lake, the organic input from the forest is higher in the lake than in the river. In addition there is no current and water-level variation is far less than in the river.

In the following, rivers are considered macrohabitats while oxbow lakes are regarded as microhabitats. The annual average temperature is,

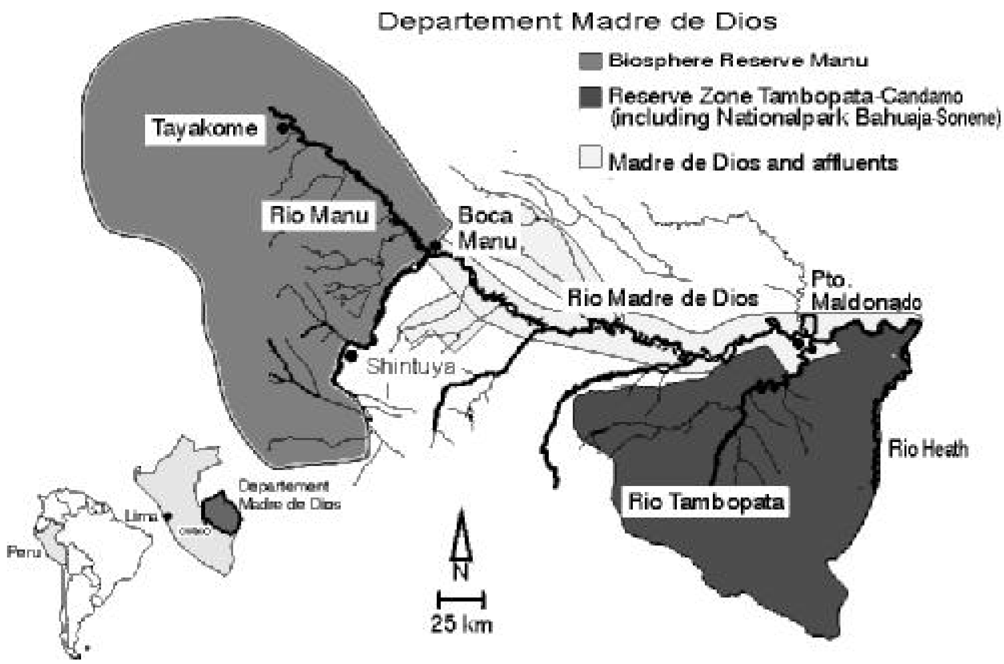

Figure 1: Study area

approximately 24°C, with a maximum temperature of 36°C and a minimum of 13°C, caused by cool Antarctic winds. There are two main seasons: October to April, when temperatures and rainfall are higher; and May to September, when temperatures are lower and rainfall diminishes. Total annual rainfall amounts to approximately 2000 mm in lower areas. The major part of the area is below 500 m in altitude. The predominant habitat consists of a river floodplain and evergreen tropical forest with a 40 m canopy. Other habitats include earlier successional stages of vegetation along the river and oxbow lake margins, tracts of seasonally inundated swamp forest, marshes and Mauritia palm stands (TERBORGH, 1983; ERWIN, 1990). The biodiversity of the area is outstanding (TERBORGH, 1992). With an average of 0.8 human inhabitants per km², the area is extremely sparsely inhabited. Nevertheless there are regions with settlers and gold miners and areas where clear-cutting of forest and agriculture occurs. We chose two main study areas: Manu National Park and the Tambopata area. One of the biggest national parks in the world, Manu extends over 18,000 km² (Biosphere Reserve) and has been relatively well protected for more than 25 years. By contrast, the Tambopata River is an area that is much more exposed to human influence. The entire Madre de Dios catchment and several smaller affluents were also extensively investigated.

METHODS

Interviews were conducted with local people (indigenous, hunters, fishermen, settlers and park rangers) to obtain initial information on the status of the otters and their current and past distribution. Lake surveys were conducted by rubber dinghy, rivers were explored using an outboard-equipped boat. By travelling slowly along the shoreline, it was possible to locate indirect signs such as tracks, spraint marking places and dens. The otters clear these areas of vegetation; scent marking lends the sites a strong smell when they are in use. Giant otters dig their dens in non-inundated high forest right on the water's edge (DUPLAIX, 1980; LAIDLER, 1984; STAIB, in prep.). If there are otters on a lake, they almost invariably approach the boat, circle it, periscope and sound their warning vocalisation, a snort. Otters were counted and filmed using a video camcorder while performing this behaviour, allowing us to record their individual throat patterns. This prevented double-countings during census. A total of nine different rivers were checked for giant otter presence, amounting to a one-way stretch of 1,246 river-kilometres. Parts of the river systems were controlled several times. Surveys were carried out at a total of 63 lakes. A total of 613 days were spent in the field.

Giant otters prefer clearer waters without much current (DUPLAIX, 1980; LAIDLER, 1984). Given the hydrographic conditions existing in Peru, the most suitable areas are thus the cochas or oxbow lakes, river segments that are cut off from the main river. Long-term observation of selected groups showed that otters live mainly in oxbow lakes (STAIB, in prep.). In the Manu National Park otters were observed for 539.3 hours on lakes compared with only 1.2 hours in the river. The preference for the cochas was also observed during the course of the Manu Monitoring Programme. Seven surveys were undertaken between 1990 and 1996, amounting to 230 river kilometres and 14 to 18 lakes per year. This census encompassed a total of 242 otters observed (not individuals) in lakes versus 21 animals in the rivers.

Comparing different oxbow lakes, habitat requirements were studied in detail on the microhabitat level. The habitat programme consists of 14 habitat parameters (size of open-water-surface, flooding vegetation, swamp areas, flooded palm forest, distance lake/river, shoreline characteristics, lake volume and bottom profile, maximal and medium depth, conductivity, visibility inside the water, fish density and human influence; for details see SCHENCK, 1996)

RESULTS

Otters were found in most of the rivers in southeastern Peru (Fig. 2). The overall density was low even in the most well-known areas for giant otters, such as the Manu National Park. The annual surveys carried out in Manu recorded an average of 41 giant otters per year (s.d. 4.1: Range 33 - 45: n = 6). The population was estimated to be about 75 giant otters for the 18,000 km^2 area (The surveys don’t cover all wetland areas of Manu. It is possible that some otters may remain in inaccessible swampland or smaller affluents. Given the landscape of the Manu River basin, its habitat features and known otter densities, about 24 animals were plausibly added to the survey numbers leading to the estimate).

On the other hand otters tend to concentrate in their preferred habitat, the oxbow lakes and territories can be very small. In the Manu National Park five groups remained in the same lakes over the past five years (STAIB, in prep.). The Cocha Salvador group consisted of four to seven otters over the five-year period from 1990 to 1995 and lived in the 108.3 hectare lake all year round. Other groups frequented swamp land and creeks in addition to the open water bodies of the lakes, making it difficult to define the exact territory size (SCHENCK, 1996). Using lake size as a gauge of territory size, the size of the Cocha Chashu group's (4 - 10 animals) territory was estimated at 55.2 hectares. The Otorongo group (7 - 10 animals) ranges over an area of

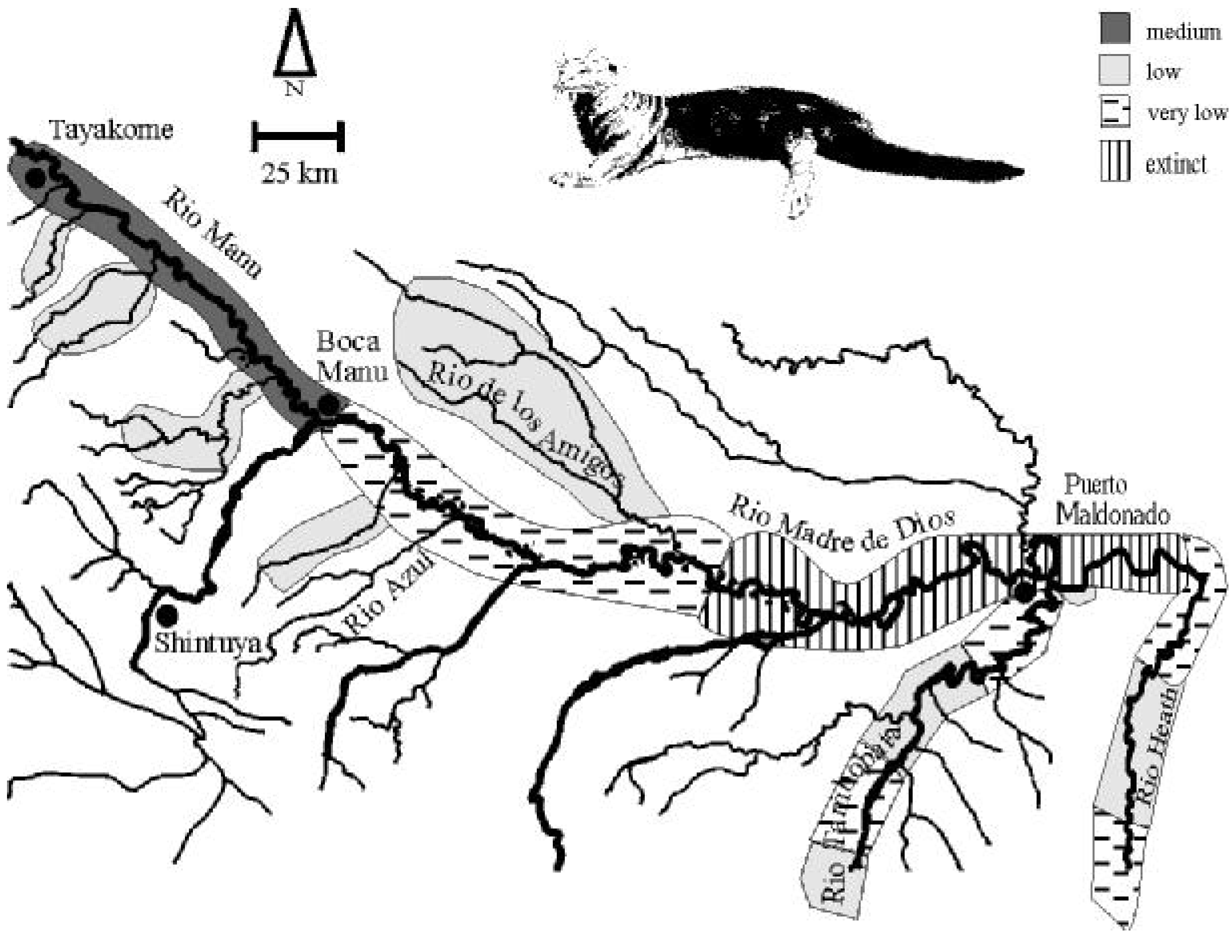

Figure 2: Overview of giant otter densities in the Department Madre de Dios (survey 1990-96)

approximately 80.4 hectares and the Juarez group's (2 - 6 animals) territory is approximately 62.4 hectares. Different river characteristics and classes of giant otter presence and human impact are listed in Tab. 1. On the microhabitat level, the occurrence of indirect signs (marking places and dens together) was positively correlated with the number of otters observed during census (Spearman-Rank correlation r = 0.7723: *P*<0.05: n=23), number of different oxbow lakes,). In comparing the habitat parameters with different measures for giant otter presence (indirect signs or otters observed per survey), no significant correlation was found for most of the parameters. An exception was lake size, where, based on direct observations, a positive correlation was found with respect to giant otter presence (r = 0.6156: *P*<0.05: n =23 number of different oxbow lakes) (Fig. 3).

Table 1: Habitat characteristics of rivers (macrohabitat) and giant otter density

River system	River width (m)	Lakes per 100 km	Otter density[1]	Human impact[2]
Madre de Dios	>400	8.6	0.009	3
Manu	150-200	7.5	0.044	1-2
Azul	50	0.0	0.000	2
Amigos	50-80	14.0	0.030	1
Tambopata	180-250	4.0	0.030	2-3
Heath	100	14.5	0.024	2-3

([1] average groups per river km; [2] estimated classes: low=1, middle=2, high=3)

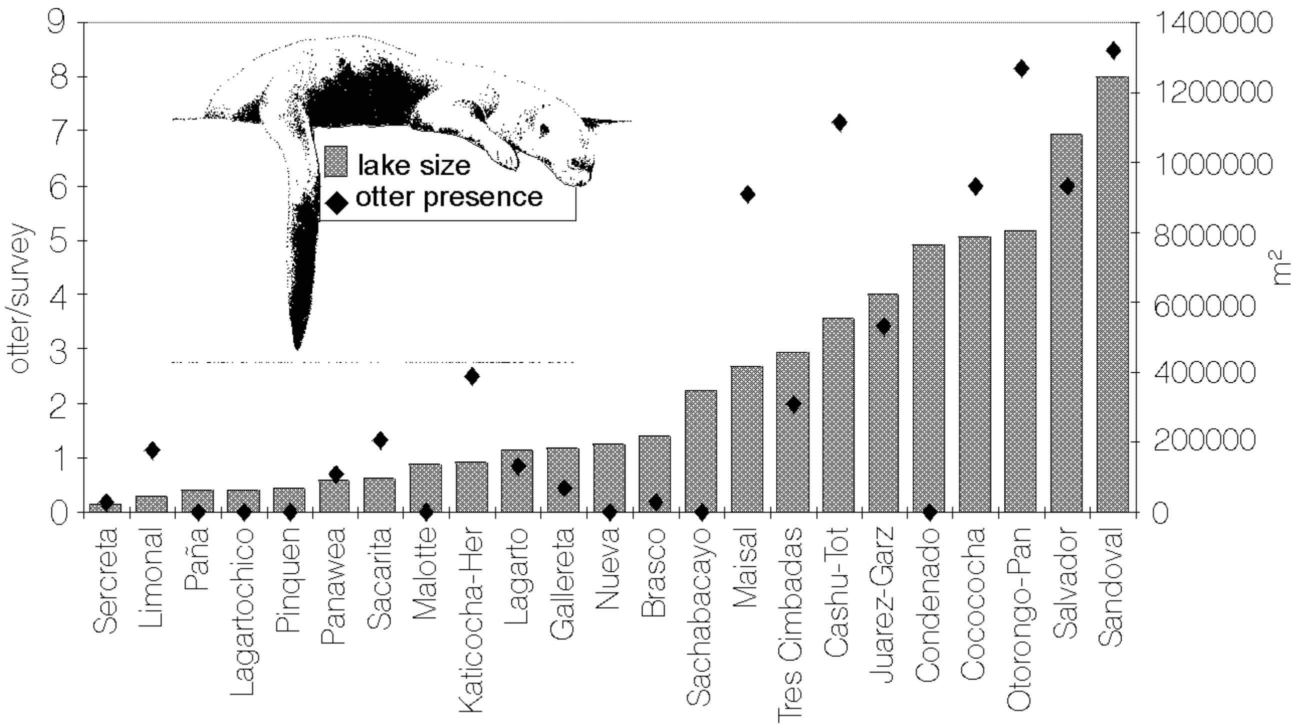

Figure 3: Giant otter presence and lake size

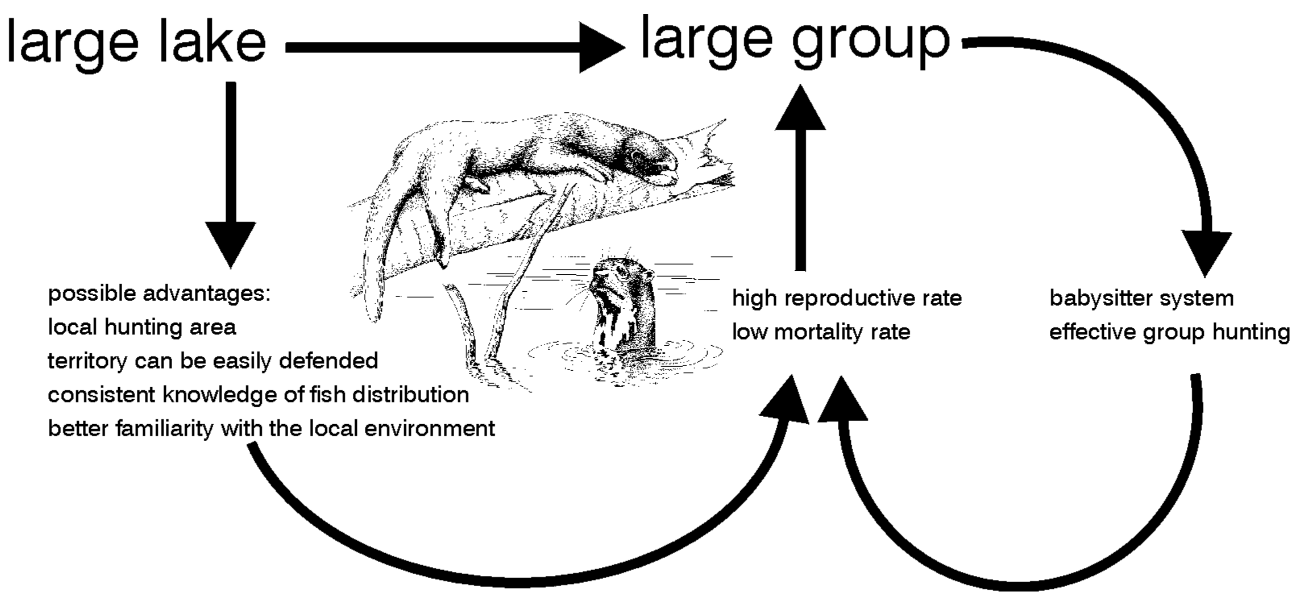

Figure 4: Positive correlation between group size and lake size

DISCUSSION

Otters concentrate in the oxbow lakes. For the reasons detailed above, as compared to the river, still water offers several advantages for an aquatic hunter. Taking into account the number of oxbow lakes per 100 river-kilometres and the width of the river, it appears that the most well-known areas for giant otters - Manu National Park is an example - are in fact not the best ones naturally. Areas with big rivers and many oxbow lakes, such as the lower Madre de Dios, may have supported higher, natural giant otter densities. Reports of local people confirm high otter densities on the lower Madre de Dios River in the past. As a result of high human impact (hunting in the past and existing settlements of over 30,000 gold miners), otters no longer exist in these areas. The size of the oxbow lake seems to play an important part in the spatial distribution of otters. Giant otter groups may prefer a big single lake as compared to several smaller ones, since the distance between hunting and resting areas is short. This is important, particularly during the period of cub-raising. Giant otter cubs normally remain in the den for about two months and the group is then bound to a certain area. Energy-taxing trips on the river while travelling from one lake to another within the territory do not occur if the group uses only one big lake. It is possible that knowledge about the local environment, fish distribution and the ability to defend the territory is better when bodies of water are not split. A big lake may support a larger otter group; significantly more cubs were observed in groups with more members ($r=0.7264$: $P<0.05$; $n=20$. STAIB, in prep.). In larger groups an effective baby-sitter system is implemented. Elder brothers and sisters help look after cubs while the rest of the group - including the lactating female - is hunting for fish (SCHENCK and STAIB, 1994). Giant otters normally hunt in groups and a correlation between group size and catch efficiency was observed (STAIB, in prep.) Large groups and large lakes form a self-stabilising system (Fig. 4).

Conservation activities should take into account these new results, which suggest that otter protection must focus on large oxbow lakes.

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RIVER OTTER REINTRODUCTION: THE PENNSYLVANIA APPROACH

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Abstract: Conservationists should consider both ecological and sociological factors during development and implementation of an otter reintroduction programme. Since 1982, the Pennsylvania River Otter Reintroduction Project (PRORP) has applied this integrated approach to reintroduce river otters successfully to 5 watersystems in northcentral and western Pennsylvania. During this project, we applied 5 developmental and implemental stages that resulted in a successful, publicly supported reintroduction project: 1) site selection, 2) identification and selection of appropriate sources and numbers of animals, 3) veterinary care, captive management, and translocation, 4) public relations and education,and 5) post-translocation monitoring and evaluation.

INTRODUCTION

PRORP was initiated in 1982 to reverse otter (*Lontra canadensis*) population declines that resulted from unregulated trapping and degradation of riparian and aquatic habitats during the 1800's and early 1900's throughout most of Pennsylvania. Prior to these human-induced perturbations, otters inhabited all major watersheds in the state (Rhoads 1903). By 1952, when the Pennsylvania Game Commission provided otters complete legal protection, the population had become limited to the Pocono Mountains region in northeastern Pennsylvania (EVELAND, 1978; Fig. 1). Otters currently are classified as a "species at risk" in Pennsylvania (KIRKLAND and KRIM, 1990). During work with the remnant otter population (SERFASS et al., 1986, 1990), we concluded that statewide improvements in water quality and wildlife management techniques provided renewed potential for restoring otters to portions of their former range. The objective of PRORP was to diversify the distribution of otter populations in Pennsylvania and, thereby, reduce chance of complete extirpation of otters in the state.

To date, PRORP has successfully translocated 92 otters among 5 drainages in northcentral and western Pennsylvania (SERFASS et al., 1986, 1993a; Fig. 1) and work is currently underway to reintroduce otters to another site in western Pennsylvania, the Allegheny River. During PRORP, we developed, refined, and applied 5 elements to the project that resulted in successful reintroduction of otters and widespread public support for the programme: 1) reintroduction site selection, 2) identification and selection of appropriate sources and numbers of animals for translocation, 3) veterinary care, captive management, and translocation, 4) public relations and education, and 5) post-translocation monitoring and evaluation. In this paper, we briefly review our approach in developing, implementing, and evaluating the reintroduction programme.

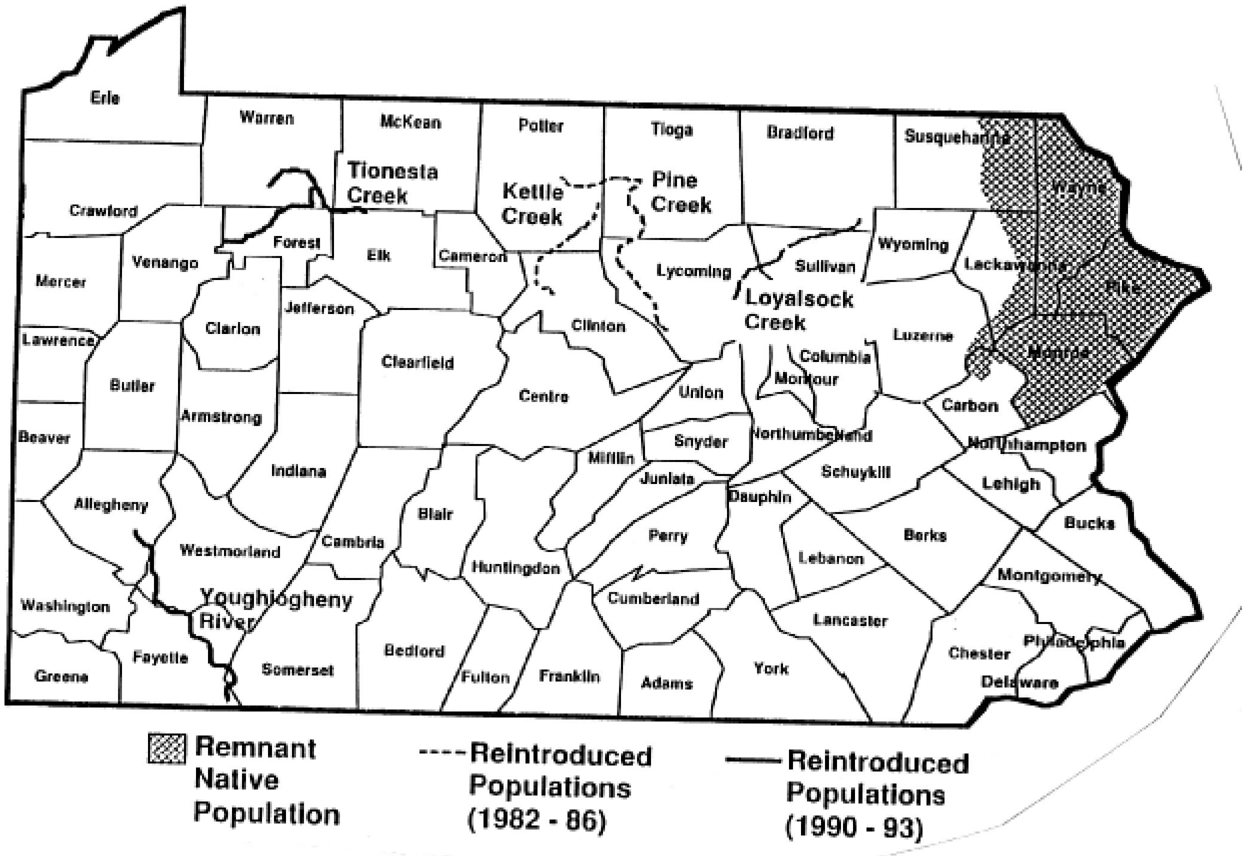

Figure 1. Study area

SITE SELECTION

Selection of reintroduction sites was based on experience obtained through work with the remnant otter population (SERFASS et al., 1986, 1990) and a literature review of otter habitat requirements. Primary concerns were selecting sites with an adequate prey base, unpolluted water, undisturbed riparian habitats with physical features that would provide denning opportunities, and adjoining aquatic habitats suitable to support range expansion. We focused on public lands for reintroductions because the long-term integrity of these habitats would not be threatened by development.

SOURCES AND NUMBER OF OTTERS FOR RELEASE

Most otters used by PRORP were obtained by live-trapping in northeastern Pennsylvania and Maryland or purchased from trappers or commercial suppliers in Louisiana, Michigan, New York, and New Hampshire (SERFASS et al., 1993b). We were criticized for releasing 17 otters obtained from Louisiana along Pine Creek during early phases of the project (1983-1984) without prior knowledge of genetic variation among populations (DALBY, pers. comm.; GENOWAYS, 1986). As a result of the criticisms and evaluation of genetic variation among otter populations throughout much of North America (SERFASS, 1994), we revised our strategies for obtaining otters for reintroduction and have since placed emphasis on use of otters from northeastern Pennsylvania and surrounding states (New York and Maryland) as primary sources for stocking.

Release of 20-30 otters per reintroduction site appears to have been sufficient to insure interaction among individuals and establish reproducing populations (SERFASS et al., 1986, 1993a). Release strategies were designed to offset consequences of genetic and demographic stochasticity (SERFASS, 1994).

CAPTURE, HANDLING, AND CAPTIVE MANAGEMENT

Reintroduction projects are often limited by cost constraints as well as by the number of animals that can be obtained for translocation. Thus, opportunities to acquire additional otters may disappear if initial reintroduction attempts fail. Consequently, high survival rates among founding individuals are essential if a reintroduction programme is to succeed. The likelihood of survival during stressful, post-release acclimation periods is enhanced when translocated animals are in good physical condition. To accomplish release of healthy otters, we developed trapping and handling techniques that reduced frequency and severity of injuries and implemented a captive management programme, involving active participation by a team of veterinarians, designed to enhance fitness of otters (SERFASS et al. 1993b, 1996).

PUBLIC RELATIONS

Initial public information and education programmes administered at reintroduction areas were based on food studies and other experiences and information gathered during preliminary investigations of the remnant otter population in northeastern Pennsylvania (SERFASS et al., 1986, 1990). We were particularly concerned that local fishermen would consider otters harmful to gamefish populations and, consequently, designed public relation campaigns to address this critical issue.

Information about the otter project was presented to citizens at proposed reintroduction sites through newspaper, television, radio reports, and public slide presentations. The slide show factually described the natural history and feeding ecology of river otters. The public relations effort has been extremely successful, contributing to strong public support for the project. To generate continued interest and support for the project, local citizens were invited to attend otter releases and were kept appraised of research findings through news releases and slide presentations. To further educate the public about management issues regarding otters in Pennsylvania, we participated in the production of a video, which documents our approach to reintroducing otters.

EVALUATION AND MONITORING

To evaluate the initial success of reintroduction, severalotters at the first four reintroduction sites (range = 4-12 otters per site) were surgically implanted with radio transmitters (MELQUIST and HORNOCKER, 1983, SERFASS et al., 1993b) and monitored for up to one year following release. Review of results from radio-tracking studies demonstrated a high survival rate among reintroduced otters and that most remained in reintroduction drainages (SERFASS et al., 1986, 1993a). Recent streamside surveys for otter sign (1997 and 1998) indicate that otters are persisting at all reintroduction sites and appear to have established self-sustaining populations.

DISCUSSION

PRORP has benefited by an integrated approach that incorporated professional expertise from various disciplines including wildlife biology, veterinary science, and population genetics. Implementation and evaluation of the project was based on 5 primary criteria: 1) selection of reintroduction sites with an adequate prey base, cover, protection from development, and opportunities for range expansion, 2) development of a public relations programme to foster public understanding and support, 3) identifying primary and supplemental sources of otters to sustain the reintroduction effort, 4) development of a captive management programme that included veterinary care to facilitate release of healthy, well conditioned otters, and 5) development and implementation of monitoring techniques to evaluate both short and long-term success of the programme. Our approach has resulted in successful restoration of river otter populations to portions of their historic range in Pennsylvania.

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BEHAVIORAL DEVELOPMENT OF OTTERS (*Lutra canadensis*) IN A MARINE COASTAL HABITAT

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Abstract: The behavioral development of group of North American river otters is described. Proficiency in aquatic locomotion was attained within 20 weeks of birth, but proficiency in aquatic hunting required more then 20 additional weeks of trial-and-error learning. Young otters attained self sufficiency at 9.5 months, and independence at 11 months. Males continued to live in their home area long into adulthood. Females did not disperse unless they were forcibly expelled by an elder resident female.

INTRODUCTION

Published accounts of the behavioral development of wild Lutrines have thus far been limited to studies of young sea otters (*Enhydra lutris*) (e.g. PAYNE and JAMESON, 1984). Some findings describing the behavioral development of river otters (*Lutra canadensis*) have been presented previously (SHANNON 1989, 1991a,b, 1992, 1994), but these data have remained preliminary in scope. This paper elaborates upon past findings, and presents new observations, which bring the author's study of otter behavioral development closer to comprehensive understanding.

STUDY AREA

The study area is Trinidad Bay (41°3'N, 124°8'W), a small, shallow marine bight on the far-northern Pacific seacoast of California. The otters' home range comprises approx. 4 linear km of marine coastline that is dominated by thickly vegetated rocky shore cliffs. The otters at Trinidad Bay are exclusively marine in their habits. There are no streams or known bodies of standing fresh water within the otters' home range. The otters obtain their water by drinking from numerous springs and seeps, which flow year-round down the faces and crags of the shore cliffs.

MATERIALS AND METHODS

Otter pups were studied by direct observation. The author's study of behavioral development began formally in May 1986, and continues to the present day. Observations were conducted during the two hours preceding sunset; daily whenever possible. During the first year of study, an ethogram was compiled. Categories included behavior associated with locomotion, foraging, socialization, grooming, play, and communication. To determine the period of ontogeny of a particular behavior, the first occasion a pup was seen to display that behavior was noted, and subsequently when all pups displayed it. Criteria for estimating the pups' date of birth were described in SHANNON (1989). The occurrence of self sufficiency was determined by the behavior of the mother, as the time when she stopped providing food specifically for her young, and began punishing pups for taking food from her. A pup was declared independent of maternal care when it was not seen in the company of its mother after a period of one week.

RESULTS

Since 1983, the author has documented the lives of 40 pups born in 16 litters from five mothers. During the study period, the author collected data on the behavioral development of sixlitters (22 pups) from "Old Mama"[F'2], two litters (5 pups) from F86A="Mama Junior"=[F'3], twolitters (4 pups) from F86B="Scarnose"=[F'4], and four litters (5 pups) from F91A[F'3]="Little Mama"=[F'5]. Of the 36 pups born at Trinidad Bay since 1986, 17 were females, 13 were males, and six died before their gender could be determined. The juvenile mortality rate was 70%. Seventeen otters died as dependent pups; 19 young achieved independence but eight of these died as yearlings. Only 11 young (30%) survived to adulthood, and just three females lived to breed. Of the 22 pups born to F'2, five (23%) survived to adulthood. Of the five pups born to F'3, three (60%) survived to adulthood and remain alive as of February 1998. All of the young born to F'4 died as dependent pups. Of the five pups born to F'5, three (60%) survived to adulthood and also remain alive as of February 1998. All of the otters living at Trinidad Bay in February 1998 are the grandpups and great-grandpups of F'2.

The author estimated that otter pups in this population were born around 1 April (all results are ±10 days). The pups were born in a natal den located outside the mother's usual home range. Pups became aquatic and were brought by their mother from the natal den to the main dens at Trinidad Head when they were approx. ten weeks old. The mother began providing fish fry to pups during week 11, and pups exhibited active fish-chasing behaviors from week 12 on. Otter pups first learned the skills of capturing and manipulating fish on land. Pups attained efficient coordination of all basic swimming movements by the end of week 14, and might be taken on their first fishing excursions out of the nursery area as early as week 15. Pups possessed the complete adult repertoire of swimming behaviors by 16 weeks of age, and could swim as proficiently as adults by the end of week 19.

The mother was the primary agent of socialization. However, multiparous mothers allowed their elder daughter(s) to return to live with her and her new pups after the process of weaning began in week 14 (suckling for comfort continued past week 22). After being accepted back by her mother, an elder daughter became a full-time, cohabiting member of the Family, and the pups' regular companion. Elder daughters provided socialization to pups, but these "big sisters" were not true alloparents/nest helpers, because they would not give food to a pup, nor would they assume parental care if the mother was absent. Encounters with adult males first took place when the pups were 16-18 weeks old. The males almost always behaved amicably toward pups that solicited social interaction, however, pup-male interactions typically remained infrequent until after the young became independent.

First fishes (sanddabs) were captured early during week 17. The first free-swimming fish fry were caught during week 19. Despite these early fish captures, the pups' overall foraging efficiency remained functionally nil for three more months. At six months (26 weeks), the pups had become very active, agile fish chasers, but they were still inefficient at actually capturing fishes, and still depended entirely on food provided by the mother. During the pups' seventh month, however, multiple solo prey captures became daily occurrences. By the end of week 36, pups became noticeably efficient at capturing small fishes (< 25cm.), although the young still depended on the supplemental food provided by their mother. Pups attained basic self sufficiency during weeks 38-42 (*ca*. 9.5 months). The mother began not providing food for the exclusive use of pups during week 38. After week 42, a mother might bite a pup that took food from her. Following the attainment of self sufficiency, it became common to see pups foraging on their own. Although the young could satisfy their individual life requirements adequately by this time, they did not achieve optimality in food procurement and habitat utilization until after they were abandoned by their mother at 48 weeks (11 months).

No mother has forced her own independent young to disperse, and no yearling has dispersed from its home area voluntarily. After independence, yearlings spent approximately three months living and wandering solitarily. By the end of May (month 14), yearlings of both sexes usually joined the male Clan. Most subadult females were members of the male Clan from May-July of their second year. In her 16th month (July), a yearling female either returned to live with her neo-maternal mother, remained with the Clan, or was expelled aggressively (and permanently) from her home area by a territorial elder sister. Males continued to base their activities at their home area well into adulthood, and some remained residents at their birthplace their entire lives. M90[F'3] will be eight years old in spring 1998, and he is still a resident at Trinidad Bay. No male had ever remained a member of the Family group during his second year of life until 1997-1998, when yearling male M96 returned to live with his mother and elder sisters, rather than joining the society of his elder uncles. M96 attained adulthood in January 1998 at the age of 22 months. This was the first time the author could document an adult son living with his mother and elder sisters.

CONCLUSIONS AND RECOMMENDATIONS

Otter pups become proficient swimmers nine weeks after leaving the natal nest, but spend most of their first year of life learning to become proficient hunters by a slow process of individual trial-and-error. Although the young essentially teach themselves the techniques of capturing aquatic prey, the experience and example of the mother is absolutely essential to their learning the logistics of optimal foraging and habitat utilization. A mother's knowledge of local sources of food and shelter would be especially important in habitats where such resources are widely dispersed or limited in availability. Logically, removal of a mother before her young have reached self sufficiency could only have a negative effect on pup survivorship and population recruitment. Therefore, conservation and management practices should be avoided that would remove a mother from her pups before they are 10 months of age.

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GENERATIONAL CHANGE IN AFFILIATION PATTERNS IN A SOCIETY OF MARINE COASTAL OTTERS (*Lutra canadensis*)

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Abstract: Affiliation patterns within a society of Canadian river otters changed from a regime of rigid sexual segregation to free intersexual interaction after a complete turnover in population membership. The author suggest that the change in this population's social "rules" was the result of collective choice by the otters themselves, rather than a result of habitat change or other ecological factors.

INTRODUCTION

Aspects of the social organization of the otter population at Trinidad Bay and some changes the author observed over his years of study have been described previously (SHANNON, 1989, 1991*a*, 1991b, 1992, 1993, 1997). To summarize, from 1988-1994, adult otters at Trinidad Bay practiced a ritualized behavioural segregation of the sexes. This sexual segregation was remarkably rigid.

A period of 70 months (1,481 observation sessions) elapsed between instances when the author saw an adult male and an adult female simply forage together, and 48 months (1,134 sessions) passed between observed episodes of intersexual play (SHANNON, 1993). The adult males were the primary enforcers of sexual segregation. A juvenile female could interact freely with the males and be accepted by them as a social co-equal, but after her first oestrus, she was thereafter shunned, and might be attacked, if she attempted to interact with an adult male. Although this pattern of sexual segregation was unequivocal and stable over many years, the author has been unable to explain the phenomenon in terms consistent with accepted biological theory (SHANNON, 1997). Some events that took place during the summer of 1997, however, have helped to better understand the process of sexual segregation witnessed at Trinidad Bay from 1988-1994.

STUDY AREA

The study area is Trinidad Bay (41°3'N, 124°8'W); a small, shallow marine bight on the far-northern Pacific seacoast of California. The otters' home range comprises approximately four linear km. of marine coastline that is predominated by thickly vegetated rocky shore cliffs. The otters at Trinidad Bay are exclusively marine in their habits. There are no streams or known bodies of standing fresh water within the otters' home range. The otters obtain their water by drinking from numerous springs and seeps, which flow year-round down the faces and crags of the shore cliffs.

MATERIAL AND METHODS

The author has been studying otters by direct observation. This study began informally in June 1983, was formalized in May 1986, and continues to the present day. Observations were conducted during the two hours preceding sunset; daily whenever possible. From May1986 until February 1998, over 3,165 sessions were conducted, and otters were observed at Trinidad Bay during 2,725 of those sessions (86% success). Since 1983, the author has documented the behavior of 63 otters of known identity or birth whose lives span five generations. During this study, the population has been comprised of 4-11 adults. Because the otters are diurnal and can be observed at close quarters (5-100 m.), they can be identified reliably by direct visual recognition. The author identifies the otters primarily by facial markings and other physical characteristics, but idiosyncrasies of behaviour are also reliable marks of individual identity. Equipment used consists of 10x28 binoculars, a tape recorder for dictating field notes, and a 35 mm camera and video camera for visual documentation. The otters have never been trapped, handled, monitored, or been subjected to any other invasive technique.

RESULTS

The event which initiated the change in this population's social system was the collapse of the resident matriarchy in July 1992, when all three of the maternal females died. Only one female remained: F91A[F'3], a yearling granddaughter of the old matriarch. Subsequently, F91A was accepted into the male Clan, and for the next ten months lived with the six resident males as their social co-equal and full-time cohabitant until the spring of 1993, when she had her first oestrus. After her oestrus ended, however, if she approached a male, instead of being greeted amicably as she was when she was a juvenile, she was shunned, often screamed at, and occasionally attacked, apparently without provocation, other than her mere presence. As spring turned to summer, even her littermate brother (M91) shunned her, and F91A became a complete social outcast. Despite being shunned, F91A persisted in attempting to interact with the males, always unsuccessfully. Finally, on 13 August 1993, as she followed the foraging males, they suddenly turned on her, and attacked her as a concerted group. Thus was F91A expelled from the males' society once and for all. F91A spent the entire third year of her life sharing the same home range with the males, but by virtue of her social ostracism, she was forced to live a completely involuntary solitary existence until she became a mother in the spring of 1994.

At the end of 1993, the male Clan lost two members, these were the last offspring of the old matriarch, and the last members of the third generation of otters the author studied. Two old males of the second generation still remained, however, as did two young adults of the fourth, but as of 1994, only two males remained who were adults during the peak years of sexual segregation (1988-1992).

After F91A attained motherhood, the author noted that one of the adult males ("Beady Eyes", the eldest male, and her brother M91) were visiting the mother and her new pup with increasing frequency. The interactions were always brief, but clearly, these two males were no longer shunning the young mother as they did when she was an adult nullipara. However, the other two males, M90 (F91A's elder brother), and "Unk" (another old male), still reacted agonistically to the presence of F91A, shunning and sometimes attacking her as before. In 1995, F91A gave birth to two female pups. Now in her second season as a mother, it was clear that F91A was becoming a dominant social presence in the population, and was being accorded a noticeable degree of "respect". F91A's littermate brother began to visit his sister's family almost daily, as did old Beady Eyes. For the first time in years, the author was seeing occasional episodes of intersexual play and foraging between opposite-sex adults. M90 also started interacting more often with the family, but he did so only to play with the mother's young daughters; M90 still behaved agonistically toward F91A herself. Only old Unk continued to strictly avoid social interaction with the family group. By 1996, when F91A bore her first male pup, the author was seeing the adult males and the mother forage and play together at least once a fortnight. Obviously, the old regime of sexual segregation was no longer being rigidly enforced.

At the end of 1996, the last two old males died. A complete generational turnover had finally taken place. In the summer of 1997, F91A's only pup died early on. In the absence of pup-rearing activity, and with the daughters born in 1995 now adults themselves, the author saw the three adult females and two adult males forage and play together often. Behavioral episodes that the author once waited years to witness were now taking place virtually every day. In fact, during a three-week period in the summer of 1997, all of the adults in the population (including the now socially-dominant matriarch F91A) briefly formed a single cohesive social group - the first time in 14 years that the author had seen all of the resident adults live together. Even though the family and the males did not maintain their association beyond the summer, and once again largely go their separate ways, when they meet now, the males and females typically interact freely with each other.

CONCLUSIONS

The otters' habitat has not changed during the study period, indicating that factors in the otters’ physical environment cannot be invoked to account for the change from sexual segregation to free interaction. Furthermore, all of the otters now living at Trinidad Bay are direct descendants of the sexually-segregated otters of the 1980s, so their form of sociality cannot be "hard wired". It is possible that the decline in the number of resident otters from 1991 to the present has contributed to the relaxation of sexual segregation. The formerly high population density may have "forced" the sexes to avoid each others' company. It is also possible that the current increased tendency for opposite-sex adults to interact may be due to the fact that all the otters now at Trinidad Bay are immediate matrilineal relatives; i.e., they are all members of the same genetic "family". For a number of reasons the author cannot elaborate upon here, the author also speculate that the old system of sexual segregation may have been caused to some degree by the presence of one particular individual: the favored eldest daughter of the old matriarch, for whom several of the males possessed an observable enmity (see also the other article from the same author in this volume). In general, the author concludes that the observed change in this population's social organization may have been due to a combination of any or all of these factors. However, all of these disparate scenarios can be parsimoniously reduced to a single unifying concept: generational change. At any given time, the otters of Trinidad Bay determine for themselves how their society is to be ordered, and the social "rules" of generations past - however long and rigidly they were maintained and enforced - are not necessarily carried on by their descendants.

Acknowledgements - Grateful thanks to my assistant, Sara Moore, for her many years of dedicated observations and all-around support. Thanks also to Daniel Lorey for his help in preparing this manuscript for publication.

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INTRAFAMILIAL KILLINGS IN A MARINE COASTAL POPULATION OF OTTERS (*Lutra canadensis*)

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Abstract: Two killings within a family of otters are described. In one event, an elder sister killed her yearling sister; in the second, a mother killed her eldest daughter. The first killing is explained as an extreme act of territorial defense. The second killing is explained as an act of retaliation against the female that committed the first killing.

INTRODUCTION

Animals of many species have been known to occasionally kill conspecifics. Among Lutrines, for example, male sea otters (*Enhydra lutris*) have inflicted mortal wounds on females during copulation (STAEDLER and RIEDMAN, 1993). Sometimes, conspecifics may kill one another in fights over territory, access to mates, or food, but among mammals, it is extremely rare for a female to kill another matrilineal-related female (e.g., mother/daughter, grandmother /granddaughter, sister/sister) for any reason. No such event has thus far been documented among Lutrines. This paper describes and attempts to explain two female/female intra-familial killings in a marine coastal population of *L. canadensis*, and elaborates upon findings reported previously by SHANNON (1991, 1992, 1993).

STUDY AREA

The study area is Trinidad Bay (41°3'N, 124°8'W); a small, shallow marine bight on the far-northern Pacific seacoast of California. The otters' home range comprises approx. four linear km. of marine coastline that is predominated by thickly vegetated rocky shore cliffs. The otters at Trinidad Bay are exclusively marine in their habits. There are no streams or known bodies of standing fresh water within the otters' home range. The otters obtain their water by drinking from numerous springs and seeps, which flow year-round down the faces and crags of the shore cliffs.

MATERIALS AND METHODS

The otters are studied by direct observation. The principal investigator began his study informally in June 1983, formalized it in May 1986, and continues to study the otters at Trinidad Bay to the present day. Observations take place during the two hours preceeding sunset; daily whenever possible. Since 1983, 63 otters of known identity or birth have been studied whose lives span five otter generations. During this period, the population has comprised of 4-11 adults. Because the otters are observable at close quarters (5-100 m.), they can be identified reliably by direct visual recognition. The otters are identified primarily by facial markings and other physical characteristics, but idiosyncrasies of behavior are also reliable marks of individual identity. Equipments used are 10x28 binoculars, a tape recorder for dictating field notes, and a 35 mm camera and video camera for visual documentation. The otters have never been trapped, handled, monitored, or been subjected to any other invasive technique.

RESULTS

In 1986, a new mother established her territory at Trinidad Bay: F'2 ("Old Mama" = OM). That spring, OM bore two daughters, F86A ("Mama Junior"=MJ), and F86B ("Scarnose" = SN). After attaining independence, yearling MJ and SN returned to live as full-time cohabitants with OM and her litter of 1987. MJ and SN became adults in 1988, yet the two sisters returned again to live with their mother and her new pups. In 1989, MJ and SN could have had pups of their own, but they did not, and that spring, they returned for the third time to their mother's family. Over these years, it became obvious that MJ was the more "faithful" of OM's elder daughters, and further, that MJ was OM's "favored" daughter - and her "heiress apparent". In 1990, MJ finally bore her first litter (SN still remained nulliparous). Despite now being a mother herself, MJ did not disperse, and she (and SN) returned yet again to live with OM after both MJ and OM weaned their respective pups. Thus was a stable three-generation "Super-family" formed. The two mothers and their pups lived together and foraged together, but each mother provided only for her own offspring. If a pup solicited or took food from the wrong mother, the pup was likely to be vocally warned or physically punished. Despite the pups' occasional transgressions, though, OM and MJ rarely aggressed against each other's young, and if punishment did occur, the bites inflicted were not severe.

In the spring of 1991, however, two portentous events took place. The first was that, for the first time since 1987, a female pup of OM survived to independence: F90C ("One Eye"=OE). As stated previously, a mother was rarely aggressive towards a related mother's dependent young, but now that OE was an independent yearling, MJ began to attack her younger sister with extreme uninhibited aggression. As a result of MJ's attacks, OE was forced to disperse from Trinidad Bay. The second event of portent was that, in 1991, at the age of 60 months, SN bore her first litter. OM had tolerated her favored elder daughter MJ to remain with her at Trinidad Bay, but now that her lower-ranking daughter SN had become a mother, OM turned against her. Like MJ attacked OE, OM now began to attack SN. At the same time, MJ began to be aggressive towards her sister's newborn. The observer had never seen a mother gratuitously attack a related mother's pup before, but on 26 July 1991, in SN's presence, MJ attacked one of SN's pups, apparently with the intent to kill it. SN tried to defend her pup by biting at MJ, but this only increased MJ's ferocity. MJ stopped her attack only after SN mounted MJ (among females, mounting is a sign of appeasement and submission by the mounter). Mere minutes later, OM encountered SN and attacked her. At five years of age, with her mother aggressively intolerant of her presence and her sister now a mortal danger to her pups, SN was finally forced to disperse from her birthplace.

After OE and SN were expelled in 1991, OM and MJ again formed a Super-family. Initially, both mothers had three pups, but an accident killed two of

OM's soon after the Super-family was formed. OM's sole surviving pup was a female, F91B[F'2] ("Little Porpoiser"=LP). During 1991-1992, OM was unusually attentive to LP, while concurrently, OM seemed much less attentive to her old favorite daughter, MJ. In June 1992, when both mothers were due to bring new litters to the bay, OM returned pupless, and she was already cohabitating with LP. MJ, however, did not return to the bay when she should have. During this period, OM attacked one of her yearling granddaughters (F91B[F'3]) with the same ferocity as was observed during MJ attack OM's yearling daughter. Thus did OM expel this granddaughter from her home area. When MJ finally returned, she, too, was pupless, and equally notably, MJ did not behave like she was a resident anymore. Despite attempts to win back her mother's favor, OM shunned MJ. OM had broken any bond she had with her elder daughter in favour of her yearling daughter. MJ's status as her mother's favorite had been "usurped" by LP. Recalling what MJ had done to OE the previous year, and having seen OM attack her own granddaughter savagely, it appeared that a confrontation might soon occur between MJ and LP.

On 4 July 1992, MJ revisited Trinidad Bay, and in her mother's presence, MJ attacked LP, and killed her. OM defended her yearling daughter by biting a large section of flesh off of the left side of MJ's face, but was too late to save LP from being slain. MJ was gravely wounded by OM. The observer has never seen an otter's face so swollen and distorted by an injury. OM was not wounded physically in the fight, but as it turned out, OM’s behaviour could be described as being mortally wounded emotionally. For three days after LP's death, OM did not leave her dead daughter. Most astonishing were OM's cries of mourning. Her loud, sonorous, descending-pitched, loon-like wailing ("Uuurrr-r-r-r! Uuurrr-r-r-r!") was audible 100 m. away. Five days after the killing, it became clear that OM had lost her will to live. Still crying intermittently, OM was seriously emaciated from not eating for days, and she was visibly languishing. OM was seen alive for the last time on 9 July. MJ was last seen alive on 10 July. On 11 July, MJ was found dead on the northern beach of Trinidad Bay. MJ had died from wounds received prior to her actual time of death, as the position of her body indicated that she had simply lain down and died peacefully. On 18 July, the wasted body of OM was discovered farther east along the same beach. The old matriarch had died from intentionally failing to maintain her life requirements. In effect, Old Mama had committed suicide.

CONCLUSIONS

Adult females at Trinidad Bay will attack and even kill their younger female kin to retain exclusive possession of their territory. MJ's attack on her yearling sister was an unambiguous attempt at territorial expulsion that was carried to its fatal extreme. OM's mortal wounding of MJ was in obvious retaliation for MJ's lethal attack on OM's yearling daughter. These killings were remarkable, not only because they are behaviours that, according to biological theory, are not supposed to happen, but also because it illustrates graphically how a single episode with a relative frequency of near zero set in motion a series of events that overthrew and utterly destroyed a matriarchy that had been cohesive, stable, and ultimately adaptive across two generations.

Otters may grieve their dead. Otter mourning behavior was described previously by MOORE-WILLSON (1898) (quoted in SETON, 1929), and by KULISH (1969). Their observations were fully affirmed and substantiated in the present study.

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FRIENDS OF THE OTTERS JAPAN

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INTRODUCTION

Japanese river otter (*Lutra Lutra whitely*) is said to be almost extinct in Japan. But possibly a few individuals are still alive.

Key questions

- Why were they almost extinct?
- What should we do for them?
- How can we make a future for them?

THE FRIENDS OF THE OTTERS JAPAN is a NGO and was established in 1988. Our activities include monthly meetings, publishing a quarterly newsletter, organizing and opening "Otter Friendly Meetings" and other special events. And we also cooperate with the Asian Otter Secretariat. Some of the recent actions include a joint meeting with the IUCN Otter Specialist Group in Saitama, Japan, in November 1996, and surveys of otter habitat in Kochi, in October 1997.

ABOUT THE JAPANESE RIVER OTTER

1) History

The Japanese river otter used to live throughout Japan. In the 19th century, they occurred even in the center of Tokyo. However, from the beginning of the 20th century, and, in particular since Japan became an industrialized nation, the otter suffered from the impact of human activities and their number gradually declined. The main assumed reasons are:

i) Rifles for hunting became widespread among the general public, and many otters were killed for their fur, which was used to make winter clothing. In the 1920s, Japan prohibited otter hunting, but illegal killing continued and otter furs were traded secretly as commodity.

ii) Economic development was a priority for the Japanese nation. As result, otter habitats were destroyed by canalization of rivers and many otters were killed on the road or in fishing nets.

iii) Heavy use of agricultural and industrial chemicals polluted the rivers, damaging the otters and polluting or diminishing their food sources.

The combined effect of these factors was that otters were almost extinct by the 1940s. But in 1949, a population of otters was discovered in the Shikoku District, in particular occupying the Ehime and Kochi prefectures. In an effort to save these populations, otters were declared a Natural Monument and the nation and the prefectures started to plan how to protect the remaining populations. One effort was to capture individuals and keep them in zoos for breeding purposes. Unfortunately, these trials failed completely. In spite of the otter's protected status, administrations also failed to conduct effective protective measurements. Even worse, otter habitat continued to be destroyed and poaching seemed to continue. Otter numbers declined again in Shikoku; in the early 1970s, otters probably became extinct again in the Ehime Prefecture. The last remaining sanctuary is the Kochi Prefecture, which is now thought to have a few individuals left. Individual otters are occasionally observed, but there are only a few confirmed observations or indications for their existence. The last picture of an otter was taken in 1979, hair (1992), spraint (1994) and tracks (1996) being the only evidence of otter occurrence in the last decade. Undoubtedly and unfortunately, the Japanese river otter is faced with imminent extinction.

TAXONOMY

The Japanese river otter was thought to the same species as the Eurasian otter (*Lutra lutra*). However, in 1949, IMAIZUMI argued that that the Japanese river otter is a subspecies of the Eurasian otter, and proposed the scientific name *Lutra lutra whiteleyi*. This name stuck in the academic society for a long time, but in 1989, IMAIZUMI and YOSHIYUKI announced that the Japanese river otter was a separate species. This was based on a morphological study of an otter specimen collected in 1972. They reported that two species co-occur in Japan. One species occurs in Honsyu, Shikoku and Kyusyu, the other species occurs in Hokkaido. The former and latter species are distinguished by the length of the tail and the form of the head bone and nose. On these characteristics, the former species was considered to be an independent species, to be called *Lutra nippon.* The latter species was regarded to be the Eurasian subspecies *Lutra lutra whiteleyi*. The study also stressed the need for further study. However, WILSON and REEDER argue that this classification is invalid and that the Japanese river otter is the same species as the Eurasian otter.

In 1994, the Japanese Otter Urgent Protection Committee decided that it was necessary to clarify the genetically true character of the Japanese river otters. SUZUKI et al. studied a specimen thought to be a Japanese River Otter. Analyzes of cell material showed that this specimen was indeed genetically different from other Eurasian otters in base arrangement. This is thought to be sufficient proof that the Japanese river otter is indeed an independent species.

CONCLUSION

Eventually only a few individual otters are still alive in Kochi today. But their present situation is very severe. Lately, the administration in Kochi began to try to build an otter center. If the trial is a success, information and technologies will be collected and some projects, for example, reintroduction may be discussed.

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FACTORS ALLOWING HIGH DENSITY OF OTTERS IN EASTERN EUROPE

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Abstract: From a long-term study (1983-1998) of otters *Lutra lutra* in different parts of Belarus, eastern Poland and adjacent regions of Russia, the main factors allowing high density of otter populations were revealed. In Eastern Europe, high density of otters depends on sufficient habitat carrying capacity of small watercourses which comprise a main part of the river network and which can be inhabited by otters year-round. Highly developed and extensive construction activity by beavers, which leads to a substantial increase in the carrying capacity of small watercourses and an abundance of common frogs, concentrated in streams for hibernating, supply the necessary minimum numbers of prey and other habitat requirements.

INTRODUCTION

Many publications have analyzed the factors leading to the decline in Eurasian otter (*Lutra lutra*) numbers (MASON and MACDONALD, 1986 and references therein; MASON, 1989; FOSTER-TURLEY et al., 1990 and references therein, SMIT et al., 1994), whereas there are fewer publications considered factors which favour otters (REUTHER, 1985; SIDOROVICH, 1990, 1992, 1997; KRUUK, 1995; PIKULIK and SIDOROVICH, 1996). In this paper, we try to summarise our studies on factors allowing high density of otters in eastern Europe.

Otter habitats in Eastern Europe are still characterised by a high carrying capacity. There, otters inhabit the majority of aquatic ecosystems in both natural and artificial landscapes, and the density of otters is rather high where either they are protected from poachers (in reserves), or the number of poachers is limited due to the wild nature of the area and a low human density. In such areas of Belarus, otter population density can be up to 29 individuals per 100km^2, and between 3.7 and 10.7 on average. In various rivers, otter density was up to ten individuals per 10km of water course, and on average between 1.7 and 5.9 (SIDOROVICH, 1992; SIDOROVICH et al., 1996).

A long-term study (1983-1998) on otters in different parts of Belarus, in eastern Poland and adjacent regions of Russia (SIDOROVICH, 1990, 1992, 1997; SIDOROVICH et al., 1996; PIKULIK and SIDOROVICH, 1996) suggest that in eastern Europe the main factors favouring high density of otters are:
- a dense network of rivers and other aquatic ecosystems;
- a high diversity and abundance of fish in the large and medium-sized rivers, as well as in lakes;
- at small watercourses, wide spread and highly developed beaver construction activity which lead to a substantial increase in the carrying capacity of these habitats;
- an abundance of common frogs (*Rana temporaria*) concentrated in streams for hibernating.

An important feature of the spatial structure of otter populations in Belarus and adjacent areas is that otters can fairly densely inhabit small rivers and the majority of brooks throughout the year despite very low fish abundance (ZHUKOV, 1965). Highly developed and wide spread construction activity by beavers, which leads to a substantial increase in the carrying capacity of small watercourses and an abundance of common frogs, concentrated in streams for hibernating, supply the necessary minimum numbers of prey and other habitat requirements, there. Taking into account that in eastern Europe, small watercourses comprise a main part of the river network, it becomes clear that here the comparatively high density of otters is due to they can inhabit these small-sized habitats year-round.

STUDY AREAS, MATERIAL AND METHODS

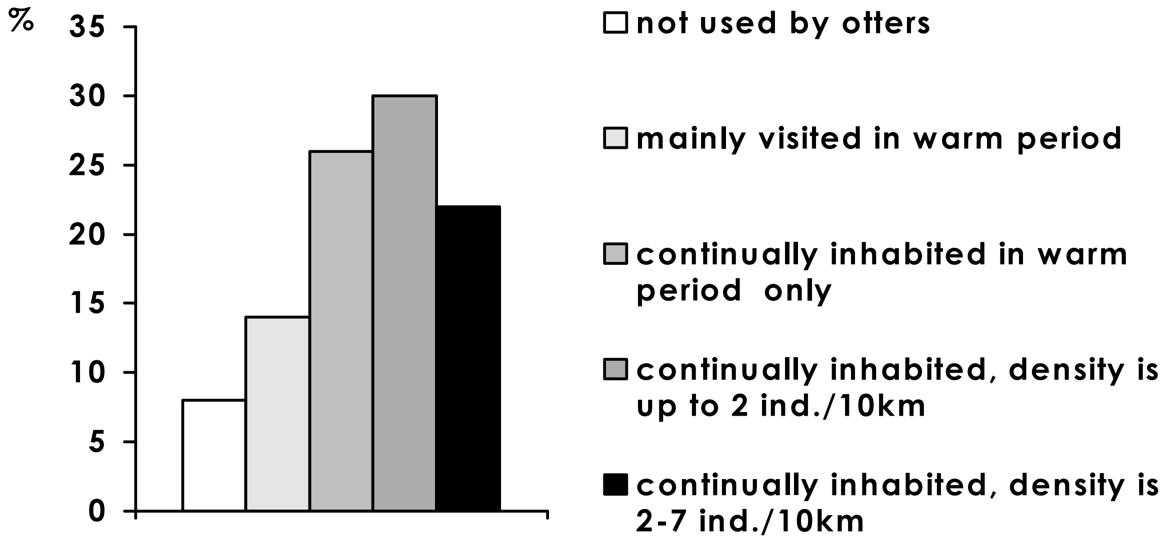
We studied otters from 1983 to 1998 in different parts of Belarus, and for several years (1994-1998) in eastern Poland (the Narev upper reaches, the reserve in Bialowieza Primeval Forest, Bialostok region) and adjacent regions of Russia (the Lovat and Zapadnaya Dvina catchment-areas, Pskov and Tver regions). In Belarus, we obtained data mostly from the Lovat upper reaches, Obol and Drissa basins (Vitebsk region), in the Eastern Berezina upper reaches (Berezinsky reserve, Vitebsk and Minsk regions), and in the Western Berezina basin (Naliboky reserve, Minsk and Grodno regions).

Otters were censused along watercourses during the winter by searching the banks, shores and floodplains for tracks and other signs of otter activity (SIDOROVICH, 1992, 1997; SIDOROVICH et al., 1996). We tried to count the number of otters living on surveyed stretches of rivers. To do this, we applied the following criteria. According to the methodological results related otter census (SIDOROVICH, 1992), the prints of hind feet were measured to estimate the age category of an individual, which may be: juvenile (< 1 year old), subadult (in second year of life), and adult (>2 years old). In our field survey, differences in footprint measurements of single otters consistently >1 cm were accepted as criterion for differentiating individuals. Fresh marking places (with urine and faeces) were searched to determine sex. In relation to the prints of hind feet, males mainly leave urine marks on snow in front of a scat, whereas females defecate and urinate in the same place or urine marks are sprinkled behind the scat.

Frogs were censused on 1mx10m transects. Crayfish abundance was estimated by special net, which was set for one night with lure (fried frog) inside. Information about fish was obtained from local fishermen or from special fishing by means of net.

RESULTS AND DISCUSSION

In Belarus, there are 20.8 thousands rivers having the total length about 90.6 thousands km. Average density of the river network ranges from 0.3 to 0.7 km/km^2. From 70 to 76% of the river network consist of small watercourses with a length up to 25 km, which are characterised by a very low fish abundance (ZHUKOV, 1965). Nevertheless, the majority of small watercourses investigated (53%; n=172) with a length up to 25 km were inhabited by otters year-round (Fig. 1). About 39% (n=172) of the small watercourses were continually inhabited by otters, or merely visited by them in the warm period. At 6% (n=172) of the small watercourses, mainly brooks of length 1-3 km, otter signs were not recorded. In drainage canals, a similar situation was observed; in spite of low fish abundance, but used by otters (Fig. 1).



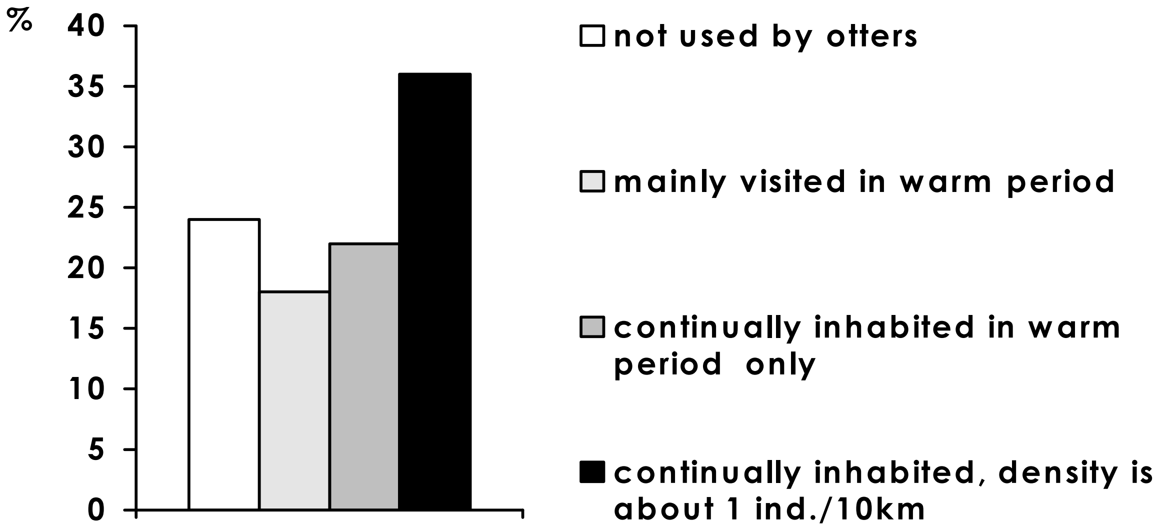


Figure 1: Otter presence at small watercourses of length up to 25km in Belarus. Natural streams of length up to 25km (n=172); 2. Drainage canals (n=103)

In water-abundant rivers and lakes, fish diversity and abundance are fairly high. In such aquatic ecosystems located in the catchment areas of different large rivers, from 17 to 38 fish species were recorded, and, at least half of the fish species were common (ZHUKOV, 1965), but the large aquatic ecosystems having abundant fish populations comprise only small part of aquatic network.

The above data highlights the important role of small watercourses with a length up to 25 km as otter habitats, and otters inhabiting such streams comprise the basis part of the otter populations in Eastern Europe. But why do otters inhabit in numbers such small watercourses with very low fish abundance? Other factors, such as beaver construction activity and common frog abundance, can provide the necessary minimum of prey and other habitat conditions for otters in small watercourses.

Otters benefit a lot from beavers, which create numerous ponds and shelters such as burrows and/or lodges. For small watercourses, highly statistically significant positive correlations between otter density and density of beavers (r_s=0.77-0.82: P<0.01) as well as with their construction activity (with abundance of burrows and lodges - r_s=0.86-0.92: P<0.01; with square of ponds - r_s=0.65-82: P<0.01) were found (SIDOROVICH, 1992, 1997).

Taking these correlations into account, two hypotheses can be made: otters benefit from beaver (*Castor fiber*) construction activity, or the correlations are determined by the influence of other factors. As for the second hypothesis, we did not find any factor, which could really be responsible for the correlations. Along small watercourses the distribution of both species correlated well with the proportion of forested bankside. Undoubtedly, this factor affects beaver distribution, because directly provides food for beavers; but there is no explanation how this factor provides substantially higher food supply for otters in order to increase its population density. There is no doubt, that it may not be a marked difference in aquatic prey abundance between shallow streams with forested and mostly open banksides (completely open stream banks are rare in eastern Europe). It is more likely to say that such higher food supply comes with beavers, taking into an account the results published for North America (GARD, 1961; HANSON and CAMPBELL, 1963) which confirmed that the abundance of fish and other prey of otters increase in beaver ponds. In Belarus, data confirming the first hypothesis were also obtained (Tab. 1).

Table 1: Abundance of various prey available for otters at beaver ponds and non-flooded parts of the same stream in Belarus

Prey category	Natural streams of length up to 25km		Drainage canals	
	Non-flooded part	Beaver pond	Non-flooded part	Beaver pond
Crayfish, in ind./1 net-night	0.6 (0 - 4), (n=24)	2.1 (0 - 7)* (n=9)*	0 (n=6)	0 (n=6)
Number of fish species which is common	2.9 (0 - 6), (n=12)	5.3 (2 - 9)*, (n=32)	1.3(0 - 4), (n=11)	3.0(2-5)*, (n=11)
Green frogs, in ind./1m×10m transect	0.1(0-3), (n=124)	2.6(0-19)*, (n=65)	0.9(0-12), (n=114)	3.6(0-25)*, (n=18)
Hibernating concentrations of common frogs	small one common, big one very rare	small one very common, big one common	small one rare or common, big one nearly absent	small one common, big one rare
Mallard	rare or common	very common	rare or common	very common

Mean, range and sample size are given; statistically significant differences ($t \geq 3.7$, P<0.01) are marked by *.

Abundance and diversity of prey, which are used by otters increase substantially in a beaver pond compared to a non-flooded part of the same stream. Very often otters used both abandoned and active beaver burrows and lodges (Fig. 2). Basically, otters use these constructions as a sheltered rest site, and sometimes as a den. Thus 16 otter litters with blind cubs were found in such sites during the long-term fieldwork (SIDOROVICH 1991; SIDOROVICH and TUMANOV, 1994).

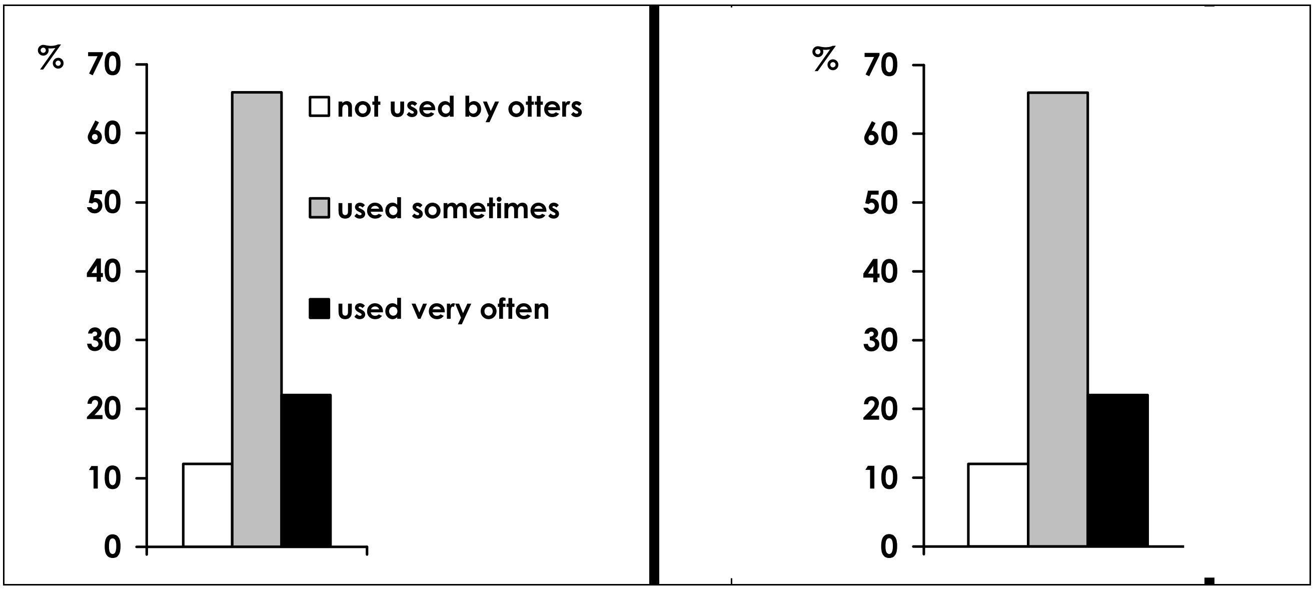
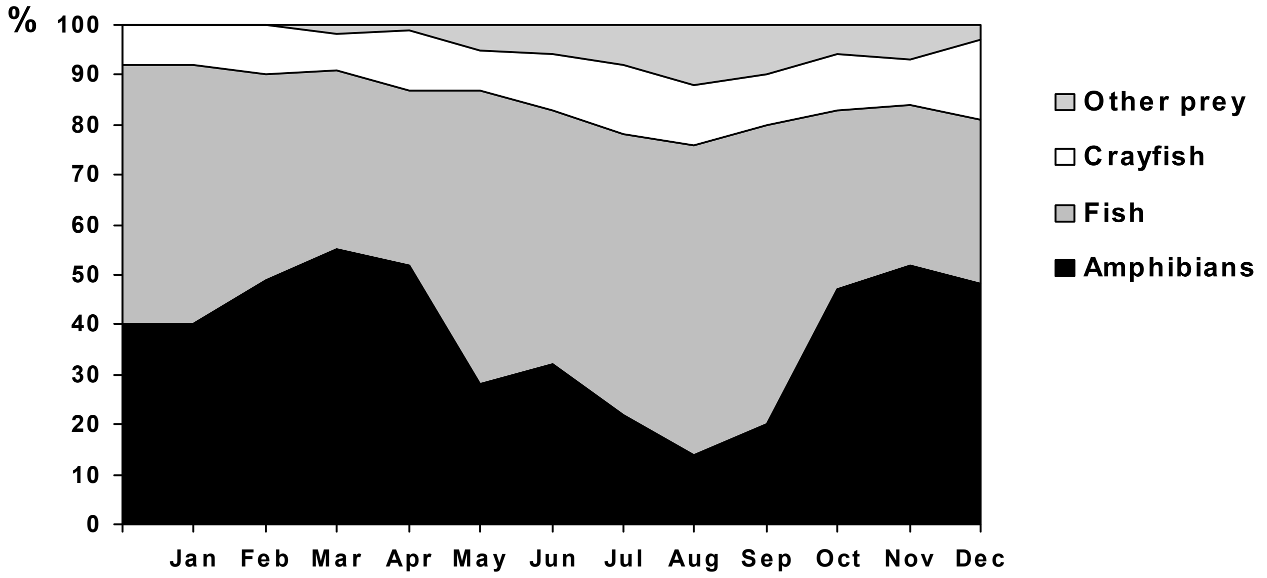


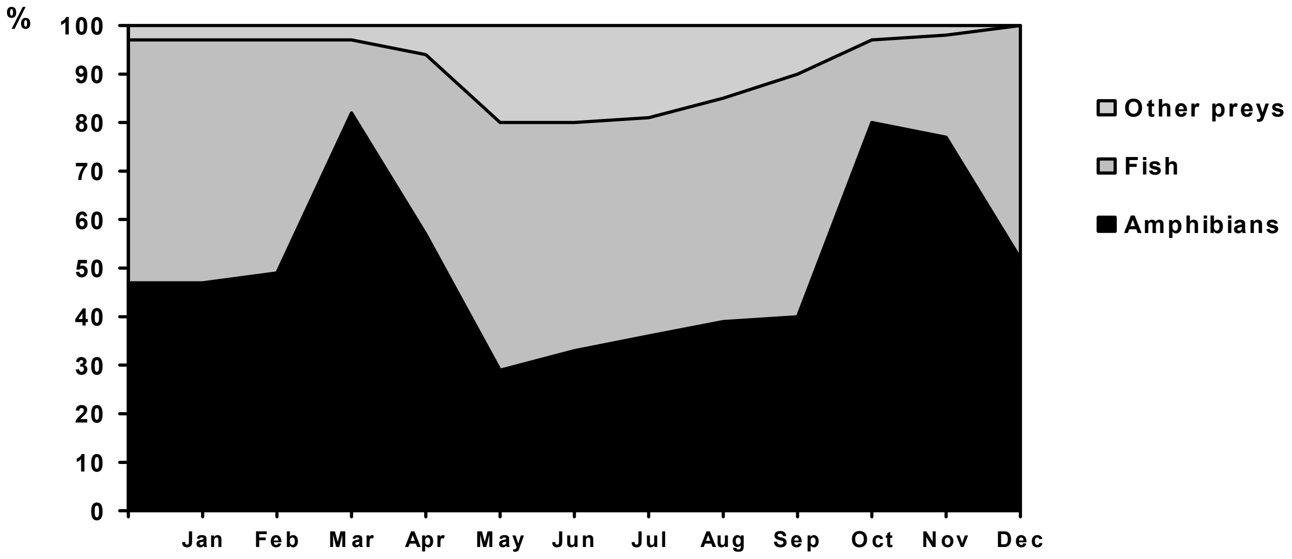
Figure 2: Use of beaver burrows and lodges by otters at small watercourses of length up to 25km in Belarus. 1. Drainage canals (n=163). 2. Natural streams of length up to 25km (n=352)

During the otter and beaver survey carried out in the winter of 1982-1983 in the Volka small river basin, 19 beaver ponds and 22 otter locations (here, an otter location means the particular place inhabited by either lone otter or family group of otters) have been recorded. After the period of gradual expansion of beavers into the catchment area, 174 beaver ponds and 52 otter locations have been found during the similar survey in winter 1997-1998. The simultaneous increase of otter and beaver numbers is a typical trend for Belarus and adjacent areas, and it is confirmed by the above mentioned the positive correlations between the densities of the two semiaquatic species.

Undoubtedly, high densities of common frog, which concentrate in streams for hibernating is another important factor allowing a high density of the otter populations in Eastern Europe. According to PIKULIK (1985), in Belarus in the warm period, common frog density was very high and ranged from several to 3325 individuals per a hectare, on average was up to 70. This amphibian species hibernates in streams creating concentrations up to thousands individuals. Rough estimates of the biomass of common frogs hibernating in rivers range from 156 to 858 kg per km of river stretch on average (PIKULIK and SIDOROVICH, 1996). In a detailed study during the winter of 1995-1996 in small rivers of the Lovat upper reaches, average biomass of common frogs was 395 kg per km. This biomass could be enough for three otters to overwinter. Studies in Belarus showed, that in small watercourses under the conditions of a low abundance of the preferred prey such as fish and crayfish, common frog and other amphibians are a substituting food for otters, and were consumed by this semiaquatic predator in high numbers. The highest occurrence of amphibians in the diets of otters was at fast and moderately flowing small rivers and brooks - up to 87.2%, with 16.5-40.1% on average; and at drainage canals it comprised 24.5-59.3% on average (SIDOROVICH, 1997). Among amphibians, otters much more frequently prey common frogs. In small watercourses, amphibians play the most important role in otter diet during the cold season (Fig. 3).



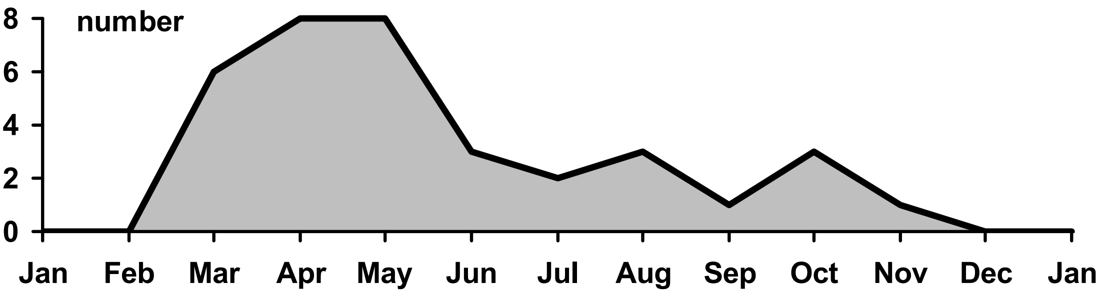
A. Small rivers and brooks;



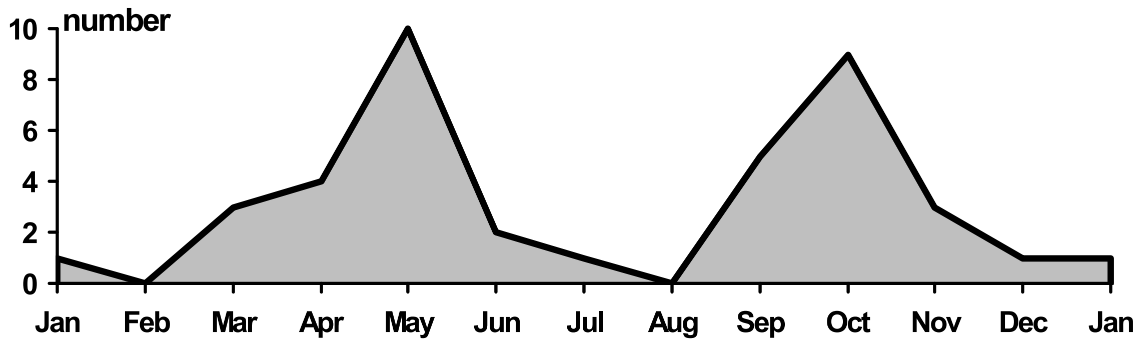
B. Drainage canals.

Figure 3. Seasonal dynamics of otter diet at small watercourses (in occurrence of the main prey categories, %)

A very interesting feature of otter breeding in Eastern Europe is the timing. This is autumn (SIDOROVICH and TUMANOV, 1994; Fig. 4) when the otter breeding seems to coincide with reduced prey availability due to water freezing-over and low air and water temperatures is a strange phenomenon. In Belarus, in fast and moderately flowing streams (≥0.3 m/sec) the autumn breeding of otters was more frequently observed than in slowly flowing streams and non-flowing waters (Fig. 4) . The phenomenon of autumn breeding by otters and its difference for the different aquatic ecosystems could be explained by the wintering concentrations of common frogs which are especially common in fast flowing streams (PIKULIK, 1985; PIKULIK and SIDOROVICH, 1996). Also, in winter otter access to an aquatic ecosystem is much reduced (2-25, on average 14 times) due to water freezing-over, as compared to the warm period. On account of these two factors, a 2-10 fold and even higher increase in prey availability was calculated. Thus, in Eastern Europe under the conditions of high common frog abundance, otters can inhabit small watercourses year-round, and even can breed successfully in the cold season.



a:



b:

Figure 4. Seasonal distribution of births in otters. **a.** Slowly flowing rivers, drainage canals, lakes and other aquatic ecosystems which are normally ice-bound by winter; **b.** Fast flowing rivers and other aquatic ecosystems, where normally there is sufficient access for otter foraging in water environment by winter.

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THE STATUS OF OTTERS IN THE ASIAN REGION

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Abstract: There are four species of river otter in the Asian Region; in addition, there is one species of sea otter. Of the river otters, the status and the ecology of the Eurasian otter, smooth-coated otter and small-clawed otter in some of the countries in the region, are fairly well known. However, there is hardly any information available on the status and the ecology of the sea otter and hairy nosed otter. In highly developed countries such as Japan, Hong Kong, Taiwan and Singapore, even the presence of the otter is uncertain. This could be attributed to several factors, and habitat destruction and the pollution of waterways that has been brought about by industrial effluents and deforestation could be considered as two of such major factors. The otters are also subjected to poaching in some countries, mainly for the pelts and some organs, which are used in local medicine. Moreover, the otter is a neglected species in Asia in comparison to the attention paid to the large mammals. Recently, the Asian otter researchers set up an Asian Otter Secretariat in Sri Lanka mainly to conduct awareness programmes, and to co-ordinate research in the region. At a workshop held recently by the Secretariat in Thailand it was decided to give research priority to surveys on hairy-nosed otter in Sumatra, Thailand and Malaysia, where it is suspected to be present.

INTRODUCTION

There are four species of river otters in Asia, namely, the Eurasian otter (*Lutra lutra*), smooth-coated otter (*L. perspicillata*), hairy-nosed otter (*L. sumatrana*) and small-clawed otter (*Amblonyx cinereus*). In addition, there is the sea otter (*Enhydra lutris*), which is found in the east and west coast of the Pacific Ocean. Little else is known about the ecology etc. of this species. Of the four riverine species, little information is available on the hairy-nosed otter, except that its presence has been recorded in Sumatra, Thailand and Malaysia (FOSTER-TURLEY, 1990). Also, there is no reliable information on otters from several countries (Table 1). Furthermore, in comparison to the western hemisphere, the otter does not have the same emotional appeal from the people in Asia. Some are not even aware of the existence of otters in the wetlands. Thus, otters could be considered as a neglected species in the region.

STATUS

Relatively satisfactory information is available on the status of the Eurasian otter in the Asian Region. It is the most widely distributed and common species. Healthy populations still exist in many countries (Table 1) and a fair amount of research on its ecology has been carried out in some countries. PHILLIPS (1984) presented a general description of this species, and de SILVA (1991) studied its distribution of it in Sri Lanka. The food and feeding ecology, and the seasonality of feeding have also been studied (de SILVA, 1995; 1996). Several other projects are in progress in Sri Lanka, especially a study of it's distribution within the National Parks. Recently the author was able to collect otter scats from a very pristine stream flowing through the only primary forest present in the island, namely Sinharaja Forest.

The small-clawed otter is also fairly well distributed (Table 1) across the region and healthy populations exist in several countries such as India, Malaysia, Thailand and Indonesia.

SIVASOTHI and BURHANUDDIN (1994) reviewed the taxonomic position of the otters in Malaysia and Singapore. BURHANUDDIN (1989, 1996) established the status of otters in Malaysia and also conducted ecological studies on small-clawed otter and smooth-coated otter in the Malay Peninsula. KRUUK et al. (1994) studied the niche separation in three sympatric species of otters, namely, Eurasian, smooth-coated and small-clawed otters in Huai Kha Khaeng Wildlife Sanctuary in Thailand. They described the small differences in the use of major sections of the river by the different otters and the variations in the micro-habitat and food with implications for conservation management of the area. SIVASOTHI (1996a) studied the ecology of the small-clawed otter in Malaysia.

Healthy populations of smooth-coated otter seem to be present in countries such as Bangladesh, Bhutan, India, Indonesia, Laos, Malaysia, Myanmar and Thailand. HUSSAIN (1993) used radio telemetry to study the status, seasonal movement, home range and habitat use of the smooth-coated otter in National Chambal Sanctuary in North India (HUSSAIN and CHOUDHURY, 1993; HUSSAIN et al., 1996). Furthermore, HUSSAIN (1996) described the variations in group size, group structure and the breeding schedule of smooth-coated otter in relation to months and seasons by monitoring four radio-implanted otters in National Chambal sanctuary. NAGULU (1996) described the status of otters in Southern India.

However, there is a dearth of information on the hairy-nosed otter in the region and it is considered as a threatened species (IUCN, 1996). There are some indications, including previous records, of the presence of hairy-nosed otter in Sumatra, Thailand and Malaysia (Table 1). Therefore, at present, the otter researchers have given high priority to surveys on hairy-nosed otter in the region. During the period from January to June, 1998 surveys on this species had been carried out by Priyo Budi Asmoro (Indonesia), Budsabong Kanchanasaka (Thailand) and Mohamed Burhanuddin (Malaysia) as decided at the last workshop conducted in Huai Kha Khaeng (HKK) Wildlife Sanctuary in Thailand in 1997. Preliminary surveys have already commenced on this species, but to date, no information or evidence has come to light about its existence.

In general, reliable information on otters is lacking from several Asian countries such as Bhutan, Laos, Cambodia, Vietnam, Bangladesh, Pakistan, Philippines, Papua New Guinea and China. Perhaps, it may be a good idea to conduct awareness programmes in countries such as Bhutan to make people aware of the otter and the importance of the conservation of its habitat, the wetlands, thereby popularizing the existence of otter.

Table 1. Status and distribution of otter species in Asia. (AC-*Amblonyx cinereus*; LL-*Lutra lutra*; LP- *Lutra perspicillata*; LS-*Lutra sumatrana*.) (Conservation status: X-may have become or may soon be extinct; E-endangered; V-vulnerable; N-no risk yet in localities of occurrence; K-insufficient information.)

Country	Species present	Occurrence	Status	Legal Status
Afghanistan	LL	Recorded	K	No information
Bangladesh	LP	Common	N	Protected
	AC, LL	Very rare	E	Protected
Bhutan	AC, LL, LP	Recorded	K	No information
Brunei	AC, LP, LS(?)	Recorded	K	No information
China	AC	Rare	V	Protected
	LL, LP	Common	N	Protected
Hong Kong	AC, LL	Presence uncertain	X	Protected
India	AC, LL, LP	Rare	V	Protected
Indonesia	AC, LP, LS(?)		E	Protected
	LL	Rare	V	Protected
Iran	LL	Recorded	K	No information
Iraq	LL, LP	Recorded	K	No information
Israel	LL		E	Protected
Japan	LL	Presence uncertain	X	Protected
Jordan	LL		E	Protected
Kampuchea	AC, LP, LS(?)	Recorded	K	No information
Korea (North)	LL	Scant information	K	No information
Korea (South)	LL		E	Protected
Laos	AC, LL	Recorded	K	Protected
	LP	Recorded	K	Protected
	LS	Presence uncertain	X	Protected
Lebanon	LL	Recorded	K	No information
Malaysia	AC, LP	Common	N	Protected
Mongolia	LL	Very rare	K	Protected
Myanmar	AC, LL, LP	Recorded	K	Protected
Nepal	LP	Rare	V	Protected
	AC, LL	Very rare	E	Protected
Pakistan	LP	Common	V	Protected
	LL	Rare	E	Protected
Philippines	AC	Common	V	Protected
Singapore	AC	Presence uncertain	X	Protected
Sri Lanka	LL		N	Protected
Syria	LL	Recorded	K	No information
Taiwan	LL	Presence uncertain	X	No information
Thailand	AC, LP	Threatened	N	Protected
	LL, LS(?)		E	Protected
Turkey	LL	Common	V	No information
Vietnam	AC, LL, LP, LS(?)	Recorded	E	No information

THREATS TO OTTERS IN ASIA

The IUCN designates all four species of otters as threatened in some of the countries in the continent (IUCN, 1996). It is therefore important to point out that perhaps, the environmental deterioration that has taken place across the region has brought about the possible disappearance of otters in several countries. Untreated waste discharges from domestic as well as industrial sources into waterways is a common practice throughout the region and it could have done much damage to the existence of the otter. Very often waterways are the recipients of sewage and industrial waste as well as run-off from the agricultural areas. This results in contamination of the water with pesticides and residues of heavy metals (ANDO, 1996). Due to a considerable increase in industries during the past decade, the amount of waste matter getting into the waterways has also increased greatly. Heavy metal pollution and pesticide pollution, therefore, have now become major threats to the existence of the otter in many industrialized countries in the region (ANDO, 1996).

As shown in Table 1, the presence of otter is uncertain (or not recorded recently) in Japan, Hong Kong, Singapore and Taiwan, which are heavily industrialized countries, although there are records to indicate the presence of the otter in these countries some decades ago. In South Korea, another country undergoing fast industrialization, there is evidence of decreasing otter numbers along the coastal areas as well as in the freshwater habitats (MYONG-HEE, 1996). ANDO (1996) described the chronology of the declining history of the otter in Japan (Table 2), where there has been no record of it since 1983. He highlighted the 'failure story' of otter in Japan and warned Korea and other Asian countries, which are under very rapid industrial growth, to consider it as a lesson and to take effective conservation measures. If this is not done immediately, we may not be in a position to listen to any `success story' of the otter in other Asian countries as well.

LEE (1998) reported on otter sightings in Kinmen and on Little Kinmen Island, Taiwan. However, there have been scarcely any sightings in recent years in the mainland China and Taiwan. So much so, the Eurasian otter has been locally declared endangered. A similar situation exists in Singapore. There had been no otter sightings in the mainland since 1960s (SIVASOTHI, 1996b). The occasional sightings of individual animals were believed to be 'visitors' from the coast of Malaysia. However, recent surveys revealed a single family of small-clawed otter resident on Pulau Tekong Besar, an island to the north-east of the main island of Singapore. Also, since 1994 a solitary otter believed to be a smooth-coated otter, appears to be resident around the Sungei Buloh Nature Park, which is a part of the mangroves. But, unfortunately, both Pulau Tekong Besar and Sungei Buloh Nature Park are threatened with reclamation activities at present (SIVASOTHI, 1996b).

Another major threat to otters in the region is the disturbance of waterways. It is mainly brought about by the disruption of the riparian vegetation and also the increase of silt in the river and stream beds. Deforestation leads to soil erosion, which brings about high turbidity levels and sedimentation in the waterways. Forests are being cleared especially for agriculture purposes and to establish housing schemes for the escalating human population. This results in heavy erosion and therefore, siltation of water ways leading to the degradation of the riparian and littoral vegetation.

Mining activities (e.g. sand, gem and metal mining) cause considerable damage to the riparian vegetation and riverbed. Reclamation of marshes is another important activity to consider, as it is detrimental to the fauna of the marsh habitat such as the otter. However, within the last decade wetland conservation has been given high priority in several countries in the region. Some Ramsar sites have been established to protect the wetlands in countries such as Thailand, Indonesia, Malaysia and Sri Lanka.

Table 2. Chronology of extinction of the Japanese otter (Source: ANDO, 1996)

Time	Socio-economic conditions	Conservation efforts	Status of otter
1800s	Agriculture	None	Maintaining country-wide distribution
1900s	"National enrichment and security" policy	None	Extinction from urban areas
1930s	Continuation of national enrichment and militarism	Exclusion from game animal species	Countrywide declining tendency
1940s	War time	No references	No information
1950s	Reclamation of lakes/ lagoons for more rice production	None	Extinction from mainland
1960s	High economic growth Serious pollution	Specially-designated natural monument; Official otter survey at Ehime-Prefecture; Captive reproduction efforts by a private sector	Extinction from Seto inland-sea area
1970s	Advancement of motorization and river/road improvement works	Official otter survey at Kochi Prefecture; Small scale conservation efforts	Confinement at Kochi Prefecture; Decline of field signs at coast of Kochi
1980s	Booming of resort development	No further conservation measures	Record of last carcass (1983). Few field signs
1990s	Earn for outdoor life and clean rivers	Otter survey at Kochi Prefecture by Environment Agency	No field signs. Exterminated?
2010s	Re-introduction???		

AWARENESS ON OTTERS

In the Asian Region, conservation efforts are focused mostly on the large mammals such as the elephant (*Elephas maximus*), rhino (*Rhinoceros sondicus, R. sumatrensis, R. unicornis)* tiger (Panthera tigris) and leopard (*P. pardus*) and as they are very much affected by habitat destruction there is a concerted effort to protect the forest habitat. The small aquatic mammals, such as the otter, are very much neglected in Asia compared with much of the western world. What is mostly lacking throughout the continent is the awareness of and the emotional appeal towards the otter from the general public. Once the people recognize the existence and the importance of otter to the wetlands, the future of otter may not be that bleak.

In 1997, the OSG members in Asia were able to establish an Asian Otter Secretariat in Sri Lanka with a view to create awareness of otters among the people and to coordinate research on otter conservation in the region. As a first step, a workshop was conducted in Thailand, in November 1997, on methods of surveying and monitoring of otter populations in the wild. The main objective of the workshop was to train at least one interested person from each country in the region on otter surveying and to standardize the methods. Twenty six workers from 15 countries participated in the workshop and the organizers were able to invite participants from countries such as Vietnam, Myanmar and Nepal, in which there is little information on otters.

Huai Kha Khaeng Wildlife Sanctuary, in the north-west of Thailand, was chosen as the venue of the workshop as three of the four riverine species (exception being the hairy-nosed otter) are present in the region. Hans Kruuk who has done extensive work on the otters in HKK and helped identifyotter tracks and the participants benefited much by the fieldwork as they learnt to identify the tracks of the three species among the tracks of the other mammals and reptiles, as well as learning to detect otter scat in the habitat. Moreover, the organizers were able to find funds for some preliminary surveys to be carried out on otters in Myanmar, Vietnam and Nepal. It was also decided at the workshop to give priority on surveys of hairy nosed otter in Malaysia, Thailand and Sumatra.

The next workshop has been planned mainly to provoke awareness of otters among local people and media groups and the venue for this is tentatively fixed to be either Seoul (S. Korea) or Kuala Lumpur (Malaysia).

Acknowledgments - I wish to thank Prof. Mangala de Silva for reading the manuscript and Prof. Charles Santiapillai for his continuous encouragement given me in conservation efforts on otters. Also, I am grateful to Dr. Motokazu Ando of the Japanese Otter Group, Dr. Claus Reuther of the Otter Centrum, Hankensbüttel, and Dr. Robert Dulfer of the Organizing Committee for providing funds and facilities for my participation in the VIIth Otter Colloquium.

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Addition to the original manuscript: Since the VIIth Otter Colloquium in Trebon the hairy-nosed otter (*L. sumatrana*) has been sighted in Phru Toa Dong peat swamp forest in Southern Thailand and Vietnam by researchers working in association with the Asian Otter Secretariat.

THE DIET OF THE NEOTROPICAL OTTER (*Lutra longicaudis*) IN COSTA RICA

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Abstract: We analyzed the diet of the Neotropical otter from 407 scats collected between August 1993 and February 1994 from the middle stretch of the Sarapiqui River and the lowest stretch of the Puerto Viejo River, Costa Rica. Crustaceans and fish were the most common prey groups in both rivers. Crustaceans (61.0%) were more frequent than fish (38.3%) ($P<0.001$) in the Sarapiqui River. Shrimp were the most consumed prey in the Sarapiqui River. Crustaceans (50.0%) and fishes (48.1%) were consumed in similar proportions ($P<0.5$) in the Puerto Viejo River. Shrimp and cichlid fish were the most frequent food items in the Puerto Viejo River. We registered seasonal variations in otter diet. Slower fish were consumed more than faster swimming fish.

INTRODUCTION

The neotropical otter (*Lutra longicaudis*) is a top predator in tropical aquatic environments. However, basic information about this species is unknown. There is no reported study on the food habits of the neotropical otter in Central America. The wide range of the species, from Mexico to Central Argentina, suppose a generalist diet. Otters prey principally on aquatic organisms and prey availability is considered an important limiting factor in otter populations (KRUUK et al., 1993). Diet analysis provide the basic information to understand feeding relationships (i.e. predator-prey interactions) in order to develop a conservation strategy for the neotropical otter. This study describes the composition and seasonal variation of the neotropical otter diet in two lowland tropical rivers.

STUDY AREA

"La Selva" Biological Station (LSBS) is a 1500ha protected area located in the confluence of Puerto Viejo and Sarapiqui Rivers (10°23'N, 84°59'O), Sarapiqui County, Heredia Province, Costa Rica. The mean annual precipitation is 3962mm, with a monthly bimodal, with peaks of more than 400mm. The monthly average temperature is 25.8°C,with little variation between months (SANDFORD et al., 1994).

The study was conducted in two stretches of river (6.0 and 5.6 –km respectively) in the Puerto Viejo and Sarapiqui Rivers. The Puerto Viejo River is a tributary of the Sarapiqui River. The first 3.0km of the study area on the Puerto Viejo River runs through cattle farms and the last 3.0km is the northwest border of LSBS. Almost the total length of the right bank and 1.6km of the left of the Sarapiqui River is included in LSBS. The rest is associated with cattle farms.

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METHODS

We analyzed the diet of the Neotropical otter from scats collected between August 1993 and February 1994. Scats collected between August and December were considered to be from the rainy season (average monthly precipitation 362.2mm), while those collected in January and February were considered to be from the dry season (average monthly precipitation 100mm).

Scats were washed with water and soap, rinsed through a 1mm mesh size, and dried at room temperature. Fish and crustacean remains were identified with the help of a reference collection. The level of identification varied from species to family. We grouped prey remains in prey categories and also, pooled in prey groups (crustaceans, fish, insects and reptiles).

The results were expressed as a) occurrence (O, number of occurrences of each prey category); b) Relative Frequency (RF, numbers of occurrences of a prey category x 100/total of occurrences for all prey categories in the sample) (MAHHR and BRADY, 1986). Any evidence of a prey category in a scat, even when we recognized more than one individual of the same prey category, was considered as one occurrence.

We calculated the theoretic sample size for a confidence interval of 95%, considering a deviation of 5% of the true value with a relative frequency nearest to 50% (HANSON and GRAYBILL, 1956). We compared the number of occurrences into samples and among different samples (rivers, seasons) with a chi-square test. Multiple comparisons were conducted calculating the Bonferroni confidence intervals for the expected proportions of use and compared with expected proportions derived from a homogeneity hypothesis (NEU et al., 1974; BYERS et al., 1984).

RESULTS

The theoretic sample size calculated was 400 scats. One thousand and eighty occurrences founded in a total of 407 scats analyzed were classified in 15 categories of prey. The most frequent groups of prey were crustaceans and fish. Furthermore, we found insects in very low proportions and one scat with remains of a member of the Iguanidae family.

Crustaceans were more frequent than fish (χ^2=3737; df=1; P<0.001) in the scats from the Sarapiqui River. The categories of prey most frequent were shrimp (*Atya* spp. and *Macrobrachium* spp.), cichlid fish (Cichlidae family) and a clingfish (*Gobiesox nudus*) (Table 1). The occurrence of crustaceans was similar to to the occurrence of fish (χ^2=0.14; df=1; P<0.5) in the scats from the Puerto Viejo River. The categories of prey with higher occurrences were shrimps (*Macrobrachium* spp.), cichlid fish, shrimps (*Atya* spp.) and crabs (Table 1).

Fish were consumed more frequently in the Puerto Viejo River than in the Sarapiqui River (χ^2=5.75; df=1; P<0.025). In this group, cichlids and catfish (*Rhamdia* spp.) were taken most frequent in the Puerto Viejo River than in the Sarapiqui River (χ^2=6.30; df=1; P<0.025 and χ^2=12.29; df=1; P<0.001, respectively. However, clingfish was consumed more frequently in the Sarapiqui River (χ^2 =6.73; df=1; P<0.01).

Table 1. Occurrence (O) and relative frequency (RF) and chi-square analysis of prey categories found in 407 otter scats collected during the rainy and the dry seasons in the Sarapiqui and Puerto Viejo Rivers, Costa Rica, August 1993-February 1994 (n= number of analyzed scats).

	SARAPIQUI RIVER				PUERTO VIEJO RIVER					
	Rainy S. (n=141)		Dry S. (n=125)		Rainy S. (n=47)		Dry S. (n=94)			
Prey Category	O	FR	O	FR	O	FR	O	FR	χ^2	gl
FISH	(133)	(34.8)	(141)	(42.5)	(59)	(47.2)	(116)	(48.5)	8.33	3*
Gobiesocidae										
Gobiesox nudus	59	15.4	44	13.2	11	8.8	20	8.4	7.32	3
Cichlidae										
Unident. Cichlids	49	12.8	71	21.4	20	16.0	66	27.6	8.87	3**
Pimelodidae										
Rhamdia spp.	11	2.9	9	2.7	15	12.0	16	6.7	21.58	3**
Characidae										
Brycon guatemalensis	2	0.5	0	0.0	4	3.2	4	1.7		
Unident. Characids	0	0.0	2	0.6	4	3.2	0	0.0		
Mugilidae										
Agonostomus monticola	9	2.3	5	1.5	0	0.0	3	1.2		
Joturus pichardi	1	0.3	0	0.0	1	0.8	0	0.0		
Poeciliidae										
Unident. Poecilids	1	0.3	2	0.6	0	0.0	2	0.8		
Eleotridae										
Gobiomorus dormitor	0	0.0	2	0.6	1	0.8	1	0.4		
Unident. fish	1	0.3	6	1.8	3	2.4	4	1.7		
CRUSTACEANS	(246)	(64.1)	(191)	(57.5)	(63)	(50.4)	(119)	(49.8)	6.38	3
Pseudotelphusidae										
Unid. Pseudotelpusids	27	7.0	8	2.4	15	12.0	25	10.5	18.65	3**
Palaemonidae										
Macrobrachium spp.	95	24.7	89	26.8	29	23.2	65	27.2	0.85	3
Atyidae										
Atya spp.	124	32.3	94	28.3	19	15.2	29	12.1	30.58	3**
INSECTS	(5)	(1.3)	(0)	(0.0)	(2)	(1.6)	(4)	(1.7)		
Unident. Insects	5	1.3	0	0.0	2	1.6	4	1.7		
REPTILES	(0)	(0.0)	(0)	(0.0)	(1)	(0.8)	(0)	(0.0)		
Iguanidae										
Unident. Iguanid	0	0.0	0	0.0	1	0.8	0	0.0		
TOTAL	384	100.0	332	100.0	125	100.0	239	100.0		

* $P<0.05$; ** $P<0.001$

Crustaceans were found more frequently is scats from the Sarapiqui River than the Puerto Viejo River ($\chi^2=5.27$; df=1; $P<0.025$). In this group, shrimps (*Atya* spp.) were more frequently recorded in the Sarapiqui River than in the Puerto Viejo River ($\chi^2=29.62$; df=1; $P<0.001$). More crabs were consumed in the Puerto Viejo River than in the Sarapiqui River ($\chi^2=13.25$; df=1; $P<0.001$). The occurrence of shrimps (*Macrobrachium* spp.) was similar in both rivers ($\chi^2=0.0$; df=1; $P=0.995$). No differences were found in the occurrences of insects between rivers ($\chi^2=1.57$; df=1; $P<0.5$), while the remains of reptiles was found only once, in the Puerto Viejo River.

During the rainy season in the Sarapiqui River, crustaceans occurred more frequently than fish ($\chi^2=33.69$; df=1; $P<0.001$). The most frequent prey categories were shrimp (*Atya* spp. and *Macrobrachium* spp.), clingfish, and cichlids. During the dry season in the Sarapiqui River, crustaceans were recorded more frequently than fish (χ^2=7.53; df=1; *P*<0.01). Shrimp (*Atya* spp. and *Macrobrachium* spp.), ciclids and clingfish were the categories of prey with most occurrences (Table 1).

During the rainy season in the Puerto Viejo River, crustaceans and fish were the most important groups of prey with similar occurrences (χ^2=0.13; df=1; *P*<0.9). Shrimps (*Macrobrachium* spp and *Atya* spp.), cichlids, crabs, and catfish were the categories of prey consumed most frequently. During the dry season in the Puerto Viejo River, crustaceans and fish were also the prey most frequently recorded with similar occurrences (χ^2=0.04; df=1; *P*<0.9). Cichlids, shrimps (*Macrobrachium* spp. and *Atya* spp.), and crabs were the categories of prey more frequent (Table 1).

When we compared the diet between seasons and rivers, fish were taken less frequently in the Sarapiqui River during the rainy season. Within this group of prey, cichlids were the most common in the Puerto Viejo River during the dry season but less common in the Sarapiqui River during the rainy season. Clingfish were consumed in similar proportions in both rivers and in both seasons (Table 1).

Catfish were consumed more frequently in the Puerto Viejo River during the rainy season. Crustaceans were consumed in similar proportions in both rivers in both seasons. More shrimps (*Atya* spp.) were consumed in the Sarapiqui River during the rainy season, while shrimps (*Macrobrachium* spp.) were consumed in similar proportions in both river and both seasons. Crabs were consumed less frequently in the Sarapiqui River during the dry season (Table 1).

DISCUSSION

The diet of the neotropical otter in the LSBS was composed of aquatic prey, almost exclusively crustaceans and fish. Insects, whether ingested directly or indirectly were not an important diet component. We did not find remains of amphibians, birds or mammals in the scats, prey that have been reported by others for the neotropical otter in other regions (GALO, 1989; OLIMPIO, 1992; PARERE, 1992).

The high consumption of crustaceans, particularly shrimps, could be explained by their high availability in the study area, confirming the opportunistic feeding strategy of the species. Otters can eat a large number of shrimps over short periods of time (pers. obs.), thus obtaining a large amount of biomass per unit of feeding time.

The majority of cichlids were taken during the dry season, when the water level in the rivers decreased and the vulnerability of fish consequently increased. The occurrence of clingfish and shrimp (*Atya* spp.) in the neotropical otter diet could be correlated because they occupy the same microhabitat (i.e. under stones in riffles of the river).

The neotropical otter in LSBS consumed principally slow moving fish (Cichlidae, Gobiesoxidae, and Pimelodidae). Fast moving species (Characidae, Mugilidae, and Poeciliidae) were eaten in lower proportions, even when species from these families have an important relative abundance. The family Poeciliidae was the group with the highest relative abundance, followed by

Cichlidae, Atherinidae, and Characidae in two tributary creeks of the Puerto Viejo River included in LSBS (BURCHAM, 1988). In Argentina, the neotropical otter freffered to eat slow moving fish (Loricariidae and Cichlidae) (PARERA, 1992, 1993).

In this study area, the neotropical otter population is not affected directly by hunting or control for conflict with hatcheries. Therefore, neotropical otter conservation will depend of an appropriate management of the Sarapiqui River watershed, to avoid water pollution and the loss of the riparian forest that could affect indirectly the otter population by influence negatively prey biomass.

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TESTING A METHOD TO MONITOR THE OTTER (*Lutra lutra*) POPULATION IN FINLAND A PILOT STUDY BASED ON SNOW TRACKING

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Abstract: Current data about the status of the otter in Finland indicate that the otter is widespread throughout the country. In 1994, the environmental authorities in Finland decided to test a monitoring system based on snow tracking. The monitoring system covers 17 study areas, comprising 37 000 km^2 of Finnish river and lake landscapes. The individual study areas range in size from 1 466 to 4 038 km^2 (mean 2 334 km^2). About 100 permanent sites are selected in each study area for the survey. In the winters of 1995/96 and 1996/97 the total number of sites in the study was 1465 and 1670, respectively. In 1995/96, otter tracks were found at 286 sites (19.5 %), and in 1996/97 at 291 sites (17.4 %). The preliminary results from the study support the present assumption that Finland, in a European perspective, hosts a viable otter population. The three-year pilot study will be evaluated in the winter of 1998/99.

INTRODUCTION

Current data on the distribution of the otter *(Lutra lutra*) in Finland are based on questionnaires (STJERNBERG and HAGNER-WAHLSTEN, 1991), on information obtained in connection with game research and on regional field surveys. No nationwide field survey has been carried out. Since the data indicate that the otter is widespread in Finland, there is a need to establish a monitoring system that could detect changes in the otter population.

Field surveys based on searches for droppings or spraints, have been carried out in several European countries, including Finland. Problems connected to this so called standard technique have been elaborated by, for example, CONROY and FRENCH (1987, 1991) and ROMANOWSKI and BRZEZINSKI (1997). SULKAVA and STORRANK (1993) studied an area in central Finland using both the standard technique and snow tracking.

In northern latitudes, snow tracking can apparently provide more detailed information about otter populations than the standard technique. Using snow tracking it is possible to roughly estimate the number of otters and to obtain data on reproduction, home range size etc. (ERLINGE, 1972; REID et al., 1987; SULKAVA, 1993; SIMEK, 1997). In addition, snow tracking is relatively easy to carry out and the tracks are easier to recognize than spraints.

Field tests of techniques for estimating the population density of otters based on tracks left in the snow are still scarce. In the 1970s, ERLINGE (1972) undertook comprehensive field studies in the winter, but his aim was not primarily to develop a monitoring method. REID et al. (1987) tested a possible method in northeastern Alberta, Canada. More recent studies based on snow tracking are, for example, surveys carried out in Germany and the Trebon

Biosphere Reserve in the Czech Republic (KLENKE, 1996; SIMEK, 1997; DULFER and ROCHE, 1998).

STUDY AREA, MATERIAL AND METHODS

In 1994, the environmental authorities in Finland decided to carry out a pilot study during the period 1995-1998. The aim of the study is to test a monitoring system based on field surveys carried out during the winter. The surveys will, at the same time, provide data about the status of the otter in Finland. The study is being coordinated by the Finnish Environment Institute. The Regional Environment Centres and the regional administration of the Forest and Park Service carry out the field work. Trained volunteers also take part in the survey.

The Finnish pilot study is being carried out using a snow tracking method that was developed and tested in the early 1990s in central and eastern Finland (SULKAVA, 1993). The monitoring system covers 17 study areas (Fig. 1), comprising 37 000 km^2 of Finnish river and lake landscapes. The aim is to establish a geographically representative system of study areas. Practical considerations, i.e. the location of the field worker`s headquarters, have also influenced the selection of sites. One of the areas on the south-west coast, was not surveyed during the winters of 1995/96 and 1996/97. About 10 per cent of the country is covered by the survey. In the winter of 1995/96 the number of field workers was 53, the following winter 49. The number of hours in the field totalled 830 and 772, respectively.

The individual study areas range from 1466 km^2 to 4038 km^2 (mean 2334 km^2). About 100 permanent sites are selected in each study area for the survey. The sites are usually located near bridges and other sites that are easy to reach by car. At each site 20 - 600 meters of banks are searched for otter tracks, the length depending on the ice cover and other physical characteristics of the watercourse. An open stream should, for instance, be surveyed for a longer distance than an inlet covered by ice. The distance between the sites varies between one and usually no more than 5 km in each watercourse. The field work is carried out between November and April.

As most of the streams are covered by ice in the winter, the otters have to use relatively large areas in their search for food. It is possible to identify different individuals on the basis of the age, size and direction of the tracks. The field work is carried out no later than three days after the last snow fall, thus making it possible to estimate the age of the tracks. The physical conditions of the watercourse, i.e the system of lakes, streams and rivers, provide an additional basis for the estimation of the number of otters. For instance, if tracks are found in two streams seperated by a lake without tracks, the individuals are most probably different. The distance travelled by an individual otter does not usually exceed 10 km/twenty-four hours, the average distance in central Finland is 3.3 km/twenty four-hours (SULKAVA, 1993).

Data on age, size and direction of the tracks are noted at each positive site. The number of individual otters at each site and watercourse is estimated by the field workers, using the described criterias. Spraints are recorded, but not taken into account when evaluating the results. The field work is carried out no later than three days after the last snowfall, thus making it possible to estimate the age of the tracks.

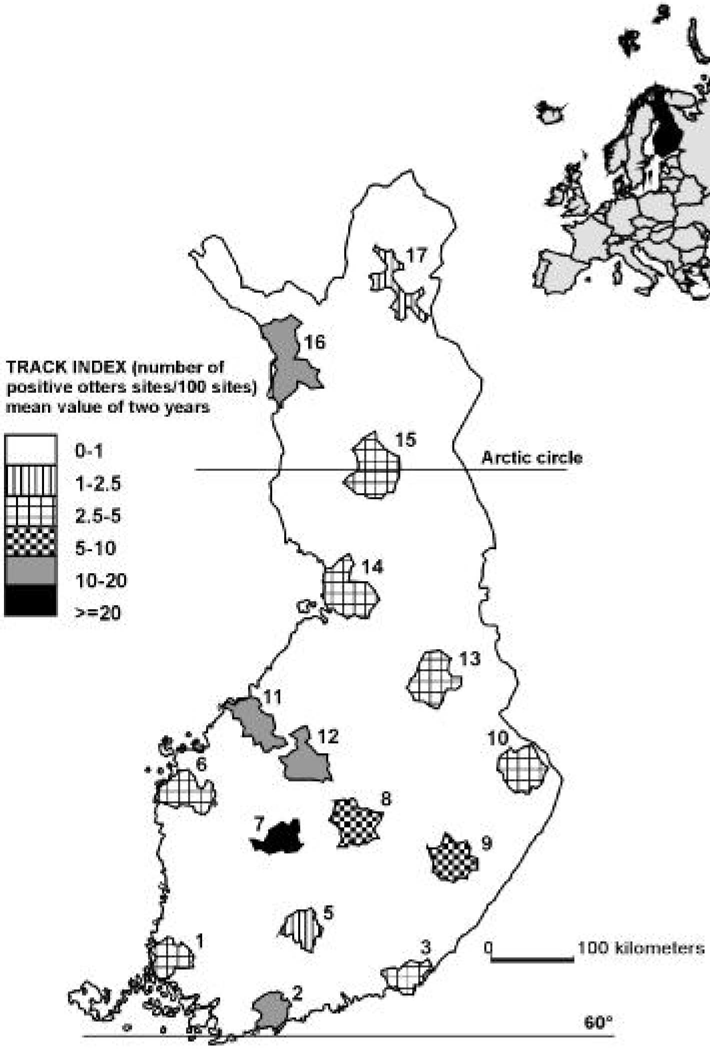

Figure 1. The monitoring system in Finland covers 17 study areas. An index of otter density is calculated for each study area (number of positive otter sites/100 sites)

All the observations are compiled in a data base by the Finnish Environment Institute who also estimate the number of otters in each area. Maps with the positive sites plotted constitute an important basis for the estimation. The field data and criterias used by the field workers in separating different otter individuals are checked thoroughly. The numbers presented are minimum numbers.

RESULTS

During the winters of 1995/96 and 1996/97 the total number of sites in the study was 1465 and 1670, respectively. In both winters about 250 kilometres of watercourses were surveyed. In the first winter otter tracks were found at 286 sites (19.5 %), and in the second winter at 291 sites (17.4 %). The minimum number of otters counted in the study areas was estimated at 189 and 170 individuals, respectively (Fig. 2). Otter tracks were found in every study area in both years. The results show that the otter population is at its densest in the central part of the country, but still low in the coastal areas of south-west Finland. An index of otter density, based on fresh tracks, was calculated for each area (Fig. 1).

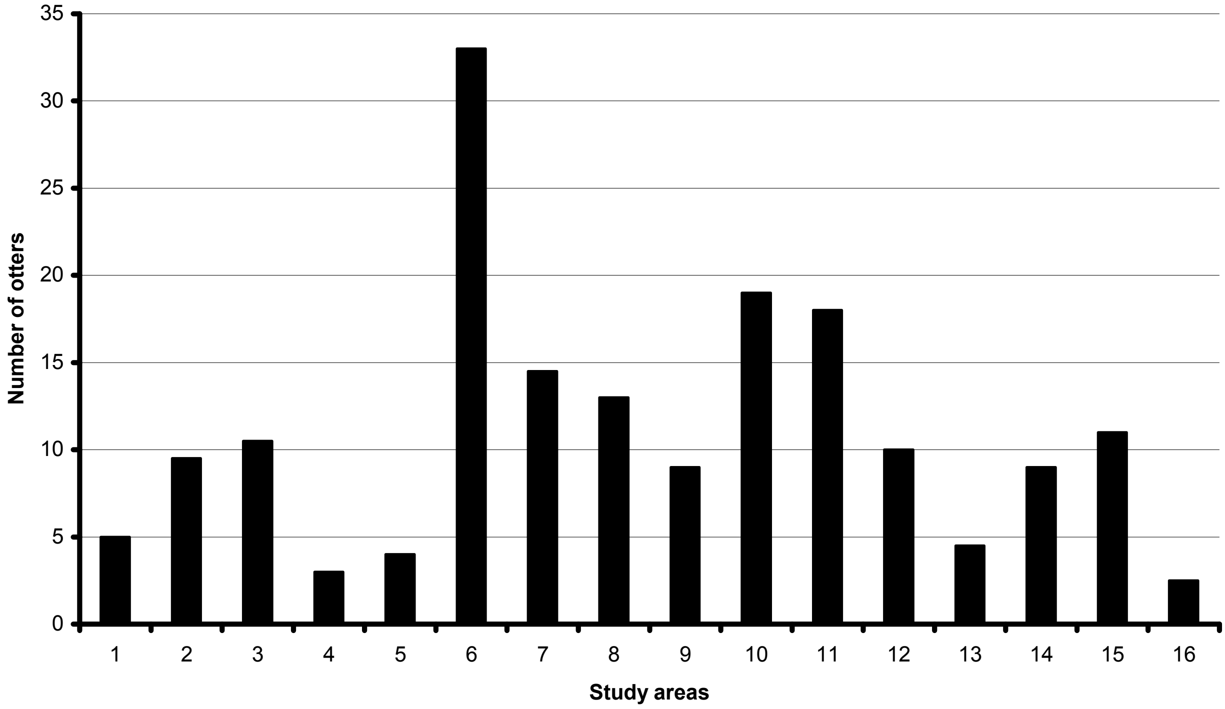

Figure 2. The minimum number of otters counted in the study areas (mean values of two years). Otters were found in every study area except of one (number 4), which was not surveyed during the winters of 1995/96 and 1996/97.

CONCLUSIONS

It is obvious, that a degree of uncertainty is connected to all field methods for surveying otters, including methods based on snow tracking. In this method, for instance, it is not possible to detect all the otters in an area. As the goal of our study is to develop a monitoring system, this is not necessary any problem. Our method differs quite a lot from the standard technique based on spraints. The proportion of positive sites detected using our snow tracking method should therefore not be compared to studies based on spraints.

The snow tracking method used in the Finnish pilot study seems to provide a sound basis for rather accurate estimation of the minimum number of otters in an area. More important, however, we belive that this method could be a useful tool in monitoring the Finnish otter population. When evaluating the status of the otter in Finland, other surveys and data should also be taken into account, e.g. the Finnish wildlife triangle system (LINDÈN et al., 1996).

The results from the pilot study will be evaluated in the winter of 1998/99. The preliminary results from our study, however, support the present assumption that Finland, in a European perspective, hosts a viable otter population (MACDONALD and MASON, 1994).

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HISTORICAL REPRODUCTIVE AND REARING SUCCESS OF GIANT OTTERS (*Pteronura brasiliensis)* IN ZOOS

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Abstract: The giant otter does not appear to be particularly difficult to keep in captivity, but successful rearing of offspring has been rare. In 1997, fifteen zoos were surveyed to gather basic life history data and to determine what husbandry practices might be important for successful parent rearing of giant otters in captivity. From 1970 to 1997, sixty-nine litters were born in six zoos. Litter size ranged from one to six cubs; mean 2.9 cubs. Of 145 cubs born live, only 20 (13%) survived to one year of age or older. The data available for 90 of those 145 cubs indicated that 53% died during the first week of life, while 50% of the cubs surviving to one week died before reaching four months of age. The most important husbandry practice appears to be the isolation of the parents from human disturbances and presence during cub rearing.

INTRODUCTION

The giant otter, *Pteronura brasiliensis,* is an endangered species distributed throughout the river systems of northern South America. This species does not appear to be particularly difficult to maintain (e.g. ZELLER, 1960; AUTUORI and DEUTSCH, 1977; HAGENBECK and WÜNNEMANN, 1992), but successful rearing of offspring has been rare. At present, records available indicate that only four institutions, São Paulo Zoo, Cuiabá Zoo and Brasília Zoo in Brasil and Hagenbecks Tierpark in Germany, have reared cubs successfully (AUTUORI and DEUTSCH, 1977; FLÜGGER, 1997; LOUZADA da SILVA, *Pers. com.*). According to HAGENBECK and WÜNNEMANN, (1992) and FLÜGGER, (1997) once a compatible pair is found, successful rearing depends on the ability to isolate parents from human disturbance and presence during cub rearing. This study is aimed at identifying what common husbandry practices are responsible for successful parent rearing of giant otter litters.

METHODS

In 1997 a questionnaire was sent to 28 zoos worldwide that hold or previously held giant otters to gather basic life history data and to determine what husbandry practices might be important for successful parent rearing of otter cubs in captivity. This 8-page survey requested information on husbandry, reproduction, behavior, and captive management of giant otters. Additional information was gathered from published papers, unpublished reports and personal communications.

RESULTS

Fifteen (54%) of the zoos surveyed responded (see acknowledgements). Successful rearing of giant otter cubs in captivity was rare (Table 1). (A cub/litter is considered successful when a cub or at least one cub in a litter survives to one year or more.) From 1970 – 1997, 69 litters were born in six zoos. Because complete historical data for litters born in previous years at Cuiabá Zoo were unavailable, numerical data from this zoo were only presented in Table 1, but not represented in the totals on Table 1 or elsewhere within the statistics of this paper.

Table 1. Historical reproductive and rearing success of giant otters in captivity.

Institution	Survey period	No of successful litters*/ total no. of litters	No of cubs surviving to 1 yr/ total no. of cubs born
Hagenbecks Tierpark (1)	1976-1994	5/19	9/66**
São Paulo Zoo (2)	1970-1971	1/4	1/11
Brasília Zoo (3)	1975-1997	4/36	10/58
Cuiabá Zoo (4	1992-1993	2/2	9/9
Caracas Zoo (5)	ca.1972	0/3	0/5
Dortmund Zoo (6)	1995-1997	0/6	0/9
Chestnut Centre (7)	1997	0/1***	0/3
Total****	1970-1997	10/69	20/152*****

*at least one cub in the litter survives a year or more; ** of four cubs hand reared, only two survived; ***aborted litter; ****data from Cuiabá Zoo not included in total; *****of 152 cubs, 145 born live

Data Sources: 1) HAGENBECK and WÜNNEMANN (1992), FLÜGGER (1997) (2) AUTUORI and DEUTSCH (1977) (3) Daniel LOUZADA da SILVA, Marcelo Lima REIS, Adriona Sartori de Almeida SANTOS (pers.com.), Wolf BARTMANN (unpublished report) (4) Daniel LOUZADA da SILVA (pers. com.) (5) Trebbau (1972) and (1978) (6) Wolf BARTMANN and Volker GATZ (pers. com.) (7) Carol HEAP (pers. com.). Table designed by Karl KRANZ.

Data from the six other zoos (Table 1) gives a complete historical overview and these are mentioned throughout this paper. During this 27- year period, there were three aborted fetuses, four stillbirths and 145 live births (152 cubs). Of the 145 live births, only 20 (13%) survived to one year of age or older. Eighteen cubs were parent reared and two were hand reared. More detailed data were available for 90 of the 145 cubs born. These data showed that 53% died during the first week of life. Fifty percent of cubs surviving to one week died before reaching four months of age. Most of these deaths were reported to occur because parents, stressed by human disturbances, failed to properly care for their cubs. (FLÜGGER, 1997; HAGENBECK and WÜNNEMANN, 1992; WÜNNEMANN, 1995a,b; AUTUORI and DEUTSCH, 1977; TREBBAU, 1972; Brasilia Zoo, pers. com.; Dortmund Zoo, pers. com.). These two main mortality phases suggest that different factors may be responsible; i.e. gross parental neglect in the first week (when most cubs were eaten or/and not cared for properly) and medical illness either independent of or resulting from parental neglect thereafter. Litter size ranged from 1 to 6 cubs, with a mean of 2.9 and common litter size of 2 cubs (n=31).

The four zoos that successfully reared cubs used several husbandry practices, which, according to them, appeared important for successful parent rearing of giant otter cubs in captivity. No data were available on pair compatibility and vaccination use at São Paulo Zoo. Other than isolating the parents, no other data were available for Cuiabá Zoo. If the institution's name is not mentioned under any of the particular husbandry practices listed below, this means that this institution either did not use this practice or it was not applicable to their situation.

ISOLATION OF THE PARENTS

All zoos with successful parent reared litters, provided parents with privacy and isolation/seclusion (visual and acoustic) from human disturbances and presence (staff, visitors) during cub rearing.

Otter parents at Brasília Zoo dug multiple nesting dens in the hill sides of their 635m^2 exhibit. These dens provided privacy as they were isolated underground (Daniel LOUZADA da SILVA, Marcelo Lima REIS, Adriona Sartori de Almeida SANTOS, pers. com.). Food was put in the exhibit from outside the enclosure. A wooden barrier erected around the exhibit prohibited all visitor access near the enclosure. Cuiabá Zoo's 4,282m^2 outdoor exhibit, with otter dug underground dens, allowed parents to get far away from human disturbances (LOUZADA da SILVA, pers. com.). At Hagenbecks Tierpark all humans (except for the caretaker most familiar with the otters), visual and acoustic disturbances were prohibited near the exhibit from 14 days before parturition until cubs reached 3-4 months of age (HAGENBECK and WÜNNEMANN, 1992; WÜNNEMANN, 1995; FLÜGGER, 1997, pers. com.). A room containing nestboxes was totally isolated from all humans. Multiple nestboxes (4) allowed parents to move cubs to the safest feeling nestbox. Cubs and parental care were monitored with infra-red video cameras and microphones placed within the nestboxes and a monitor situated outside of the enclosure area. Feeding and limited cleaning were done only in areas outside the immediate vicinity of the nestbox room. São Paulo Zoo isolated its exhibit from all human disturbances during cub rearing, cleaning was not done, and food was put in the exhibit from outside of the exhibit (AUTUORI and DEUTSCH, 1977).

REMOVAL OF OLDER SIBLINGS

FLÜGGER (1997) at Hagenbecks found it necessary to remove six-month-old juveniles from their parents before the birth of the next litter. In two instances juvenile otters either competed with the new cubs for milk or played too roughly with the cubs. This resulted in the loss of both litters. Removing one-year old juveniles from parents rearing a successive litter, stressed the parents so severely that it caused the loss of the newest litter.

INCREASED FOOD SUPPLY

The São Paulo Zoo female raised a litter only after she was provided an unlimited supply of live fish and isolation from human disturbances (AUTUORI and DEUTSCH, 1977). Hagenbecks and Brasília routinely increased fish amounts during lactation (HAGENBECK and WÜNNEMANN, 1992; LOUZADA da SILVA, pers. com.).

VITAMIN AND MINERAL SUPPLEMENTS

HAGENBECK and WÜNNEMANN (1992) increased vitamin and mineral supplements during pregnancy and lactation. Brasília and São Paulo Zoos did not provide any such supplements, although they fed only live fish (AUTUORI and Deutsch, 1977; LOUZADA da Silva, pers. com.). Brasília briefly experimented with supplements, but discontinued use, as it was not deemed beneficial.

PAIR COMPATIBILITY

Hagenbecks Tierpark reported that if a pair repeatedly failed to rear their young that re-pairing the mates might be necessary. On two occasions unsuccessful pairs were re-paired. After repairing, one newly formed pair was the only pair at Hagenbecks to successfully rear its cubs, but only after parents have been isolated from human disturbances (HAGENBECK and WÜNNEMANN, 1992).

SEPARATION OF THE DAM OR SIRE

São Paulo Zoo removed the mother from the father and placed her in another enclosure 30 days after breeding (AUTUORI and DEUTSCH, 1977). The other zoos considered it neither necessary nor desirable to separate the parents (FLÜGGER, 1997; LOUZADA da SILVA, pers. com.).

VACCINATIONS

Hagenbecks is the only institution that routinely vaccinated the parents and cubs (FLÜGGER, 1997).

CONCLUSIONS

The rearing success of giant otters in captivity over the last 27 years has been poor, with only 20 (13%) of 145 live born cubs (born at six zoos) surviving until one year of age or more. The effect of disturbances on the parent's ability to rear cubs successfully is clear. Most cub deaths occurred because parents, stressed by human disturbances and presence, failed to properly care for their cubs. The most important husbandry practice among the zoos where parents successfully reared their litters was isolation from human disturbances (visual and acoustic) and presence during cub rearing. BAKER et al. (1996) reviewed evidence from mammals that psychological stress, particularly for Carnivora, to the parents is often responsible for the parent's failure to rear litters successfully. After giving birth, captive carnivore parents can be especially vulnerable to disturbances and normal human activity, which did not bother them before parturition. At the time of parturition, stress to the parents include human disturbances (i.e. presence of public and zoo staff, "loud/excessive noises", and "unusual activities", etc.), and any changes to the parent's "social" (i.e. removal of any family/group member) or "physical environment" (i.e. relocation to a new enclosure, physical changes to or within the exhibit, etc.). Efforts should be made to reduce stress factors in order to increase the possibility of cub survival. Parents should be provided with additional privacy and isolation from humans and disturbances (i.e. restricted nestbox areas, isolated exhibits, expansive /complex exhibits, multiple nestboxes and underground dens, video camera and microphone monitoring and familiar caretakers limiting their activities). Inbreeding, medical, compatibility and behavioral problems should be considered for repeated breeding/rearing failure, providing proper husbandry techniques are used. Removal of any family/member during cub rearing or close to parturition will likely cause litter loss. When necessary, remove family/members before pregnancy occurs. Parents should not be separated during pregnancy or rearing. With the exception of the obvious need for increased food supply and the proven need to remove older siblings, the effect of the other practices on successful rearing of litters is not as clear as disturbance seems to be.

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OTTER DISTRIBUTION IN PORTUGAL

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Abstract: The main objectives of the study were to obtain data on the distribution of otters in Portugal and to establish a reliable reference base to monitor species status. A survey was undertaken between January and October 1995 on a 989 UTM 10x10 km grid that covers all the country. The results confirmed that the Eurasian otter occurs throughout Portugal and in all types of aquatic habitats. Positive signs of the otter presence were found in 881 squares (89.1%). Presumably, populations are locally abundant, but in four geographic areas otter signs were few and otter presence irregular. Assuming that otter conservation actions must be a priority in areas with healthy populations and where its distribution is still widespread, the authors suggest some major actions that must be considered in a national strategy for the species' conservation.

INTRODUCTION

Regular reports on the distribution of the Eurasian otter (*Lutra lutra*) in Portugal have only become available since the 1980s, when a start was made to compile old and recent data, which were available from occasional field surveys and inquiries, examinations of dead animals and of furs and skulls. Although no systematic survey was ever undertaken at a national level, results from subsequent studies showed that the situation of the Portuguese otter population differed from the precarious situation faced by otters in most other European countries.

In 1995, within the framework of a Life/EC Project "Knowledge and Management of Natural Heritage", an action named "Otter Conservation in Portugal" was developed and a first national survey undertaken. The main objective of this survey was to obtain data on the distribution of otters in Portugal, and to establish a reliable reference base to monitor changes in the species' status. Other goals were to establish what kinds of habitat otters inhabit, the conservation status of these habitats, as well as listing the main problems and threats facing the species and its habitats.

METHODOLOGY

The survey was carried out between January and October 1995 by a team of two biologists. The standard method described by MACDONALD (1983) was used, based on the identification of field signs (spraint or footprints) within the national 10x10 km grids (UTM squares). All UTM squares were investigated at least once; the sites in each square were chosen so as to cover the diversity of aquatic habitats in the country, and for ease of access. Once a sign of otter presence was found, the search was terminated and the site recorded as positive. If no signs were found during the first 600 m searched, other sites in the same square were chosen. A square was assumed to be positive if at least one of the sites within the square was positive. A data sheet was completed for each site surveyed, regardless of result, detailing information on habitat, potential food resources and on environmental factors that may affect otter presence or absence (for example, water quality, urbanisation, vegetation cover). The habitat was graded according to the potential for holts or lying-up sites.

RESULTS

Otter distribution was mapped on a grid of 989 UTM squares; 881 UTM squares (89.1%) had positive signs of otter presence, and only 108 squares (10.9%) were considered negative (Fig. 1). However, 26 of the negative squares were completely dry when the search was done. A total of 1008 sites were visited (1.02 sites per UTM square) on 35 previously defined hydrographic areas. In most sites (86%) otter signs were found within the first 200 m searched (Fig. 2).

The authors visited 596 different wetlands of ten classes (rivers, freshwater streams, marshes, ponds, dams, freshwater lagoons, brackish lagoons, artificial canals, estuaries, coastal areas), although the majority of the searches were along freshwater streams (44.8%) and rivers (39.3%).

The Portuguese wetlands are intensively used for fishing, boating or other recreational uses, washing, irrigation or watering livestock, or for other agro-industrial demands. Few sites showed highly visible pollution. Many rivers were found to be organically polluted, but only a few were visibly polluted by industrial wastes. The domestic pollution caused by dumping or garbage in the river beds was a widespread problem, with greater impact on small streams. Some pollution was caused by mining. Many rivers were also used for gravel extraction. All these pollution problems became worse during the summer, when many wetlands had very low levels of running water, were completely dry, or reduced to scattered pools. This feature was particularly important in the southern and eastern regions of Portugal. Deforestation is a common practice and affects both the flow of many rivers and their trophic structure, as well as the shelter capacity of the river margins. There was still a great number of wetlands with dense bank-side reeds, thickets of bramble, and riparian vegetation of diverse kinds, which provided margins with enough cover for the requirements of otters.

The otter distribution and other data collected in the field indicated four critical geographic areas, where few signs were found and otter presence seemed irregular (Fig. 3). In most cases, human pressure was the main factor responsible, mainly by changes induced in both quality and quantity of water, and on the riparian vegetation (critical areas 1 and 4). These problems are particularly critical in areas where wetlands are geographically isolated from each other or by human facilities (critical area 3 and coastal region of area 2). In some places there was evidence that otter populations were becoming fragmented (critical area 2).

DISCUSSION

Portugal has a large variety of landscapes and a suitable network of river basins and artificial water reservoirs which until now enabled a relatively good otter population to inhabit this country (TRINDADE et al.,1997). The spatial distribution of otter signs clearly indicates that the animals still occur throughout Portugal, living in a large variety of aquatic habitats ranging from coastal habitats to freshwater inland lagoons at 1800 m altitude (SOUSA et al., 1997), and from highly seasonal streams in dryer region of the south to permanent streams in the north.

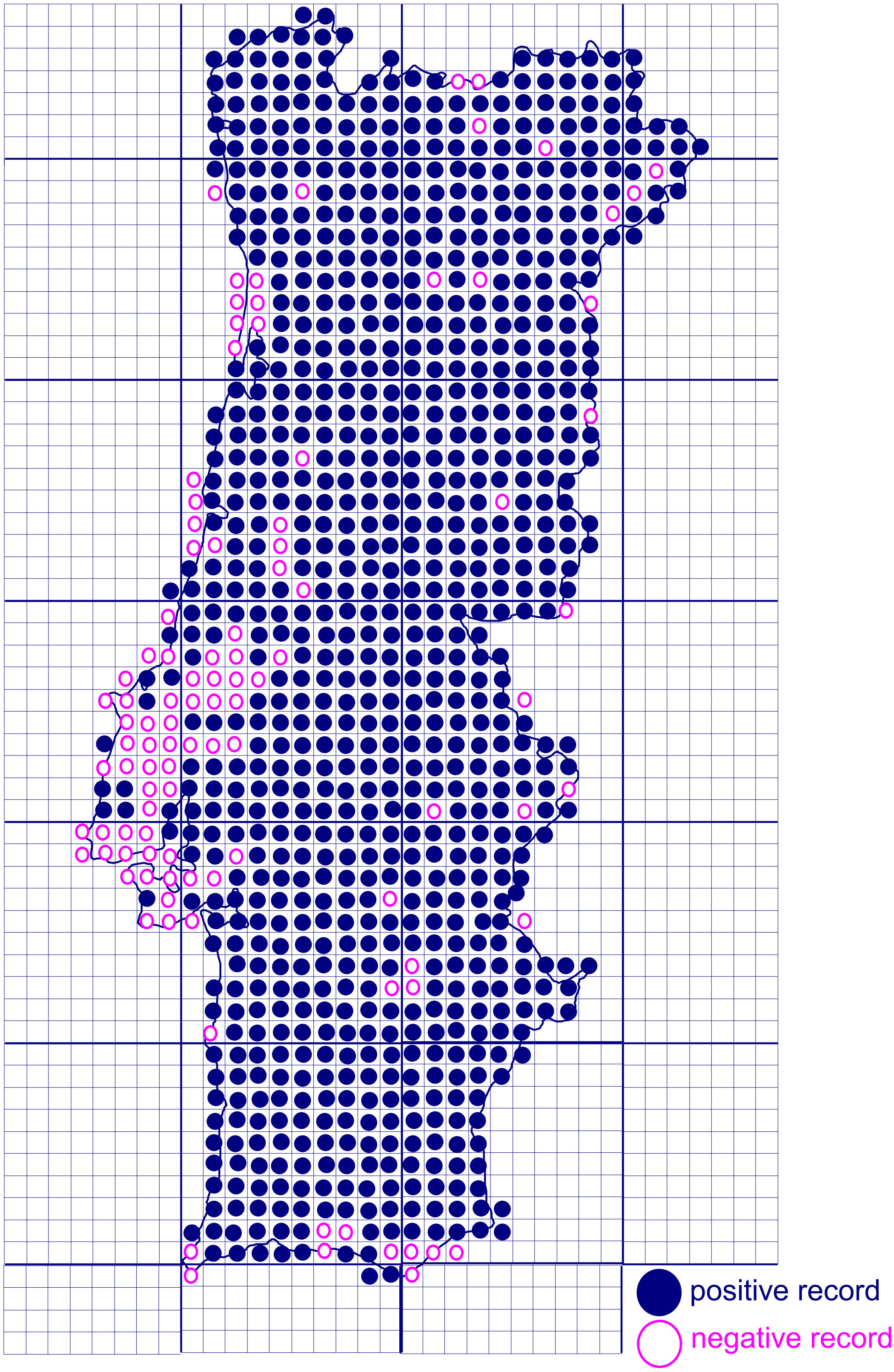

Figure 1. Otter distribution in Portugal in 1995, as found during surveys of 10 km square grids.

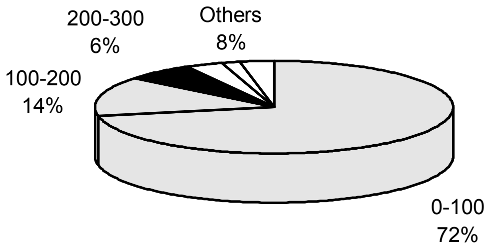

Figure 2. Positive sites per distance (meters) searched.

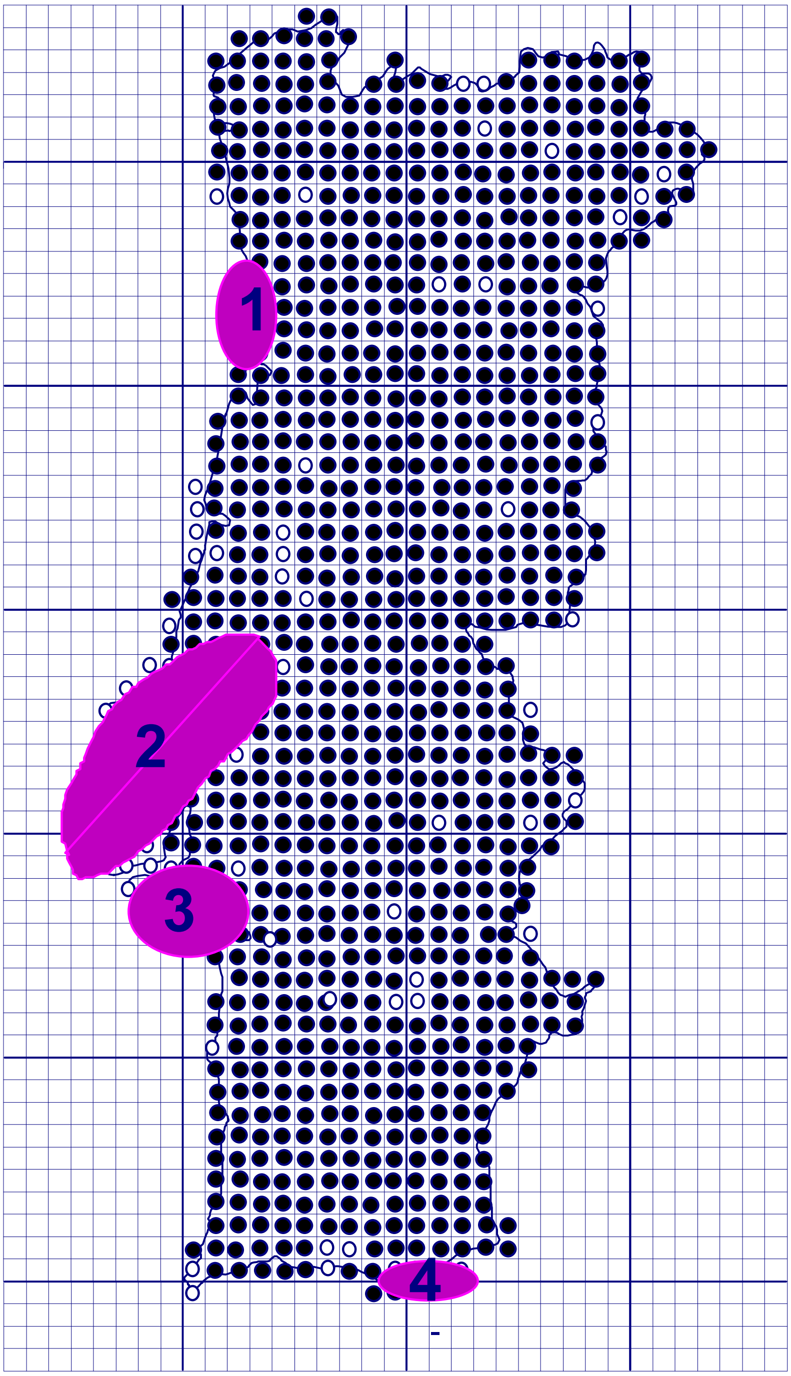

Figure 3. Critical areas (1-4) for otter conservation, superimposed n the national grid.

Despite being distributed widely at present, threats that caused the decline of the species in many other European countries are present in Portugal as well. Three main groups of threats were identified: i) destruction and changing of aquatic habitats natural features, removing of bankside vegetation, declining water quality and quantity, scarcity of food resources and human interference; ii) accidental mortality, especially due to road traffic and to drowning in fish traps; and iii) illegal hunting, by hunters, fisherman and fish farmers.

There have been losses in otter habitat due to land drainage, cutting and destruction of bankside cover and of riparian vegetation. In addition, in many places where otters presumably could find sufficient shelter, chemical pollution limited food supplies (few cyprinids and amphibians, and abundance of crayfish *Procambarus clarkii*). However, the American crayfish now has an important role in the trophic structure of many rivers and streams of dryer regions, becoming the main prey available for otters, particularly when water levels are low.

Four critical geographic areas were identified from where otters are expected to disappear in the very near future if nothing is done to improve the local status of the species and the wetlands where it lives. However, if habitats in these geographical areas become more suitable again, otters could readily recolonise them because they are not far from regions with viable otter populations.

Assuming that otter conservation initiatives should be a priority in areas with healthy populations where the species is still widespread, the authors suggest conducting major actions such as regular surveys and monitoring, habitat management, research, education, public awareness and institutional arrangements concerning biodiversity conservation. All these actions should be fully incorporated into a national strategy for species conservation

The authors have already identified the more important areas for otter conservation within three levels of importance: sites A - conservation priority, sites B - conservation important, site C - to be considered. The species is fully protected and is listed in the Portuguese Red Data Book of 1990 within the category of "Insufficiently known". In face of the knowledge now available and the new criteria of IUCN, the conservation status of otter in Portugal will be revised very soon to a *"species of special concern at a national level",* but not as a threatened species.

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STATUS AND REPRODUCTIVE FEATURES OF OTTER (*Lutra lutra L.)* IN THE NORTH-WEST OF RUSSIA

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ABSTRACT: An analysis of the dynamics of otter abundance during the period 1967-1997 has shown the numbers of animals to be relatively stable with the relative population density in the main habitats equaling 0.6 to 1.3 otters/10km of the river bank. The intervals between the population peaks, which seem to be affected by hunting pressure, were 3-6 years (average 4.5 years). The sex ratio in the natural populations is nearly 1:1 in the groups of both young and adult animals. Young individuals make up about 30% of the population; their survival percentage during the brood period being 77-80%.

INTRODUCTION

There is little, and mainly fragmented, evidence on the status and reproductive features of otter in North-West Russia and the adjacent territories (DANILOV and TUMANOV, 1972; 1975; 1976; NAZAROV et al., 1990; SIDOROVICH, 1991; 1992; SIDOROVICH and TUMANOV, 1994). The present work summarises the author's data on the ecology of the Eurasian otter *Lutra lutra L.* in the region, covering about 30 years. An analysis of the dynamics of its numbers is given.

STUDY AREA

The north-western region of Russia occupies an area of about 520,000 square kilometres. By its botanical-geographical characteristics much of it belongs to the subzones of middle and southern taiga. The northern part comprises the Kola Peninsula and the northern regions of Karelia with associated severe climate and vegetation of the tundra and forest-tundra zones. The southern part belongs to the northern taiga subzone (Figure 1). The difference in mean annual air temperatures between the north and south of the territory is 70-80 ^{o}C, with up to three months snow cover. On the whole, it is a large-scale forested area with a dense river network characterized by high abundance of potential prey species, favoring the presence of otters in the region.

MATERIALS AND METHODS

Observations over the period 1967 to 1997 were summarized. Counts and trapping of otter by signs were performed annually at permanent stations and in individual water bodies. The features of feeding, breeding and the state of the population were investigated. Using a histological analysis method, the reproductive organs of 99 hunted animals were processed. The structure of the population was determined by examining the fur and carcasses of animals caught in the commercial hunting regions. The numbers of otters over large areas during autumn were estimated from analysing special questionnaires distributed among hunters (up to 500 questionnaires per year), and on the basis of data submitted by local hunting organizations to the Game Protection Department.

RESULTS

The differences in climate, hydrological features, as well as prey diversity and abundance between the northern and southern sections of the study area are thought to affect the difference in otter diet between the two areas (Figure 2). In the Kola Peninsula, otter diet is based on fish; frequency of occurrence of fish in food remains is 88-95%. In the southern areas, otters use a wide variety of prey, consuming amphibians, fish, small rodents, crustaceans, waterfowl and aquatic insects. In the south, in the Novgorod and Pskov Districts, occurrence of fish in the food remains decreases to 12-43%. However, the share of amphibians in the diet in this area reaches 40-42% in the summer and 77-79% in the other seasons (TUMANOV and SMELOV, 1980).

Most water bodies in the North-West of Russia are characterized by an abundance and diversity of prey food. Hence the distribution of otters over the territory is mainly affected by climatic factors, the hydrological regime of rivers and the presence of reliable shelter. Otters more frequently inhabit rivers 10 to 25m wide, which do not completely freeze over in winter, or in the lakes connected by streams. Such habitats are more typical of the southern part of the region due to its milder climate, high prey abundance and availability, and a large number of rivers, which do not completely freeze. On such areas with large water bodies, stable, high numbers of otters were observed during the entire study period.

In the Novgorod and Pskov Districts the mean otter population density was 1.3 to 2.2 individuals per 10km of river. In the southern and south-eastern parts this reached 2.5 to 3.3 animals in some water bodies. Large territories of the St. Petersburg Region and southern Karelia have much lower otter densities, with mean densities not exceeding 0.6 to 1.3 individuals per 10km of the river. The otter is absent in the tundra zone of the Kola Peninsula. Its population density in the habitats in the southern part of the peninsula and in northern Karelia is everywhere low, averaging 0.14 to 0.21 individuals per 10km of river. It should be noted that whereas in the south of the region, the otter’s resources remained relatively stable, in Karelia and on the Kola Peninsula food sources have significantly decreased. The main causes for the decreases in species numbers includes contamination of water bodies due to forest cutting, agricultural activities in the river valleys, drainage of swamps and swamped forests, activities of paper and pulp industries, etc.

In the southern areas of the region, with a high human population, hunting is an important factor limiting otter numbers. However, during the last years, in connection with the changed ecological situation in the country, the main hunting press is directed towards regulating animals rather than to hunt for fur. This has contributed towards the preservation of the natural populations of otters.

Monitoring studies suggest that the variations in the numbers of animals in the regions with a low commercial load are of a cyclic but arrhythmic character. Some increases in the population density of otter in the water bodies is observed within 3-6 years or, on average, every 4.5 years (Figure 3).

Counts have shown that in recent years the pre-hunting otter numbers are was as follows: 3-400 on the Kola Peninsula; 1500 -1800 in Karelia; 900-1000 in the St. Petersburg District, 1500 - 2000 in the Pskov District and 1300 - 16 00 in Novgorod District. In total, there are an estimated 5,500 – 6,800 otters throughout north-western Russia.

Otters have low levels of reproduction. According to the reports from hunters, one to four4 cubs were recorded in the 96 nests found(average 2.5-2.6 young per female). Based on the same data sources, by autumn the females had, on average, two cubs each. Thus their survival only for the brood rearing period is around 77-80%.

The sex ratio in different age groups of otters is characterized by a high level of stability. Of the 15 families observed in the wild, the sex ratio was close to 1:1. It was same among the groups of animals of other ages. Hence catch data during the hunting seasons provide information about the sex ratio in the species populations.

In the natural groups of otter, young individuals (up to a year) comprise, on average 30% of the population (DANILOV and TUMANOV, 1976). Of 72 young otters (up to a year) caught by hunters, there were 35 males and 37 females, i.e. the sex ratio was equal. An analysis of 505 fells [ARNO What are 'fels'?] of adult individuals hunted in the St. Petersburg and Novgorod Regions, as well as 83 carcasses of animals from the Pskov Region have allowed us to determine that the proportion of males in the former was 51.1% and in the latter 51.8%. The male and female of otter of different age groups is probably equal .

The birth of otter cubs in North-West Russia does not seem to have a clear seasonal component, although cubs are born more often in April-June and September-October. Histological study of reproductive organs from 81 adults (37 males and 44 females) and 18 young (0 +) has shown that under natural conditions otters become sexually mature at two, sometimes three years of age (SIDOROVICH and TUMANOV, 1994). At this age, other representatives of the Mustelidae - *Meles meles L, Gulo gulo L*. and *Martes flavigula Bod* begin first breeding in Russia as well. It is also necessary to note a different quality of the population by reproductive indicators. Unlike other predators of the region, the otter does not have a constant period of mating. Females can come to the state of sexual activity in different seasons of the year. There are always males in the population that are capable of mating. The time of the sex systemof females becoming active for productive mating is probably governed not only by temperature regime and photo-period, but also by such factors as the physiological state of individuals, growth rate of the young, time of physiological maturity or a sharp change in the ecological situation.

CONCLUSION

Monitoring studies in the populations of otters have revealed a cyclic but arrhythmic character to the dynamics of its population affected by an irregular hunting pressure rate. The intervals between the population peaks are three to six years (on average 4.5 years). The sex ratio in the natural populations is nearly 1:1 in all age groups. The number of cubs in the litter fluctuates from one to four (average 2.5-2.6). They become sexually mature at two years or older. It should also be noted that otters do not have a constant breeding period and different females can mate with active males in different seasons of the year.

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DISTRIBUTION AND CONSERVATION STATUS OF THE NEOTROPICAL OTTER *(Lutra longicaudis)* AND THE GIANT OTTER *(Pteronura brasiliensis)* IN ECUADOR

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Abstract: We studied the distribution and conservation status of the Neotropical Otter and the Giant Otter in Ecuador. This study included bibliographical research, personal sightings and those from other reliable observers. The status assessment is based on the criteria of the Mammal Specialist's Group of Ecuador. We collected 76 sighting records of the Neotropical Otter and 49 of the Giant Otter. The Neotropical Otter is present on both sides of the Andean Mountain Range especially in the Cayapas and Esmeraldas river basins on the western slope and in most rivers on the eastern slope. The Giant Otter has become extinct in the northern part of ecuadorian Amazonia and is only present in the most remote areas of the eastern lowlands: in the Yasuní National Park and the Pastaza, Morona and Zamora river basins. Both species are threatened by habitat destruction, river pollution and poaching. Specific national legislation for the protection of both species is needed, as well as the enforcement of the existing law, protection of the areas where the otters are still present, and better public awareness concerning the importance of the species and their habitats.

INTRODUCTION

Little research has been done in Ecuador on the two otter species that occur: the Neotropical otter (*Lutra longicaudis*) and the Giant otter (*Pteronura brasiliensis*). A single, unpublished study on the Neotropical otter in the Guayas river upper basin was conducted by QUEVEDO in 1992. Most of the information available on the two otter species is restricted to records of their presence in localized areas. Recently, we started the first field investigations on these species (see UTRERAS et al., 1997).

Of the four otter species present in South America, the Neotropical otter has the widest distribution, ranging from Mexico to the northeast of Argentina. According to the Zoogeographical Map of Ecuador (ALBUJA, 1991), the Neotropical otter occurs in the Tropical and Subtropical zones, on both sides of the Andean mountain range, from 0 to 2000 m altitude. FOSTER-TURLEY et al. (1990) stated that the Neotropical otter occured in all of continental Ecuador, including the Andean highlands (i.e.: Nangaritza, Yacuambi and Zamora Rivers); they also mentioned that this otter was common in the eastern tropical forests and the northwest region.

The Giant otter is widely distributed in South America occurring in Brazil, Guyana, Surinam, Venezuela, Colombia, Ecuador, Peru, Bolivia and Paraguay. Currently, it is assumed to be extinct in Argentina and Uruguay (FOSTER-TURLEY et al., 1990). In Ecuador, this otter is present in the lower Eastern Tropical Zone (ALBUJA, 1991). MELQUIST (1984) states that the Giant otter occurs in isolated localities of the lower eastern tropical forests of Ecuador, including the Ishpingo and Bobonaza Rivers close to the eastern borderline;

and in the Cuyabeno, Guepi, Lagartococha and Tarapuy rivers in the northeast. FOSTER-TURLEY et al., (1990) mention its presence in the Cuyabeno Faunistic Production Reserve and in the Yasuni National Park.

The objective of the present study is to determine the current distribution and conservation status of the Neotropical and Giant otters in Ecuador.

METHODS

Since 1994, we have conducted a systematic compilation of otter sighting records throughout Ecuador. The records come from the literature, personal observations and from other researchers, naturalists, indigenous and local people, whose data are reliable. The conservation status assessment is based on the criteria of the Mammal Specialist’s Group of Ecuador, in which we participated, and on interviews with local hunters and traders.

RESULTS

Neotropical otter (local names: lobo de agua, nutria)
Distribution: We collected 76 records of Neotropical otter occurrence from different localities. This species is present on both sides of the Andean Mountain Range: in the Cayapas, Esmeraldas, Cojimíes and Guayas river basins on the western slope; and in the Aguarico, Napo, Curaray, Pastaza and Zamora river basins on the eastern slope (Figure 1). Of these records, 77% occur in the Tropical Zone (0-1000 m.a.s.l.); 20% in the Subtropical Zone (1000-2000 m.a.s.l.) and 3% in the Temperate Zone (2000-3000 m.a.s.l.). The Temperate Zone records fall between 2600 to 2620 m. The broad altitudinal range recorded confirms the wide variety of habitats used by the species. This information agrees with that of FOSTER-TURLEY et al. (1990). Most of the records in the northwestern region are from the Esmeraldas province, the only Ecuadorian province that still contains large remnants of Pacific Tropical Rain Forests (SIERRA, 1996).

Conservation status:

The Neotropical otter is protected in Ecuador under CITES, to which Ecuador is a signatory. At present there is no specific legislation for the protection of the Lutrinae; however, regulations for threatened mammal species protection will soon be approved (Sergio Lasso, pers. comm). In practice, protection till now has been insufficient due to the lack of resources and trained field personnel. The Mammal Specialist’s Group in Ecuador consider the Neotropical otter as vulnerable (VU) in the national territory (UICN-SUR/GTNBD / ECOCIENCIA, 1997), based on the criteria of the IUCN's Red Book (BAILLIE & GROOMBRIDGE, 1996).

The main threats to the Neotropical otter in Ecuador are a) habitat destruction, b) water pollution, c) hunting and fur trade.

a) Neotropical otter populations are severely affected by large-scale deforestation, especially in the western region of Ecuador, where less than 10% of the original forest coverage remain by end of the 1980's (SIERRA, 1996). There is also heavy pressure on the subtropical and temperate ecosystems on both sides of the Andean range, due to colonization, agriculture and cattle ranching expansion. As a consequence, the former habitat has been fragmented into a large number of forest patches of variable size and structure, in which the existence of viable otter populations is uncertain.

b) The pollution of watersheds also constitutes a severe threat. On both sides of the Andean range, aquatic ecosystems are deteriorating due to the intensification of oil exploration and exploitation activities, mining, and the use of chemicals in agriculture.

c) The Neotropical otter has been intensively hunted throughout its range for several decades. The pelt is used as a house ornament. Occasionally these otters are captured alive to be kept or sold as pets. It is not rare to find Neotropical otter pelts at handcraft stores or sold directly by fur-traders on the streets of settlements near forested zones or protected areas, in both eastern and western regions. In 1989, six otter pelts were offered in the Vía Ahuano (Amazon region) for the equivalent of US$ 5 each (DANIEL RUBIO, pers. comm.). The current value of a pelt is US$ 8.

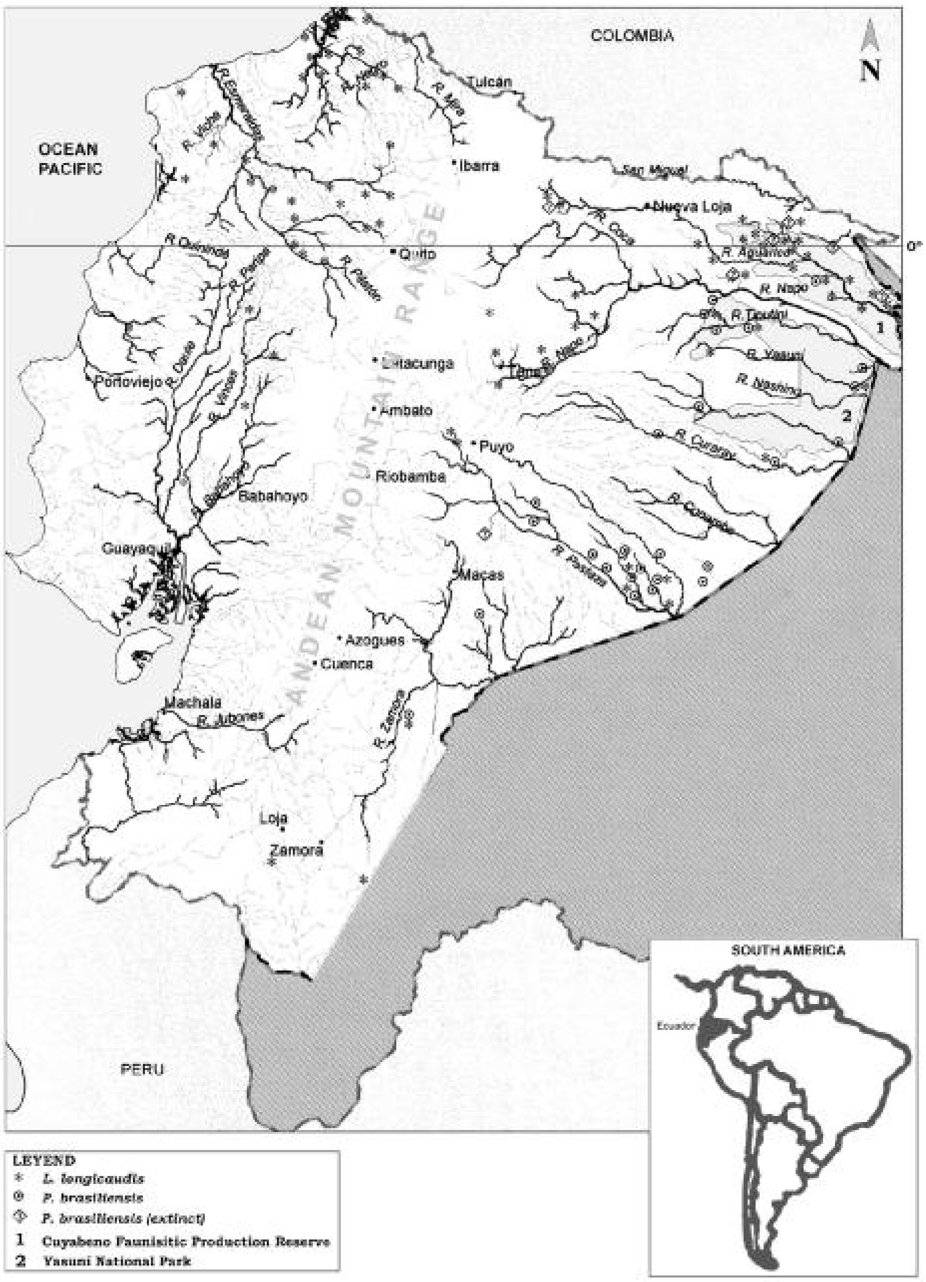

Figure 1. Study area

Giant otter (local names: nutria gigante, lobo de río)

Distribution:

We collected 49 records of the Giant otter, all from within the Eastern Tropical Zone (200-1000 m altitude), in the Tiputini, Tivacuno, Yasuní, Curaray, Pastaza, Morona and Zamora river basins (Figure 1). Some of the records from the Pastaza River come from localities very close to each other; and could, in some instances, correspond to the same individuals or groups. The Giant otter has been extirpated from most of the northern Ecuadorian Amazon region, including the Cuyabeno Reserve (Figure 1).

Conservation status:

The Giant otter is protected in Ecuador under CITES. Protection is virtually non-existent due to the lack of resources, qualified personnel and the poor commitment of the authorities towards conservation. SUAREZ & GARCIA (1986) include the Giant otter as one of the 60 most threatened animal species in Ecuador. The Mammal Specialist's Group of Ecuador consider the Giant otter to be in Critical Danger (CR) in the national territory (UICN-SUR/GTNBD/ECOCIENCIA 1997), based on the criteria of the IUCN's Red Book (BAILLIE and GROOMBRIDGE, 1996).

The main threats faced by the Giant otter in Ecuador are a) water pollution and b) hunting and fur trade. Habitat destruction is not considered as critical since ecuadorian Amazonia still preserves 70% of its forested area (SIERRA 1996).

a) Pollution of the amazonian aquatic systems represents a serious threat for Giant otters in Ecuador, and is directly related to the oil exploitation activities that have been carried out since the early 1970's. This industry is likely to expand in the future, mainly in the central and southern Amazon region (including Yasuni National Park), an important part of the species' range. In the past, several lakes and riparian systems have been affected by large-scale oil spills, especially in the northern region, even within protected areas such as the Cuyabeno Reserve.

b) Since the late 1950's to the middle 1980's, the Giant otter was intensively hunted in Ecuador. Unfortunately there is no information on the number of individuals destroyed. However, it is evident that it has been extirpated from several areas, mainly in the northern region (Figure 1). Towards 1960, the Giant otter disappeared from the Cuyabeno Reserve. Several colonists intensively hunted there to sell the pelts (RANDALL BORMAN pers.comm). Some 20 to 25 years ago, the Lagartococha region (Cuyabeno Reserve's eastern limit) presumably held a large population of Giant otters. The Quichua indigenous people used to hunt Giant otters and sell their pelts to Peruvian and Colombian traders (ROGELIO TANGOY pers. comm). "In 1984, during my visit to the Lagartococha (military post at the confluence of the Lagarto and Aguarico rivers), I saw several groups of Giant otters. They were killed and the furs stacked in large packages to be transported to El Coca city to be exported to Europe, mainly to Italy" (COL. LUIS MUÑOZ pers. comm.). In July 1997, we detected the sale of two Giant otter pelts at a handcraft store in the city of Lago Agrio for the equivalent of US$ 11. The pelts presumably came from the Nuevo Rocafuerte region.

DISCUSSION

The distribution map (Figure 1) indicates the presence of the Neotropical and Giant otter in several localities. However, nothing is known about the population status of either of the two species. If the present rates of habitat destruction, water pollution and poaching remain constant, both species could become extinct in Ecuador within the next few decades, especially the Giant otter. Several *in situ* and *ex situ* measures ought to be taken to prevent this. SCHENCK and STAIB (1994) argued that the prevention of further habitat destruction, effective protected areas management, creation of additional protected areas, research and monitoring programmes and the elimination of poaching are necessary items in an effective conservation strategy for the Giant otter in Peru. We think this applies in Ecuador as well. However, the specific national legislation concerning the protection of both species, as well as the enforcement of the existing laws and conventions related to wildlife conservation, water pollution and habitat destruction also need to be attended.

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RIVER, YASUNI NATIONAL PRELIMINARY STUDY ON THE DIET OF THE NEOTROPICAL OTTER *Lutra longicaudis* IN THE TIPUTINI PARK, ECUADORIAN AMAZONIA

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Abstract: Between April and October 1997, a preliminary study was conducted on the diet of Lutra longicaudis in the Tiputini river, central ecuadorian Amazonia. The methodology is based on the collection and analysis of spraints found on the river margins. Eight spraints were collected, which contained rests of fish (in 100% of the spraints), crustaceans (62.5%), bivalves, insects and seeds (each by 12.5%). From the spraints, eight genera of fish from six families were identified, with the Cichlidae family as the most representative. In 1997, the water level of the Tiputini river was higher than the normal average for a typical year, which probably accounts for the low number of collected spraints.

INTRODUCTION

Most of the information about the otter's diet is obtained by analyzing spraints collected at the margins of hydric bodies (CHANIN, 1985; COLARES and WALDEMARIN, 1996; WALDEMARIN and COLARES, 1996).

The objective of the present work is to publish the results of a preliminary sample of 8 spraints of the Neotropical Otter *Lutra longicaudis* collected in a segment of the Tiputini River. This is the first study of this kind conducted on this species in ecuadorian Amazonia and was executed parallel to a study on the Giant otter Pteronura brasiliensis in the same area (see UTRERAS et al., 1997).

STUDY AREA

The Yasuni National Park, a declared Biosphere Reserve (CHARVET and LEON 1992), is located in central ecuadorian Amazonia (Napo province); it covers a surface of 982.000 ha and has an altitudinal range of 200 to 600 m (Figure 1). Its characteristic ecosystem is the tropical rainforest (ECOCIENCIA 1994).

The study area is located in the northwestern portion of the Yasuni National Park (Figure 1), comprising approximately 10 km of the Tiputini River, one of the main riparian system in the area. The facilities of the Yasuni Scientific Station (ECY) of the Pontificia Universidad Catolica del Ecuador (PUCE) were used as base camp.

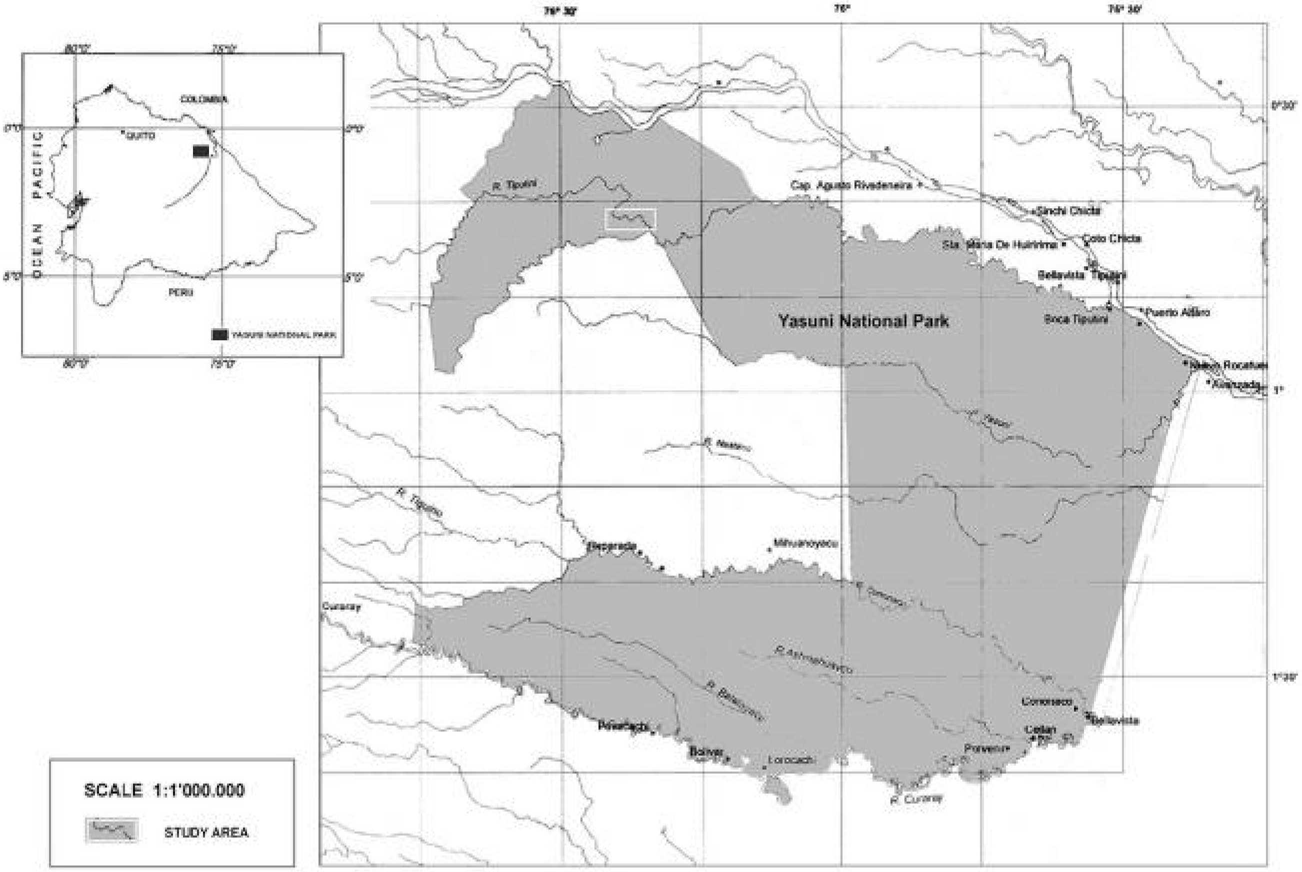

Figure 1. Study area

METHODS

Between April and October 1997, a 10 km-long segment of the Tiputini River was surveyed using a dugout canoe equipped with a 15 hp outboard motor. Both river margins were visually surveyed at a navigation speed of 5 to 7 km/h. The spraints were collected in plastic bags and later on washed, dried and separated into distinguishable solid rests (fish scales, vertebrae, teeth, bones, etc.). Identification was performed by ichthiologist Dr. Ramiro Barriga, who compared the rests found in the spraints with the Escuela Politécnica Nacional Museum (EPNM) fish reference collection. The specimens in this reference collection were collected in the same area where the present study was conducted. The percentage in which each prey family was present in the spraints was calculated by dividing the number of spraints in which a particular family was present by the total sample, and multiplied by 100.

RESULTS

Eight spraints were collected, all of them found on fallen logs on the river margins. Five of them were found fresh, presenting a cylindrical shape and a greenish coloration. The other three were several days-old spraints, disseminated into solid rests.

The feces analysis indicates that fish are the most representative item in the otter diet, present in 100% of the spraints. We identified 8 genera of fish in

6 families: Cichlidae in 50% of the spraints (genus *Aequidens* and *Crenicichla*); Characidae 25% (genus *Astyanax* and *Brycon*); Pimelodidae 25% (genus *Pimelodella*); Anostomidae 12.5% (genus *Leporinus*); Auchenipteridae 12.5% (genus *Tatia*) and Loricariidae 12.5% (genus *Panaque*). The crustaceans (family Trichodactylidae) are the second most important item, present in 62.5% of the samples. Rests of bivalves, insects (order Diptera) and seeds were present each in 12.5% of the spraints.

DISCUSSION

The analysis of otter spraints found on water bodies margins constitutes a suitable method for studying their diet, for this is a non-intrusive technique; that is, it does not involve the capture or manipulation of animals. This is important when dealing with endangered species as the Neotropical otter, which is considered Vulnerable in Ecuador (UICN-SUR/GTNBD/ECOCIENCIA, 1997) based on the criteria of the IUCN Red Data Book (BAILLIE and GROOMBRIDGE, 1996).

Studies on the diet of the Neotropical otter have been carried out by PARRERA (1992) in Argentina and by PASSAMANI and CAMARGO (1995) in Brazil. The preliminary results of this study agree to a great extend with them. Fish constitutes the most important diet item, and among them, the Cichlidae family is the most representative, presenting the highest percentage in the piscivorous diet reported by all three studies. The Anostomidae family is equally common.

No evidence of amphibians, reptiles, birds or small mammals were found in the spraints, items that are also mentioned as part of the Neotropical otter's diet in ROSAS et al. (1991) and WALDEMARIN and COLARES (1996).

This preliminar study is the first step in the research of the Neotropical otter diet in Ecuador; further and more detalied studies are needed. Between April and July (rainy season), the margins of the Tiputini remained flooded or with high water levels for most of the time, and only 3 spraints were collected. From August to September, the water level changed constantly. 5 spraints were collected during this period. In general, the water level in 1997 was higher than the normal average for a typical year, which probably had a bearing on the low number of samples collected.

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PRELIMINARY DATA ON PARASITES OF EUROPEAN OTTER (*Lutra lutra*) IN LATVIA

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Abstract: A total of 13 otters was examined for helminths. Eight helminth species were identified, of which at least six *Euparyphium inerme, Capillaria putorii, Rictularia affinis, Strongyloides martis, Globocephalus sp.* and *Physaloptera sibirica* were regarded as otter parasites. The parasitic fauna of otters in Latvia was poor in species and not of significant importance for the population.

INTRODUCTION

Although the presence of parasites in otters has been recorded, their effects mostly have not been considered to be significant for survival even at the individual level (CHANIN, 1985). Little attempt has been made to examine the relationship between infection rate and intensity with the health and/or density of the otter population. However, SCHIERHORN et al. (1991) reported a relationship between parasites and high otter density in Germany. A comparatively high infection rate (75%) of otters with helminths was reported in Belarus and was partly explained by high population density of otters (ANISIMOVA et al., 1996). Since Latvia and Belarus are neighbouring countries and seem to be evenly inhabited by otters, we extended this type of work to Latvia.

MATERIAL AND METHODS

Thirteen otters, which accidentally were killed in beaver traps during the last four years were examined for parasites (Tab. 1). Otters were sampled in four localities in central and north-eastern Latvia (Fig. 1): two localities in the Gauja River Basin (10 specimens), one in the Salaca River (1 specimen) and one in Lielupe River Basin (2 specimens). Our study area was located less than 300 km from the north-western border of that in Belarus.

Freshly dead specimens were sexed, weighed and body measurements taken prior to skinning. Skinned carcasses were preserved by freezing for a few weeks. The necropsy technique described by WOBESER and SPRAKER (1980) was used, including a complete helminthological analysis of the gastro-intestinal tract. Prior to opening of the intestinal wall, the intestine length was measured. Selected organs (lungs, trachea, liver, gall bladder, spleen, kidneys and urinary bladder) were examined separately. Detected helminths were preserved on microscopic slides (IVANOV et al., 1958). The age class was determined by skull features, state of reproductive organs in females, and the size and shape of os penis (WAGENKNECHT, 1984; ZINKE, 1997) in males.

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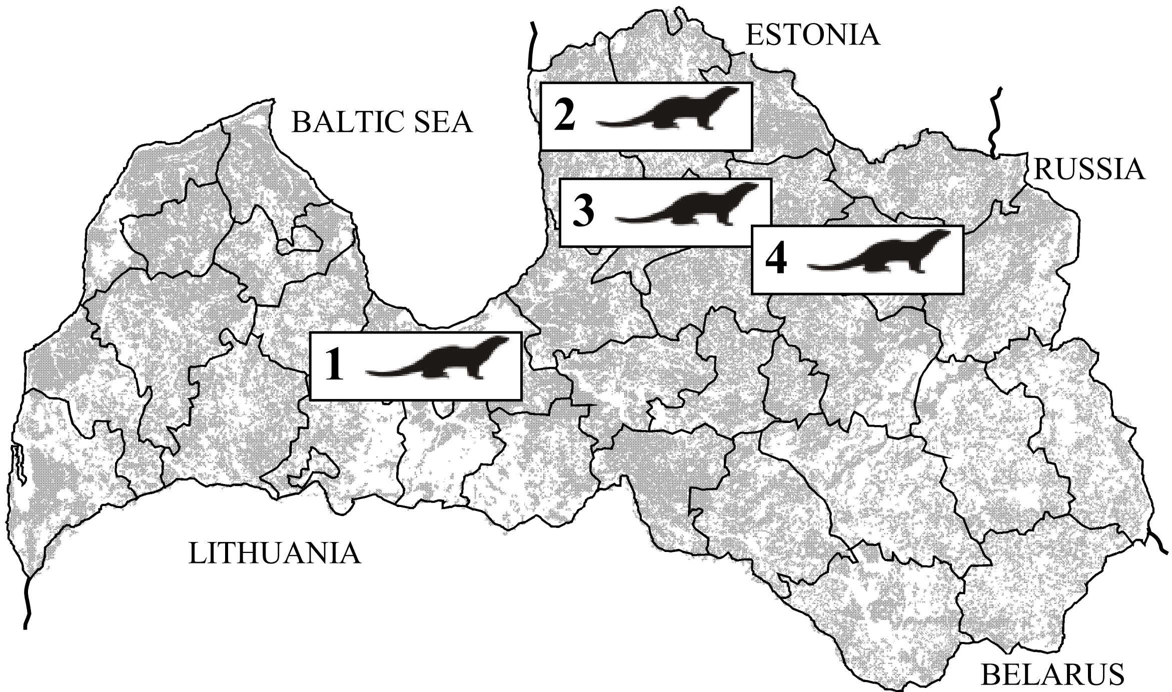

Figure 1. Study area. (1) Lielupe River Basin (2 otters); (2) Salaca River (1 otter); (3) the watershed of Gauja River Basin (1 otter); (4) Gauja River Basin (9 otters).

The body condition index was calculated for each completely measured animal (LE CREN, 1951; KRUUK et al., 1987, cited in KRUUK, 1995).

Table 1. Data on otters examined

Date	Basin	Habitat	Sex	Age group*	Body length*** (m)	Weight (kg)	Condition index C****	Intestinal length (m)	Number of helminths
94.10.20	4	main river	m	ad.	1,20	9,2	1,01	4,10	-
94.10.20	4	tributary	f	ad.	1,08	5,0	0,83	3,92	-
95.10.23	4	main river	m	subad. ?	1,04	6,1	0,95	3,80	-
95.10.16	4	main river	f	subad. ?	0,97	5,8	1,24	3,43	-
95.11.30	2	main river	m	ad.	-	8,5	-	4,30	-
96.10.18	4	main river	f	ad.**	1,12	7,2	1,10	3,50	-
96.10.27	4	main river	f	ad.**	1,04	6,0	1,09	3,33	33
96.10.26	4	main river	f	subad.	0,94	4,1	0,94	3,80	3
96.11.10	4	main river	f	juv-subad	0,91	4,0	0,99	3,33	5
97.03.16	1	tributary	m	subad.	1,03	5,4	0,86	3,92	-
97.03.21	1	tributary	m	subad.	0,96	6,2	1,16	4,07	-
97.10.02	4	main river	f	ad.**	1,08	6,8	1,14	3,10	1
97.11.30	3	watershed	m	ad.	1,10	-	-	3,80	-

* juv.-up to 1 ear, subad.-1-2 year, ad.-above 2 year, **lactating specimen; *** from nose to the end of tail; **** C=W/cL (LE CREN, 1951 and KRUUK et al., 1987, cited in Kruuk, 1995)

Spraints (n=914) were collected and analysed for a dietary study in a wide area of Latvia. Since spraints were stored in 70% ethanol until analysis, and washed and examined under 7x magnification, only adult helminths were detectable.

RESULTS

In total, eight helminth species were found: 1 cestode, 1 trematode, 5 nematodes and 1 acanthocephalan (Tab. 2). However, only five species were discovered in the intestines: trematode *Euparíphium inerme* and 4 nematodes *Capillaria putorii, Rictularia affinis, Strongyloides martis* and *Globocephalus sp*. One nematode *Physaloptera sibirica*, and the cestode and acanthocephalan were found only in spraints. The species of the latter two parasites are not clear. Both cestode specimens were too badly damaged for species identification. Acanthocephalan specimens rather belonged to the genus *Pseudoacanthocephalus*.

Table 2. Parasites in otters from Latvia, recorded from examination of 13 carcasses and 914 scat analyses

Species	Localization	Number of infected individuals	Intensity of infection			Number of parasite specimens found in scats
			mean	min.	max.	
Trematoda						
Euparyphium inerme	small gut	4	8	1	25	
Nematoda						
Capillaria putorii	intestine	1	1	-	-	6
Rictularia affinis	small gut	1	1	-	-	4
Strongyloides martis	intestine	1	6	-	-	2
Globocephalus lutrae	intestine	1	1	-	-	1
Physaloptera sibirica						1
Cestoda						
Cestoda sp.						2
Acanthocephala						
Pseudoacanthocephalus sp.						3
(P. caucasicus or P. bufonis)						
In total		4	10	1	33	19

Of the internal organs examined, only intestines appeared infected. Four of the 13 examined otters were infected (infection rate 31%), all trematode *E. inerme*. The highest infection intensity by this helminth (25 in one otter) was found in an adult female caught in 27th October 1996 (Tab. 1), which probably had two suckling cubs (state of milk glands and 2 placental scars). We also found eight nematodes of two different species (*S. martis, C. putorii)* in this otter. Trematodes were located in the small gut, and nematodes both in the small and large gut. Other organs were not infected by parasites, and the specimen was of normal body condition.

The second most infected otter (found dead 10 November 1996) contained the trematode *E. inerme* (n=5), the third otter (found dead 26 October 1996) contained the nematode *R. affinis* (n=1) and trematode *E. inerme* (n=2). The last finding was a single specimen of *E. inerme* located in the small gut of an adult female otter killed shortly after suckling three cubs (found dead 2

October 1997). According to a visual assessment proposed by TOMAN (1997) and the condition index (Tab. 1), the condition of this otter was excellent.

The average condition index was 1.04 for infected and 1.02 for non-infected animals. The diet of otters in Latvia (all seasons, relative occurrence) from the spraints consisted of 40% fish, 29% frogs, 10% insects and 21% other prey altogether including mammals, birds, lamprey, crayfish, molluscs and plants.

DISCUSSION

In Latvia, the infection rate in otters was similar to that in eastern Germany where SCHIERHORN et al. (1991) recorded 24% infection, being significantly less (Student's t-test: Latvia/Belarus t=3.21; d.f.=12: P<0.01; Latvia/Germany t=0.499: n.s.) than in Belarus. In comparison to helminth lists summarised by other authors (KONTRIMAVICHUS, 1969; SCHIERHORN et al., 1991; ANISIMOVA et al., 1996), the helminthofauna of otters in Latvia is not rich in species. We found 38% of 13 recorded Nematoda species and 7% of 15 recorded Trematoda species. Some findings require confirmation by additional data. For example, the nematode *Globocephalus sp.,* probably *G. lutrae,* has been identified twice in Latvia (Table 2), but previously was recorded only in China (POPOVA, 1955). Acanthocephalans in spraint may arise from consumed amphibians, since frogs and toads were a significant part of the otter diet. Abundant amphibians may favour infection of otters in Latvia by helminths. This may explain the presence of trematode *E. inerme* in all infected animals because frogs are the intermediate hosts (KONTRIMAVICHUS, 1969). The intensity of parasitic infection in the examined otters did not exceed published accounts (SCHIERHORN et al., 1991, ANISIMOVA et al., 1996). However, three of the Nematoda species found in Latvia *C. putorii, S. martis* and *Globocephalus sp.* were from one spraint originating from a heavily infected animal. All of the found helminths are intestinal parasites, and are thought to be less pathogenic than those located in other organs. Consequently, we did not find any damage to organs or weakness of hosts.

Our results do not agree with those of SCHIERHORN et al. (1991) who examining 50 otters and concluded that males were more infected than females. In our case, all the animals with helminths were females. While our sample size was rather small, it seems that helminths are not of significant importance in otter infections in Latvia.

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STATUS OF THE NEOTROPICAL RIVER OTTER (*Lontra longicaudis*) IN BRAZIL

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Abstract: The neotropical river otter is found throughout Brazil. There has, however, been few studies on this species and almost nothing is known about its status in the country's different states. To try and address this, a survey of the species' status in Brazil, based on questionnaires sent to professionals involved in environmental research in all the country's states, was undertaken. Based on the results from the states of Minas Gerais, São Paulo, Paraná and Rio Grande do Sul, some general trends were identified and the status of the neotropical otter in these states, together with the main threats to which they are exposed. The species was considered rare and declining in all these states and a great number of questionnaires mentioned that the species is considered to be harmful in their region. These results have shown the great importance of studies to assess the impacts to which the species is subjected, and to find ways to promote the preservation of the species.

INTRODUCTION

The numbers of neotropical river otters (*Lontra longicaudis*) have decreased significantly over the last few decades. Because of this, the species is considered threatened with extinction (AYRES and BEST, 1979; MASON and MACDONALD, 1986; IBAMA, 1989).

Due to the size of Brazil and the relatively small numbers of researchers who have been studying this animal, almost nothing is known about its status, areas of occurrence and risks to which the species are exposed.

This work had the objective of establishing a general view of the neotropical river otter in Brazil, in order to give support for future studies.

METHODS

To develop this work, a questionnaire, containing ten questions about the otter situation in Brazil was sent to professionals involved in environmental work throughout all the Brazilian states during the year of 1990. Seven states replied (Fig. 1). Because only one questionnaire was returned from Paraíba and Bahia, and two from Rio de Janeiro, these states were not included in the analysis. A total of 1030 questionnaires were returned from the remaining four states (Minas Gerais, São Paulo, Paraná and Rio Grande do Sul) and analyzed. The results of the three questions considered containing the most important information for the species in the country are presented in this paper.

The questions addressed were:
1. What is the otter situation in your region?
2. How has the number of otters changed in your region?
3. If the otter is considered a harmful animal in your region? Why?"

Figure 1: Study area

RESULTS AND DISCUSSION

From Minas Gerais, 359 questionnaires were returned from 324 cities. The species was considered rare in 46% of the responses, 'normal' in 36%, absent in 7% and abundant in 6%. The number of otters was considered to be decreasing in 46% of the replies, constant in 30%, increasing in 10% and absent in 6%. 48% of the questionnaires reported that the otter was considered harmful in their region, with attacks on fish farms being seen as the main threat, followed by the interaction with fisheries (fish predation and attack to nets and fish traps) and by attacks to fowl farms.

Of the 221 questionnaires returned from 217 cities in the Paraná state, 63% considered the species rare, 17% absent, 9% normal and 2% abundant. The number of otters was considered to be decreasing in 48% of the responses, absent in 15%, constant in 12% and increasing in 6%. The otter was cited as being considered harmful in 24% of the questionnaires, with attacks on fish farms again being mentioned as the main threat, followed by interaction with fisheries.

From the Rio Grande do Sul state, 95 questionnaires were answered from 90 cities. 60% of them considered the species rare, 22% absent and 7% normal. 53% reported that the number of otters was declining, while 22% reported it absent, 8% constant and 1% increasing. Only 19% of the questionnaires considered the species harmful and interaction with fisheries was the most cited reason for that.

Of the 355 questionnaires originated from 324 cities in São Paulo state, 57% considered the species rare, 18% normal, 15% absent and 1% abundant.

The otter was considered to be decreasing in 48% of the questionnaires, constant in 16%, absent in 15% and increasing in 6%. The species was considered harmful in 23% of the questionnaires. The main reason being attacks on fish farms, being followed by attacks on fowl farms and fisheries.

In all states from which answers were obtained, a larger number of questionnaires considered the species rare and the number of otters to be decreasing. These results emphasize the need for studies on the species in all the national territory to identify the main problems that are causing injuries to the species, in order to implement management regulations for the areas where the species occurs, to mitigate the impacts of threats and to allow the species to recover in Brazil.

A great number of questionnaires considered the species harmful, mainly due to the attacks to fish farms. Problems of this nature have been identified in many countries, and can cause problems to the otters due to the attitude of the fish farmers trying to protect their farms (BODNER, 1995; KNOLLSEISEN, 1995; DULFER et al*.,* 1996; KUCEROVÁ, 1996) This result shows the need for studies with the objective of verifying the true impact suffered and caused by otters in this kind of interaction, along with searching ways to reduce them. Special attention should be paid to areas where fish farming is a relevant economic activity, which happens in some Brazilian states. The same applies to the problem of interactions between otters and fishery, which was also cited a number of times.

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UROLITHIASIS IN EUROPEAN OTTERS (*Lutra lutra*) FROM DENMARK

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Abstract: Urolithiasis is a disease of the urogenital tract, which goes along with the formation of mineralized concrements, called uroliths or calculi. Most investigations considered only captive otters. Data from wild individuals are rare, therefore macroscopical and histological investigations were made on kidney tissue of 102 wild animals from Denmark. Concrements were analysed by infrared spectroscopy. First results show that there is an incidence of 18.8% in subadult and adult Danish animals (16 out of 85 individuals). Both sexes were affected (10 out of 45 males; 6 out of 40 females). Calculi were multiple and diffusely distributed throughout the parenchyma of the lobulated kidney, mostly without reaction of the surrounding tissue. In two cases extreme formations of calculi destroyed nearly the entire parenchyma. Ammonium urate was the main constituent of the concrements.

INTRODUCTION

The formation of stony precipitates anywhere in the urinary passages is called urolithiasis. The stones are called urolith or calculi. Calculi are found most often in the urinary bladder but sometimes in the ureter, the renal pelvis, or even in distended terminal tubules (JONES and HUNT, 1983). In members of the *Mustelidae* this disease is well known in farmed American mink (*Mustela vison*). The most important component in the urinary tract stones of mink is struvite (see, for example, LÖLIGER, 1970; ZIMMERMANN and SCHWEDER, 1985).

Captive Asian small-clawed otters (*Amblonyx cinereus*) are also a well investigated species (KEYMER et al., 1981; KARESH, 1983; NELSON 1983; CALLE and ROBINSON 1985; CALLE, 1988). The main constituent of calculi in Asian small-clawed otters is calcium oxalate, sometimes calcium phosphate or ammonium urate. To our knowledge only one publication exists in which DAENGSVANG (1973, cited in KEYMER et al., 1981) reports a stone formation in a wild *Amblonyx cinereus*.

Urolithiasis in Eurasian otters (*Lutra lutra*) is known from different otter stations and zoological gardens (KEYMER et al., 1981; JEFFERIES and HANSON, 1987; RÜBEL and HAUSER, 1987; ROGOSCHIK and BRANDES, 1989). JEFFERIES and HANSON (1987) as well as ROGOSCHIK and BRANDES (1989) mentioned case reports while RÜBEL and HAUSER (1987) evaluated necropsy reports of 22 captive Eurasian otters. Calculi were found in seven (31.8%) and were chemically analysed in three cases. Concrements consisted of more than 70% of ammonium urate; the major other component was oxalate. KEYMER *et al*. (1981) dissected 13 captive Eurasian otters and found calculi in nine of them (69.2%). Concrements were analysed in four cases and consisted of calcium urate (2), calcium urate + ammonium urate (1) and calcium phosphate (1). In addition they found ammonium urate concrements in one wild otter. Four other authors found nephroliths in wild European otters but no analyses were carried out. BROEKHUIZEN (1986) and also STEPHENS (1957, cited in KEYMER et al., 1981) mentioned a single case. JENSEN (1964) examined 95 (48:47) wild otters from Denmark between 1959 and 1963 and reported that "two emaciated animals suffered from renal stones..." (2.1 %). Necropsies on 77 wild Eurasian otters found dead in south-west England between 1988 and 1996 were carried out by SIMPSON (1997). No calculi were seen "...although it was looked for systematically...". Later approximately 30 more wild otters were dissected and calculi were found in two animals (SIMPSON, 1998, pers. com.). Urolithiasis has also been seen in wild Eurasian otters from Germany and Scotland (pers. obs.).

ANIMALS, MATERIALS AND METHODS

Deep frozen (-18 °C) kidney material from 71 Danish otters, which died between 1980-1990, was available for examination. Unfortunately in most cases only parts of one kidney from every animal had been frozen. In addition detailed necropsies on 31 deep frozen otters, that died between 1995-1996, were performed. The kidneys of these animals were measured (weight, length, width) and the ureter as well as the urinary bladders were examined.

Every kidney, respectively kidney part, was cut longitudinally in half (middle cut) and, whenever possible, every half was cut again longitudinally in two pieces. The cutting was done with a long sharp knife. This method seems to be important for finding especially very small concrements without destroying tissue for further histological examinations at the same time. Gross macroscopical findings were noted and tissue samples were fixed in phosphate buffered 4% formalin. Paraffin sections were made and stained with Haematoxylin-Eosin and van Kossa for histology. The rest of kidney tissue was cut into small pieces to ensure detection of all stony concrements. Calculi were photographed, weighed and analysed by infrared spectroscopy.

All available data about the dead otters like sex, age, length, weight, site, date and the presumable cause of death were documented. Otters were aged as juveniles (less than about 5 month old) if tooth replacement was incomplete, as subadults (5-18 months) if tooth replacement was complete but the epiphyseal closure of humerus and femur at their proximal and distal ends was not complete or as adults (older than about 18 months) (MADSEN et al., 1996). Of the 102 animals 17 (8 males : 9 females) were juveniles.

RESULTS

As urolithiasis was only found in adults and seems to be unlikely in otters younger than five months the juveniles were not included in the statistical analyses. The major causes of death in the 85 (45:40) remaining subadult and adult otters have been traffic mortality (n=43 / 50.6%) and drowning (n=30: 35.3%).

Considering that kidneys were not complete in 58 (32:26) cases the incidence in the examined subadult and adult otters is at least 18.8% (16 out of 85 individuals). Both sexes were affected (10 out of 45 males; 6 out of 40 females). Calculi were multiple and diffusely distributed throughout the parenchyma of the kidney mostly without macroscopical reaction of the surrounding tissue. None were found in the urinary bladder or in the ureter. Histological examinations of the kidney tissues are still in progress. Presently we can state the absence of inflammatory signs as well as the presence of atrophic portions replaced by fibrous tissue.

Weight of stony material per available kidney tissue of each animal ranged from 0.002g to 4.87g. In two animals, where in each case one complete kidney was available, calculi formations destroyed nearly the entire parenchyma and weighed 3.66g and 4.87g, respectively.

The results of calculi analyses by infrared spectroscopy were uniform. Ammonium urate was the main constituent of the concrements. In 11 cases 100% ammonium urate could be detected. Calculi of two otters consisted of 95% ammonium urate and 5% sodium-urate while those of two other animals contained 95% ammonium urate and 5% struvite or 5% unknown substances, respectively. In one case the calculi were composed of 50% ammonium urate and 50% struvite.

DISCUSSION

Considering that kidney tissue was incomplete in many cases and that the examined otters represent only those found mainly next to roads or in fishtraps, there is a high prevalence of urolithiasis in necropsied wild Danish otters. It remains unknown how many otters suffer from diseases in their holts, dens or wherever no one would find them. In other wild Danish species, such as badgers (*Meles meles*) and foxes (V*ulpes vulpes*), no calculi were found in more than 200 necropsied carcasses (DIETZ and RATTENBORG, 1998, pers. com.). Also in comparison to studies on wild Eurasian otters from JENSEN (1964) and SIMPSON (1997) the percentage of affected animals in the present investigation is extremly high. However, many of the calculi were very small so it is possible that some calculi were not detected in previous studies. In this context the question about the possible influence of such concrements for the animals health status and well-being is legitimate.

Ammonium urate, analysed using infrared spectroscopy, seems to be the main constituent of renal calculi in wild as well as in captive Eurasian otters. This is in contrast to analyses of concrements from Asian small-clawed otters where calcium oxalate is the main component. These differences may be a result of different analysing methods or simply of different causes/forms of urolithiasis. The following theories can be discussed for urate urolithiasis:

Urate crystalls have been found in birds, reptiles, primates and, as a special case, in dalmatian dogs. All these animals excrete uric acid enriched urine, which is a predisposing factor for urate urolithiasis. Dalmatians are unique among dogs. Most of the urinary end-products of catabolism of endogenous (nucleotides) and exogenous (diet) purines in this breed are salts of uric acid, which are relatively unsoluble. All other breeds of dogs, as well as other mammals (primates excluded), excrete the soluble allantoin as the principal end-product of metabolism of purines (LING, 1995). Purine content is very high in diets containing lean meat and fish, whereas diets composed of vegetable protein usually are much lower in purines. Dalmatian dogs appear to have a defective transport system for uric acid in the liver, the kidney and the erythrocytes (CHEW and DIBARTOLA, 1986). The effect of these inherited abnormalities is a hyperuricosuria and higher serum uric acid values as compared to other breeds of dogs (THORNHILL, 1980; GIESECKE et al., 1985). Urate urolithiasis can occur in dogs of any breed that suffer from hepatic dystrophy or atrophy. Also congenital or acquired portosystemic vascular shunts may result in constant or intermittent urate crystalluria, urate calculi, or both.

In humans urate urolithiasis is found in developing countries, associated with uric acid and ammonium enriched urine. Such conditions may occur either as result of urealytic infection or urinary phosphate deficiency of alimentary origin (KLOHN et al., 1986).

The investigation of Danish otters support the theory, that the purine metabolism of the examined animals may be different to other mammals. Further investigations including kidney histology and analyses of urine samples within the ongoing study on otters from different countries will hopefully provide more information.

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ECONOMIC ASPECTS OF OTTER (*Lutra lutra*) PREDATION ON FISH PRODUCTION IN SOUTHERN POLAND

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Abstract: The diet of the otter was investigated based on faeces (n=996) collected at carp farming ponds (n=3) and trout farming sites (n=7) situated in southern Poland. The size of the carp ponds ranged from 55 to 128 hectares and the trout ponds from 0.35 to 0.85 hectares. The remains of various animals found in the otter faeces were identified to species based on their structure, shape and characteristic parts of the skeleton. The estimated composition of the otter diet, calculated on the basis of the weight of typical prey, indicated that fish accounted for 55.8% and 91.5% of the otter diet in the carp and trout ponds respectively. In carp pond sites the proportion of carp in the otter diet amounted to only 10.8%. However, the otter diet in trout pond sites was dominated by trout *(Salmo trutta sp* and *Oncorhyncus mykiss)*, constituting 81.7% of the diet.
The results of this study demonstrate that in the examined carp ponds the otter foraging behaviour was focused on fish of small body size, that were not important for the fish farming. The impact of the otter on the trout population grown in commercial ponds was very high because availability of the other fish species, not important for the fish farming was very limited.

INTRODUCTION

In the last ten years, a numerical increase and territorial expansion of the otter (*Lutra lutra*) in Poland has been observed (ROMANOWSKI, 1984; BOBEK et al., 1997). The analysis of the occurrence of this species based on a map of hunting districts and natural parks in Poland (n=4902), showed that the otter is present now in 1684 districts and does not occur in 2575 districts (PŁODZIEŃ, unpubl. res.) The otter is most numerous in northern and south-eastern Poland, whereas it is rarely found in the central and south-western part of the country (ROMANOWSKI, 1993; BRZEZIŃSKI et al., 1996). Studies on the otter diet show that its basic food is fish (73%) with other animals, e.g. amphibians, mammals, birds and reptiles being of less importance (HARNA, 1993).

The increase in the otter population, along with an increase in the numbers of commercial fish pond operations, and the damage inflicted by otters at ponds has caused bitter conflict between the otter and man. The intensity of the damage is variable and depends on many factors. The objective of this paper is to present data on the diet of otters in two different types of commercial operations, i. e. carp and trout production ponds respectively.

STUDY AREA

The diet of otters was studied at three commercial carp ponds and seven trout ponds located in south-eastern Poland. Carp ponds are large facilities with areas of between 55 and 128 hectares. The production of carp from such operations ranged from 35,000 to 90,000 kg per year. The main species is the European carp (*Cyprinus carpio*). Other species include grass (Chinese) carp (*Ctenopharyngodon idella)*, pike (*Esox lucius)*, perch (*Perca fluviatilis)*, crucian carp (*Carassius carassius)*, tench (*Tinca tinca)*, able (*Leucaspius delineatus)*, gudgeon (*Gobio gobio)*, bleak (*Alburnus alburnus)* and stone moroco (*Pseudorasbora parva)*, were of no economic importance to fish production, being no more than 10-15 % total pond production. The trout ponds are monoculture fish breeding operations with nothing other than trout. The area of the trout ponds varied from 0.35 to 0.85 hectares. The production of trout from operations ranged from around 400 to 6,600 kg per year.

FOOD HABITS AND DIET

In the two types of operations of carp and trout ponds compared, the food habits of otters were determined by faecal (spraint) analysis (WIŚNIOWSKA, 1996; WIŚNIOWSKA and MORDARSKA-DUDA, 1998). By comparing the frequencies of occurrence of various food components eaten by otter, fish were found in most of the spraints from both carp and trout ponds (94.3% and 86.1% respectively). In carp ponds, carp was identified in only 21.1% of samples obtained, whereas trout remnants were found in as many as 67% of the samples obtained from trout ponds. The second significant component of the diet was amphibians, whose remains were found in 11.4% of samples from carp ponds and in 22.7% of those obtained from trout ponds (Fig. 1).

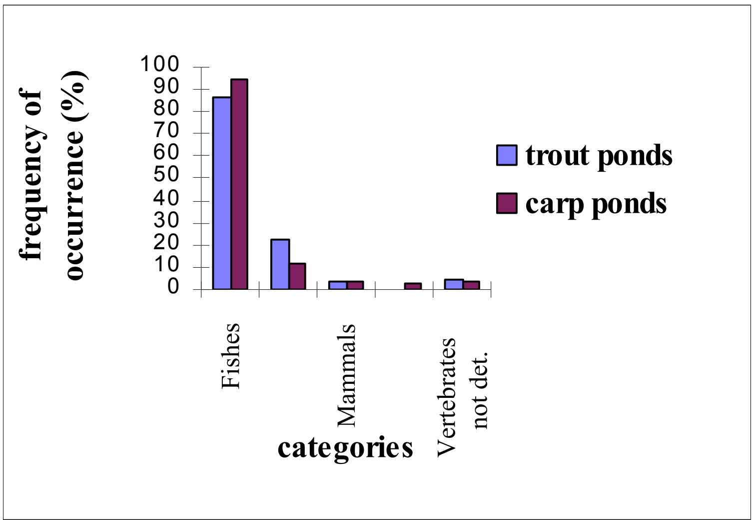

Figure 1. The frequencies of occurrence of various food categories in otter diet from trout and carp ponds.

The evaluation of diet using biomass estimates indicate that fish constituted more than half of the biomass taken by otters in both carp (55.8%) and trout operations (91.5%). The share of carp biomass in the total diet in otters preying in carp ponds, however, was small (10.8%), whereas in trout operations the trout biomass amounted for as much as (81.7%) (Fig. 2 and Fig. 3). Only 4.6% of trout in the otter diet are animals from free living trout population, the rest (77.1%) were caught by otters in the commercial ponds (WIŚNIOWSKA and MORDARSKA-DUDA, 1998).

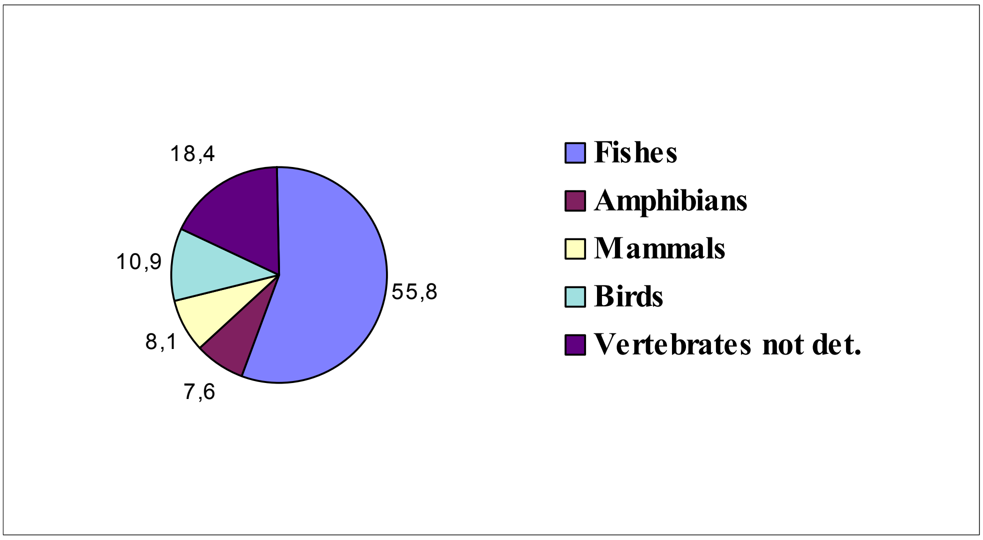

Figure 2. The percentage of biomass of the important prey categories in the otter from carp ponds.

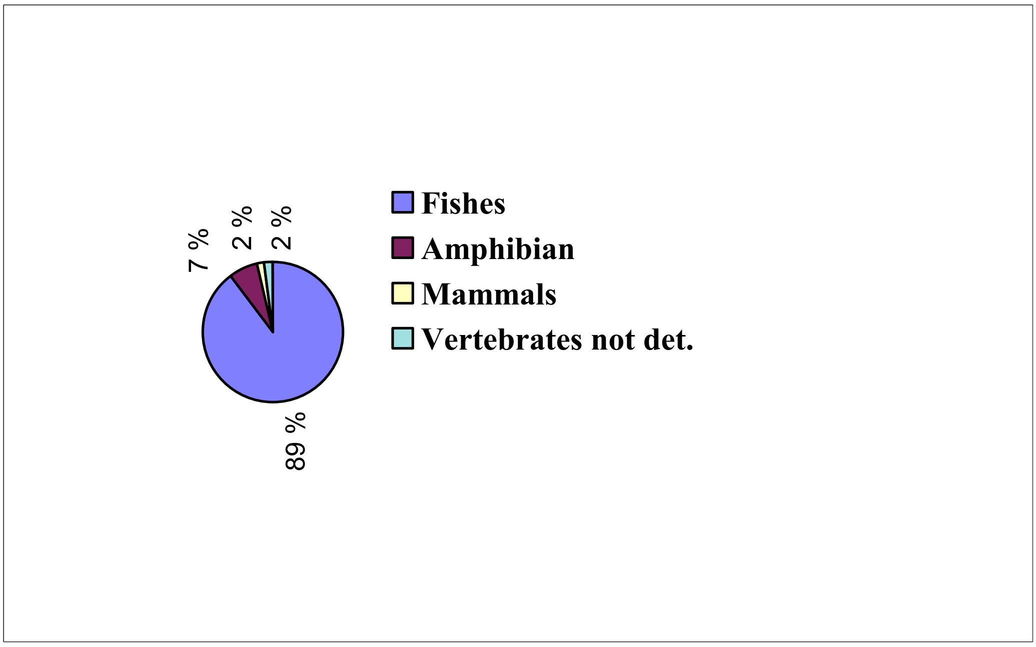

Figure 3. The percentage of biomass of the important prey categories in the otter from trout ponds.

CONCLUSIONS

The pressure from predation by otters on commercial fish pond operations could be mitigated by introducing accessory species of fish. This strategy is feasible in carp ponds, but because of limited size is uneconomical in trout ponds. Hence, preventive measures in trout ponds would be to fence the ponds to cut access by otters and secure inlet and outlet water pipes. To catch and remove otters from the ground of pond operation however, will bring only temporary relief from otters because the vacated range will soon be occupied by another individual. Damage caused by otters has not been compensated in Poland so far, but the pressure is mounting on local authorities to establish compensations. In central Europe where the damage occurs frequently and compensation is sometimes paid to fish pond owners who may shoot or trap otters illegally (GUTLEB et al., 1998; KRANZ and TOMAN, 1998; KRANZ, 1998). During a session of the Euro-American Mammal Congress (Santiago de Compostella, Spain 1998) several participants reviewing the problem of damage caused by otters, asked the audience 'Was it better to tolerate the present situation of simultaneous compensation and illegal killing than allow legal reduction and control of the viable otter population in some regions?' They received the answer - 'No'. The introduction of pecuniary compensations for operators will become urgent. There is even the possibility that with further increase in numbers, the status of this species will have to be revised.

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RECOMMENDATIONS AND RESULTS VII. INTERNATIONAL OTTER COLLOQUIUM (IOC) TREBON/CZECH REPUBLIC, MARCH 14 - 20, 1998

The IUCN/SSC Otter Specialist Group (OSG) and the participants of VII. IOC agreed on the following results of VII. IOC and recommendations for further work in otter conservation.

♦ **World-wide** they:

I 1. reiterate that the protection and support of remaining otter populations needs top priority in otter conservation world-wide;

I 2. recommend that the Ramsar Convention Bureau be asked to include the presence of an otter population as one of the criteria for designating Ramsar sites;

I 3. recommend it be made mandatory to conduct pre- and post ecological studies for any project planned that is likely to impact otter populations or wetland areas in that region;

I 4. accept that otter predation at fish-farms can cause serious economic damage.
The conditions suitable for intensive fish production are also otter habitat and the artificially high densities of fish placed in such natural surroundings increase their attraction or value to otters;
research into technical methods to assess and prevent fish farm depredation must be initiated in order to minimise conflicts and has priority over solutions like killing or translocating otters;

I 5. strongly encourage further research on various aspects of otter biology to improve current knowledge;

I 6. recommend that permits for keeping otters in captivity only be given to those persons and institutions that will provide these animals with at least the minimal requirements as described in existing or OSG husbandry guidelines for each species. Continued exhibition of otters by these individuals/institutions should be subject to periodic review;

I 7. emphasize that before an otter harvest (including trapping for translocation) can be allowed population demographic data must be provided that demonstrate this action will not pose a threat to that population;

I 8. recommend the initiation of an IUCN/SSC OSG tissue bank. It is further recommended that location options for the establishment of such a tissue bank be assessed and proposed, and that necessary standard information, and appropriate procedures and methods for the collection of these tissue samples be compiled;

I 9. suggest the necessary information be compiled for the exchange of tissue samples for scientific and conservation purposes according to CITES.

♦ For **Europe** they:

II 1. reiterate that due to the obvious recovery tendencies of *Lutra lutra* in Europe all available financial and personnel resources should be used to support this development, particularly through habitat management. The efforts to develop an Otter Habitat Network Europe (OHNE) should be supported by all governments, national and international agencies and otter specialists;

II 2. are deeply concerned about the increasing number of otter reintroduction projects in Europe that do not follow IUCN reintroduction guidelines.
The group has therefore established a Reintroduction Advisory Committee (RAC) for Europe that develops criteria for otter reintroduction projects. Elected members of this committee are:
Claus Reuther, Germany (Chairman and co-ordinator Europe of OSG)
Addy de Jongh, The Netherlands (Director Otterpark Aqualutra)
Alfred Melissen, The Netherlands (Studbook keeper *Lutra lutra*)
Hans Kruuk, Scotland (former chief scientist Institute for Terrestrial Ecology)
Arno Gutleb, Austria (Pollution expert of OSG)
Jordi Ruiz-Olmo, Spain (Chief scientist of the otter translocation project Spain)

It is strongly recommended that for every project proposal the OSG is contacted via the country's national OSG representative and the members of the RAC will evaluate the proposal. It is stressed once again that a scientific approach, raising of public awareness and a proper monitoring, evaluation, and documentation of the project are essential;

II 3. are concerned by the use of Rotenone in Norwegian river systems as a method to eradicate the Atlantic salmon (*Salmo salar*) parasite (*Gyrodactylus salaris*). Norway signed the Berne Convention in 1986 and under this they are obliged to protect the habitat of specific species including the otter. As the short-, and longterm effects of Rotenone are not fully understood further studies on the effects of this treatment on the otter, waterfowl and birds of prey (sea eagle etc.) are urged to be carried out. It is suggested that recent techniques in molecular biology be used for these studies;

♦ For **North-America** they:

III 1. encourage enforcement of current wetland regulations and promote the development of new regulations that further ensure protection of the utilizable otter and wildlife habitats in the West. Protection of riparian habitats through grazing restrictions should be encouraged. Also, land managers in western states should be encouraged to develop strategies to retain adequate water supplies necessary to maintain wildlife populations dependent on riverine and associated habitats;

III 2. recommend that North Americans should be commended for extensive efforts to restore extirpated otter populations through implementation of reintroduction projects. However, future and ongoing reintroduction projects should follow IUCN guidelines, particularily regarding:
a. using sources of otters from the nearest viable populations that evolved under similar environmental conditions,
b. implement strategies which maintain genetic variability in reintroduced populations,
c. clearly define long-term management goals for reintroduced populations;

III 3. recommend that research on the status and genetic viability of the Sonoran river otter subspecies (*Lontra canadensis sonora*) should be given top priority.

♦ For **Latin America** they:

IV 1. encourage the funding and supervision of research on otters with priority placed on the determination of distribution, habitat requirements, poaching, limiting factors or conservation threats, human impact, and ecology (feeding, behaviour and population ecology).

♦ For **Africa** they recommend that:

V 1. validity of *Aonyx congica* be confirmed genetically;

V 2. valid information be obtained on the distribution, status, degree of legal protection and the prevailing, and possible threats for all species of otters in the African countries;

V 3. areas where otters possibly can occur in Africa (but presently are not documented) be identified and surveys initiated;

V 4. countries in Africa, where conflict exists between man and otters for freshwater fish resources be identified, and the extent of conflict quantified as far as possible;

V 5. the extent and degree of hunting for skins (for trade) of otters in Africa be identified.

♦ For **Asia** they recommend:

VI 1. to promote the incorporation of known otter needs into EIAs;

VI 2. to urge governments considering the use of organochlorines (including in the fight against malaria), to take into account the interests of otters and that environmentally sound methods of pest management be considered, developed, and used;

VI 3. to promote better cooperation with NGOs and GOs active in wetland conservation and sound artificial wetland use (e.g. ricefields, general and pond fisheries);

VI 4. due to the many otter taxa proposed for the region, the geographical setting of the Asian and particularly the Oriental faunistic region to assess the genetic variability of Asian otters to enable correct conservation measures;

VI 5. to conduct reliable field assessments including spraint collection for further taxonomic analysis of the *Lutra lutra*/*Lutra sumatrana* question;

VI 6. to re-assess the viability of *Lutra nippon* on a comparative regional basis using larger sample sizes from otter species of the Asia Far Eastern region;

VI 7. to initiate more research on human/otter interaction (otters' role in ricefields; otters' predation on pest crabs; otters' predation on introduced bullfrogs in South Korea; general fisheries issues; otters' predation on target species in fish- and prawn-ponds; otters' predation on pest species in fish- and prawn ponds);

VI 8. conduct baseline surveys in regions largely uncovered by representatives so far (Syria; Lebanon; Jordan; Iraq; Kuwait; Arabian Peninsula; Afghanistan; Asian CIS: Kazakhstan, Turkmenistan, Tajikistan, Uzbekistan, Kirgistan; Pakistan; Bangla Desh; Bhutan; Nepal; mainland and insular China; Taiwan; DPR Korea; Mongolia; Vietnam; Laos; Cambodia; Brunei Darussalam; Malaysia: Sarawak and Sabah; Indonesia: Sumatra and Borneo; Philipines: Palawan);

VI 9. follow-up survey activities in the following countries: Turkey; Israel including the Palestine Areas; Iran; Russian Federation; South Korea; Japan; India; Sri Lanka; Thailand; Malaysia; Singapore; Indonesia: Java;

VI 10. assess habitat requirements of Asian otters and trends in wetland habitat availability by using, e.g. GIS methods;

VI 11. gain a better understanding of otters in the socio-cultural context in Asia (religious and philosophical context; legends and tales; art; consumptive and non-consumptive use of otters; use for medicinal purposes);

VI 12. publication and awareness material/events/media activities on Asian otters are developed.

♦ As **group internal results** the members of OSG:

VII 1.accepted the wish of Padma de Silva to retire from the position of chair of the OSG. They thank her for the work she did in this position since 1994. The group accepted her suggestion to continue her work within the OSG as a co-ordinator for Asia and as a deputy chairperson of the OSG. The group also thanks Syad Hussain for his former work as co-ordinator for Asia and is happy that he agreed to continue his work within the group as a data base co-ordinator for Asia. The members of the OSG unanimously elected Claus Reuther as the new chairman of OSG and asked IUCN/SSC to appoint him to this position. The OSG co-ordinators are asked to develop procedures and guidelines for future decisions and/or elections of an internal nature;

VII 2.wish to thank Arno Gutleb for his excellent work as the editor of the OSG Bulletin. They are happy that he offered to continue this work. All members of the OSG are asked to contribute to the bulletin and to use it as a platform of information transfer and for the discussion of specific questions related to otter conservation and research. To reduce the high personal economic risk of Arno Gutleb all members of OSG are reminded to subscribe to the bulletin. The members of OSG request that the Asian subgroup include its "Asian otters newsletter" into the OSG Bulletin.

VII 3.thank Philip Bacon and Peter Eulberg for offering to establish a homepage in the world wide web for the OSG. Philip Bacon will clarify if the server of ITE/GB can be used for this and he is prepared to maintain the website. Peter Eulberg offered to compile and to layout the website. All members of the OSG are asked to contribute to the website and to ensure that it acts as a platform for an up-to-date information transfer;

VII 4.are asked to focus interest on the situation of otters in the Middle-East. Everybody who has contacts to people or institutions in this region which can contribute to otter conservation are asked to give this information to the chairman of OSG. As long as no experienced person is available who can act as a co-ordinator for the Middle-East this region will be looked after by the chairman of OSG supported by the co-ordinators for Asia and Africa;

VII 5.feel that it is necessary to define basic positions for otter protection and research. They request the chairman of OSG arrange discussions within the group and consult with external experts to:

a. define the aims and priorities of the group regarding of otter conservation,

b. formulate fundamental positions on topics like re-introduction activities, solutions for the conflicts with fish production, guidelines for habitat management etc.

c. standardize or give guidelines for methods of research (such as survey methods in Europe, interpretation of scat analyses, post-mortem examination procedures, analysis of pollutants etc.);

VII 6.resolved that the European subgroup should have a meeting in 1999. The co-ordinator is asked to decide if this meeting will be held in connection with the 3rd European Congress of Mammalogy in Finland or if the group will follow the invitation of Marjana Hönigsfeld to meet in Slovenia. Main topics of this meeting will be:
- the revision of the Otter Action Plan for Europe,
- a workshop on the standardisation of the "standard" survey method,
- a workshop for the definition of otter specific guidelines for re-introduction activities (within the framework of the IUCN regulations for re-introductions)
- a workshop on the progress of the European otter habitat network;

VII 7.decided to accept the invitation of Gonzalo Medina to held the VIII. International Otter Colloquium in the year 2001 in Chile;

VII 8.decided to revise the Otter Action Plan. They started this work by revising the draft for the contents and structure of the action plan formulated by Claus Reuther. The following board of editors was appointed:
Claus Reuther (editor in chief)
Michaela Bodner
Gonzalo Medina
Christof Schenck
Padma de Silva
Syad Hussain
Paul Polechla
Jan Nel
Jim Estes
Alexander Burdin
It is planned to publish the revised Otter Action Plan in the year 2000;

VII 9.decided to establish an e-mail link-up as a method of improving communication between all individuals and facilities working with, or interested in, otters in captive situations. This includes zoos, otter centres, rehabilitation facilities, field researchers, veterinarians, university students, laboratory scientists and dieticians. A central library and e-mail site was selected. This will be jrsotter@iserv.net, maintained by Janice Reed-Smith. All individuals interested in sharing and receiving information on keeping otters in captivity are requested to send their e-mail addresses, species of interest, and area of expertise to the above address;

VII 10. welcome the announcement of Marc and Christiane Linet from Belgium to set up the "Linet otter prize" which will honour conservation activities of young people for the protection of any otter species and which will be awarded each second year with a sum of 2,000 USD.