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Scientific Editors

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Coimbra • Imprensa da Universidade

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## CONSERVATION BIOLOGY OF OTTER (*Lutra lutra* L.) IN THE RIVER MONDEGO BASIN

### Abstract

The European otter *Lutra lutra* L. populations has a high protection status in Europe. Although little is known on the distribution and densities of this species in Portugal, are considered one of the most stable and widespread of Europe. Nevertheless, the constant loss of habitat and human activities requires an urgent evaluation on its present situation. Here we summarise what is know on the distribution of otters in the Mondego river basin, characterise the actual status populations, identify the main threats. The otter was generally well distributed in the basin. However, the species has decreased in some areas. We found a strong relation between the presence of otters, and the quality of riparian gallery in Lower Mondego River Valley.

### Introduction

In general, otter populations (*Lutra lutra* L.) in Europe have been declining (Marín and Nieves 1999), but some exceptions to this general trend have also been referred to some zones in France (Bretagne), Spain (Galiza and Asturias) and Portugal (IUCN 1990). This situation has led to the species protection by several International Conventions and, lately, by European Directives (e.g. Habitats Directive - 92/43/CEE). In fact, since 1981 this specie is strictly protected by the Bern Convention being included in its II Annex. The European Union Habitat's Directive too has regarded the species as needing a high protection status and included it in its II Annex. Portugal has signed the Bern Convention and passed it into the National Law, as later did with the Habitat's Directive. Therefore the specie has a high protection status in both Europe and Portugal.

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In spite of its protection status, the otter is under several stresses. Poaching, fishing, water pollution and loss of habitat are the main threats to the species (IUCN 1990) (Mason and MacDonald 1986). Meanwhile, in Portugal the species distribution and abundance is considered as insufficiently known, according to the Portuguese Red Data Book of Vertebrate (SNPRCN 1990). This motivates the need to undertake studies to provide knowledge about the portuguese populations conservation status.

In 1980, S. Macdonald and C. Mason surveyed central Portugal and found a good distribution of the species in the River Mondego Basin (Macdonald and Mason 1982). Other studies provided information to support that conclusion (e.g. Simões Graça and Ferrand de Almeida 1983, Ferrand de Almeida 1987, Silveira and Reis 1991, Trindade et al. 1998). This, as well as the existence of protected areas (Natural Park of Estrela's Mountains, Natural Conservation Site of Carregal do Sal, Natural Reserve of the Marsh of Arzila) and a diversity of habitats capable of being used by the otter, enhances the natural value of the basin.

On the other hand, the basin suffers from major human pressure resulting from the strategic localisation of the basin and the uses of water. Major conflicts with nature conservation in the river and wetland habitats are the consequence of electricity production, industry, agriculture development and urban expansion. Other conflicting activities are the building of small dams, river regularisation, marginal deforestation and inert extraction. These activities are periodically undertaken, with particular expression in the last 10 years. All this generates major stresses to aquatic life, including the otter.

This paper aims to integrate scattered ecological information on the species in the Mondego basin and provide broad guidelines to its conservation.

## Materials and methods

### Study area

The River Mondego Basin covers an area of 6.644 Km<sup>2</sup> (DGRAH 1981), has a rectangular form with an orientation NE-SW. The Mondego river is the largest totally portuguese river, with 234 Km in length.

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Several important natural areas are classified by Ramsar Convention, Habitats Directive (92/43/CEE), Birds Directive (79/409/CEE) and some belong to the National System of Protected Areas.

The Lower Mondego River Valley consists of about 250 Km<sup>2</sup> of lowland alluvial soils. It has an intensive agricultural use, producing mainly corn and rice. In the last 20 years, the valley has been through severe modification processes aiming to the flood prevention and water supply to industry, agriculture and human use. The river course was altered, the drainage system was modified and the field structure was redesigned. Some wetlands were drained and the riparian galleries were reduced in extension.

## Distribution of otters in the River Mondego basin

In 1999 a survey was carried out between January and December in order to determine the distribution of otter in the Mondego river basin. The Basin was divided in 10 × 10 Km squares and all major streams in each square were visited in search of otter marks i.e. foot prints and faeces (Martins et al. in press). The site selection was not random as preference was given to easy access places. Visits were made to all major water reservoirs of the basin. The IUCN method was followed (IUCN 1990) for searching otter spraints. The collected data was integrated using Geographic Information System (GIS) software, namely for the spatial distribution graphics.

## The quality of the riparian gallery in lower Mondego River section

We assessed the quality of the riparian gallery using data from the Basin Management Plan (MAOT 2000). This classifies stretches of a river according to its bankside coverage, evaluated by aerial photo analysis. The riparian gallery was classified in four categories according with their development (see Table 1). This classification was crossed with the grid used for the distribution survey in Lower River Mondego Valley and corresponding classes were attributed to each square. The entire Lower Mondego Valley was prospected for marks of otter presence (Reis and Tenreiro 1995). The area was divided into 254 squares of 1 × 1 Km. All squares presented potential for otter use including rivers, streams, drainage ditches and different wetlands. Each square was visited at least once, from October 1994 to July 1995. The IUCN method was followed (IUCN 1990). The collected data was integrated using Geographic Information System (GIS) software, namely for the spatial distribution graphics.

Table 1. Classification of the quality of the riparian galleries.

Class	Description
High	Shrubby and arboreal stages well developed on both margins
Median	Shrubby or arboreal stages on both margins
Low	Shrubby and / or arboreal stages well developed on one margin
Incipient	Margins with no shrubby or arboreal stages or shrubby stage in one margin

## The diet of otter in the lower Mondego River

The diet of the otter in the Marsh of Arzila was studied by spraint analysis (Silveira and Reis 1991) collected monthly from January to December 1989 following a transept (Silveira and Reis 1991). Simões Graça and Ferrand de Almeida (1983) studied Marsh of Marujal and Casal Novo do Rio (a sector of the old main course of River Mondego). In that study, spraints were collected from November 1980 to June 1981.

The preys identified in spraint analysis were grouped in five categories: fish, amphibia, insects, birds and others. In the latter were included items less preyed such,

as reptiles (*Natrix* sp.), crustaceans and mammals. The data was analysed by comparing relative frequencies of occurrence. Seasonal approach was considered, and chi-square method was used to determine significant differences in otter's diet between seasonal prey consumption.

## Results

### The distribution of the otter in river Mondego basin

In this survey we visited 144 locations, including large and small rivers and reservoirs. At 85 locations (59%) (Fig. 1) we found evidences of the presence of otters. Those locations will be referred as "positive sites". Positive sites covered most of the basin, including artificial hydroelectric power reservoirs, in opposition to Macdonald, S.M. and C.F. Mason (1982). Locations where no evidences for otter were found will be referred as "negative sites". Most of the 59 negative sites (41%) were found in the N-NE region and SW region of the basin (Fig. 2).

In the upper basin sector, Rivers Múceres and Dão had the lowest frequencies (<35%), whereas the highest frequencies were registered in Rivers Pranto and Ceira and in the medium and lower Mondego River, with 100% of positive sites, which is indicative of the importance of the main river for otter population.

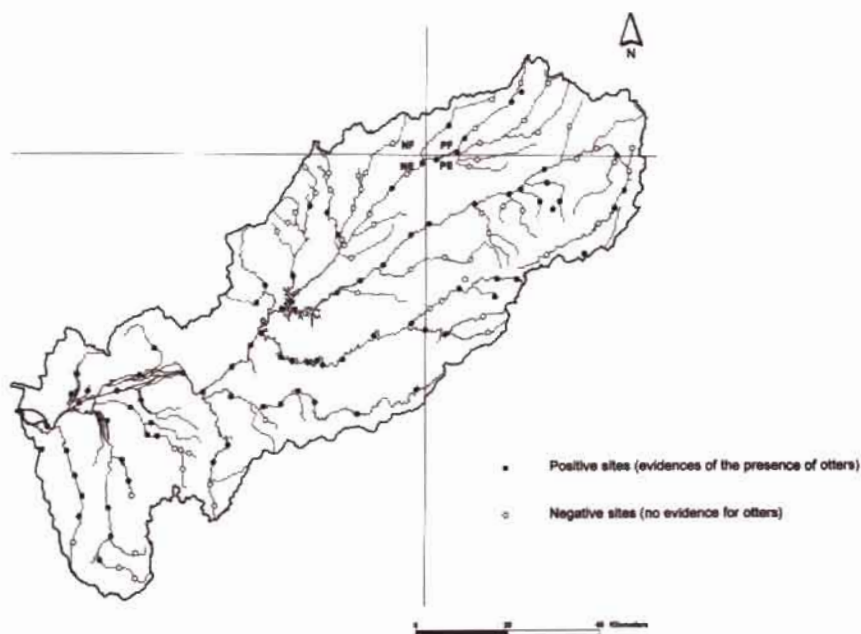


Figure 1. Study area: River Mondego Basin. Distribution of otter in River Mondego Basin based on data from Martins, et. al. (2000).



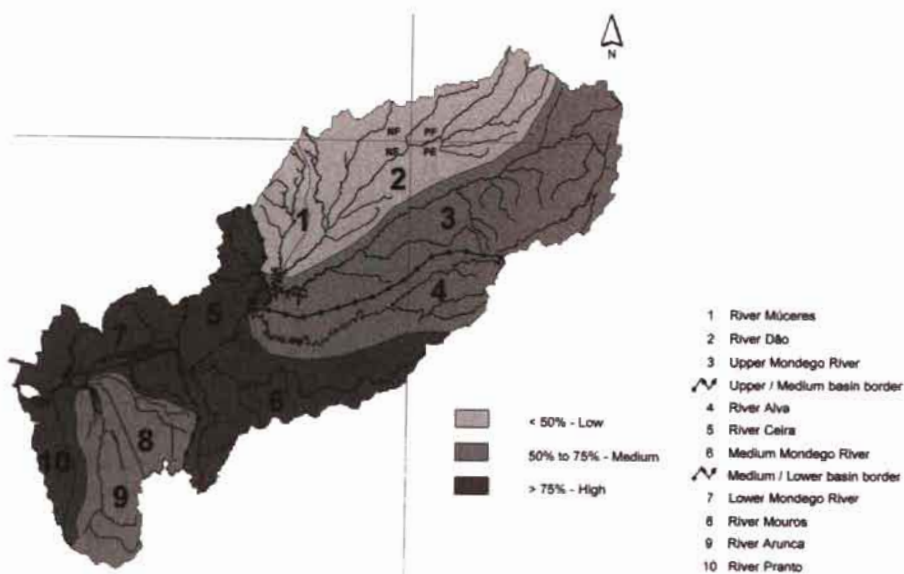


Figure 2. River Mondego Basin: small basins within each Sector. Frequency of positive stations determined for each small basin according to Martins, et al. (in press).

Otters were not randomly distributed among the Upper, Medium and Low basin Sectors as judged by chi-square analysis ( $\chi^2=15.9$ ; d.f.=2;  $p<0.05$ ), although there was no significant difference between the Medium and Low Stream Sectors ( $\chi^2=0.3$ ; d.f.=1;  $p>0.05$ ). Small basins within each sector were also compared and showed no significant difference for Upper Sector ( $\chi^2=4.3$ ; d.f.=2;  $p>0.05$ ), Medium Sector ( $\chi^2=1.9$ ; d.f.=2;  $p>0.05$ ) and Lower Sector ( $\chi^2=1.9$ ; d.f.=3;  $p > 0.05$ ).

#### The quality of the riparian gallery in the Lower Mondego Section

We found 103 positive sites in the lower Mondego river section. In this area, the otter uses intensely the secondary basins of the valley (Fig. 3). These basins present 57% of positive sites (in 119) versus 26% of positive sites in the central valley (in 135 sites surveyed). This difference was significant, as judges by the chi-square test ( $\chi^2=25.567$ ; d.f.=1;  $p<0.001$ ).

Crossing positive squares against the quality of riparian galleries suggest a more frequent use of the squares with higher riparian gallery quality (Fig. 3). The otter occurred more frequently when both margins present good coverage (57% for High and 51% for Median) and scarcely when they present incipient coverage (7%) (Fig. 4). These differences were significant ( $\chi^2=35.608$ ; d.f.=3;  $p<0.001$ ).

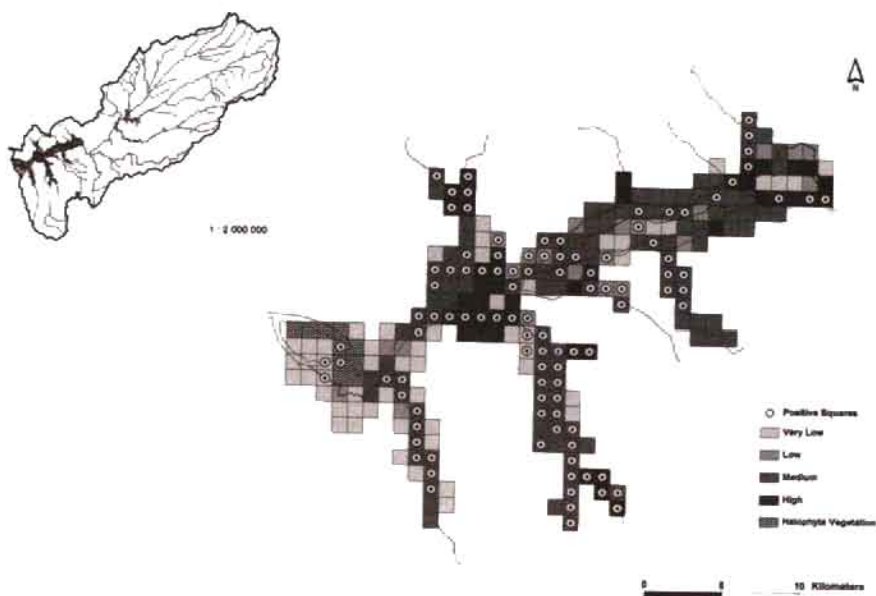


Figure 3. Lower Mondego River sector: otter distribution and quality of riparian gallery.

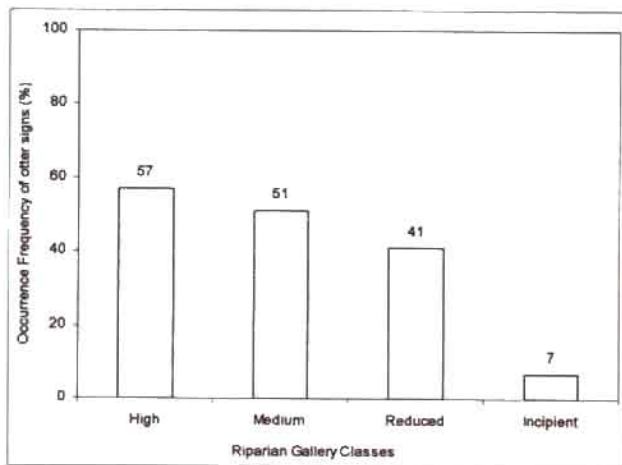


Fig. 4. Occurrence Frequency of otter in four classes of riparian gallery quality (data: MAOT 2000).

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#### The diet of the otter in the lower Mondego River

In all the locations studied the main prey category consumed was fish (Fig. 5). amphibia (mainly *Rana*) and insects (only *Hydrous*) were important prey with similar weight in both marshes. In Casal Novo do Rio amphibia were noticeably more important than insects. Birds (Ralliforms and one Anseriform in Arzila's marsh) were consumed only in the marshes.

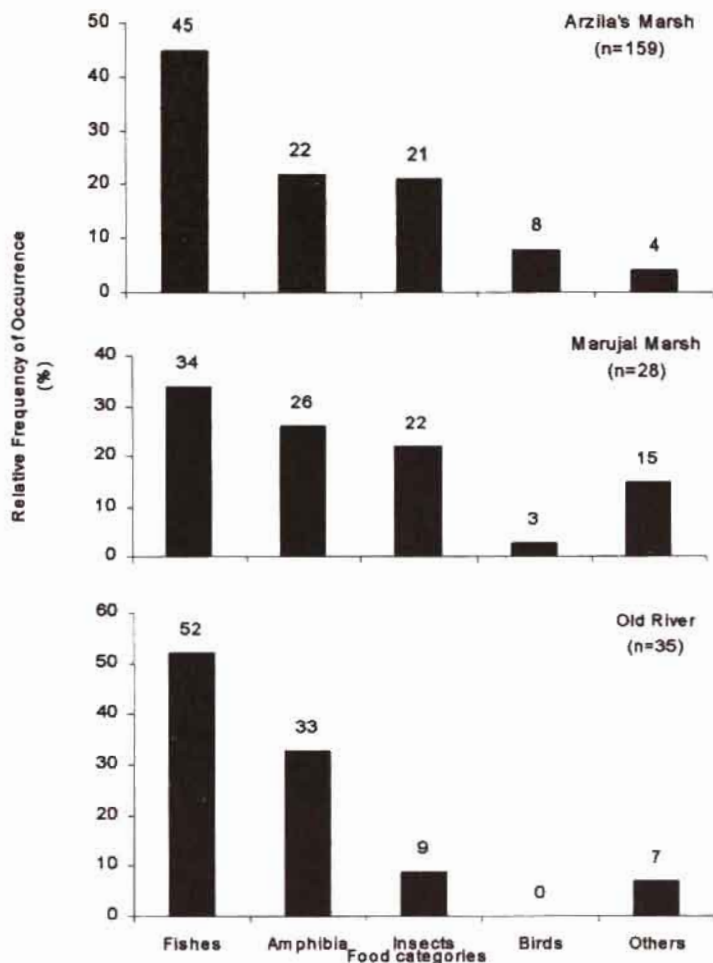


Fig. 5. Diet of otters in Lower Mondego River (Arzila data from, Silveira and Reis 1991, Marujal and Old River from, Simões Graça and Ferrand Almeida 1982)

A seasonal analysis for the Marsh of Arzila (Fig. 6), showed that the frequency of fish in spraints decreased in Autumn. Amphibia and insects do not show significant variation, being consumed throughout the year ( $\chi^2=2.261$ , d.f.=3,  $p>0.05$ ). Birds were specially consumed in Autumn, being absent from spraints in Spring and Summer.

Ten species of fish were identified in the otter spraints (see Fig. 7). *Gasterosteus aculeatus* and *Anguilla anguilla* were the most frequent taxa (respectively 25% and 23%). Other species had annual relative frequencies <15% each.

Although preyed fish were usually of small size, occasionally remains of large individuals of *Cyprinus carpio* were observed.

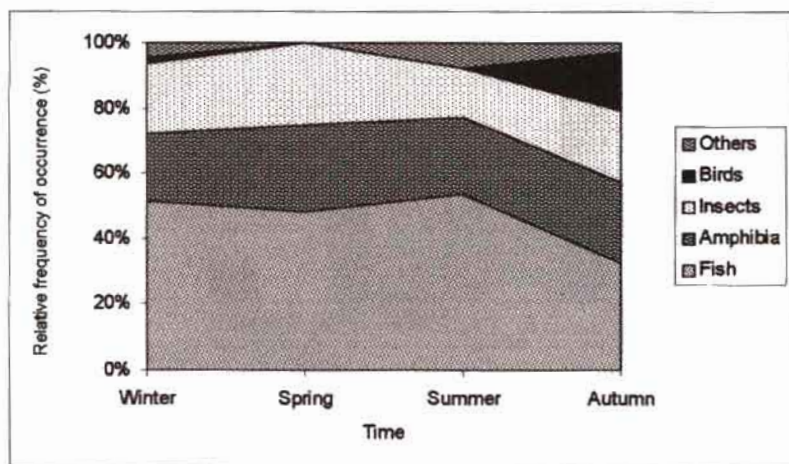


Fig. 6. Seasonality of otter diet in Natural Reserve of Arzila (data: Silveira and Reis 1991)

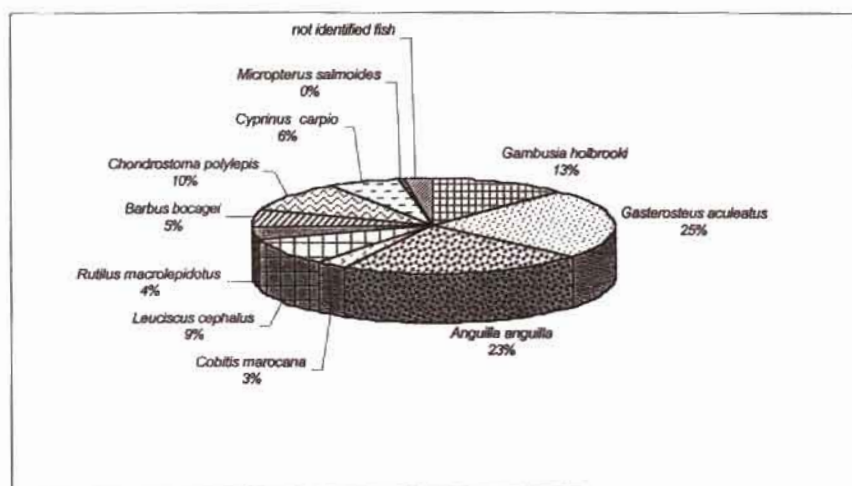


Fig. 7. Relative frequency of fish species in otter diet (data: Silveira and Reis 1991).

## Discussion

According with our research, the River Mondego basin supports a widespread population of otters. However, the otter population in this basin is starting to show problems in some of the small basins. There are clear signs of regression especially in the upper parts of the rivers and in River Dão basin where previous positive observations turned negative in the last survey (Fig. 8).

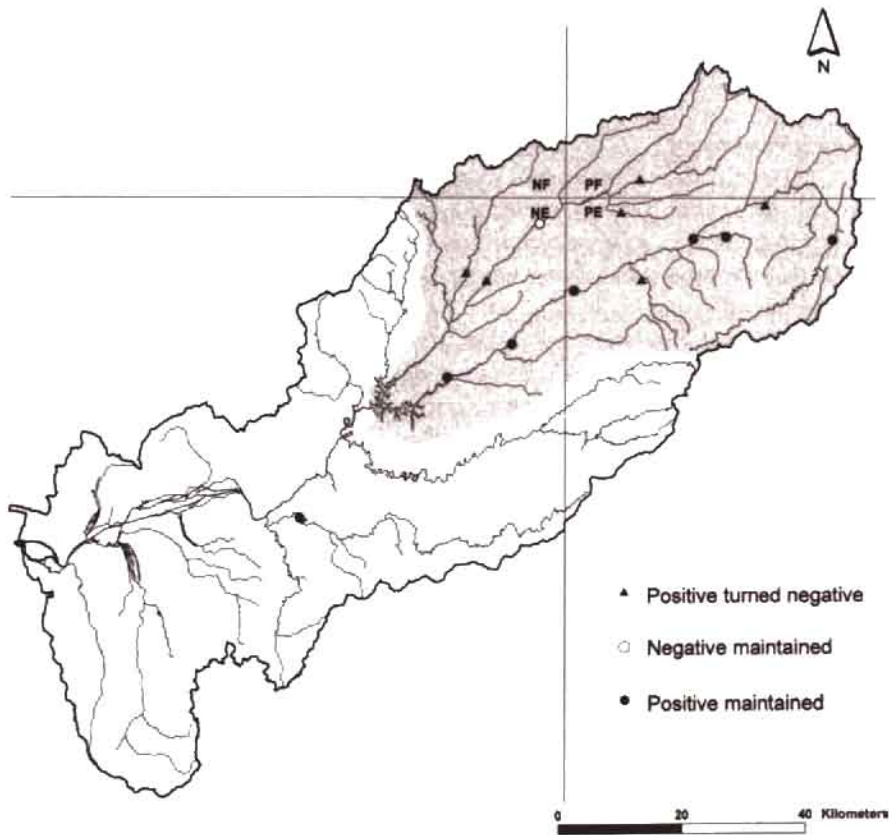


Fig. 8. Comparison and evolution of otter in River Dão and Upper Mondego river based on data from Martins, et al. (in press), Macdonald and Mason (1982).

This regression could be due to several causes, namely the degradation of water quality and destruction of marginal vegetation caused by human activities.

In the upper Mondego river, 2 of the 8 previously positive sites referred in the 1980 survey (Macdonald and Mason 1982) turned out negative in 1999. This could be caused by localised stress factors, nevertheless it shows the need to watch short-term evolution in this particular area.

At the present times, Medium and Lower basin sectors are the most important of the Basin, especially the smaller basins of River Ceira and River Pranto. These areas should have a special protection status to assure the stability of the population and to operate as a birth area from where individuals can recolonise abandoned or regressive areas in the Mondego Basin.

According to Macdonald, S.M. and Mason, C.F. (1982) hydroelectric power reservoirs, were not used by otters. However we did recorded the presence of this species in some reservoirs. It is plausible that the species managed to exploit the

artificial lakes, probably due to the high availability of food. Interesting was the existence of latrines in some sites at reservoirs, which is an uncommon behaviour for the species, in this kind of habitat. No latrines were found in other habitats.

The surveys carried out by Trindade, et al. in 1998 and Martins, et al. "In press" analysed, respectively, 12 and 14 sites in the Lower Mondego basin area, both showing 100 % of positive sites. These studies suggest a more extensive use of the valley by the otter population than a survey carried out by Reis and Tenreiro (1995). In fact, in such survey a total of 151 squares prospected (59%) showed no sign of otter. This may suggest that the large-scale surveys tend to show a, not real, more favourable status of the populations.

The different intensity of sprainting activity in the lower Mondego river basin is elucidative of the importance of the secondary basins towards the conservation of otter. It suggests a higher use of the secondary basins, probably a consequence of a more intensive human use of the central valley.

Several studies pointed out a strong influence of the quality of the riparian gallery on the otter distribution and use of habitat (Prenda and Granado-Lorencio 1996). We also found a strong relation between the quality of the riparian gallery and the otter occurrence. In fact, only four squares classified as Incipient riparian gallery were found positive.

As stream and ditch maintenance practices in central Portugal usually involve the clearance of the margins, changes or adjustments to these practices may be regarded as a strong conservation issue. Despite that the more recent maintenance strategies tend to preserve one of the margins, the practices still carry a potential severe impact on the otter conservation. This situation is equivalent to the low class of the riparian gallery quality scale, which presented an occurrence frequency of 41%.

Good ditch maintenance practice should imply the preservation of the riparian galleries and favour its development. When that is not possible, different, less damaging strategies should be developed.

Other factors such as prey availability, water quality and human disturbance, have been less investigated. In the Lower Mondego River, prey availability doesn't seem to be a limiting factor: the Basin Management Plan (MAOT 2000) indicates the existence of an abundant ichthyofauna.

In terms of diet, and at the time of the studies, fish were significantly the most important prey category in the three locations. Nevertheless there are differences between the two habitats studied: the river (Casal Novo do Rio as reported by Simões Graça and Ferrand de Almeida 1983) and the marshes (Arzila and Marujal as reported by Silveira and Reis 1991, Graça and Ferrand de Almeida 1983). In both marshes amphibia and insects were consumed similarly (in Arzila's marsh this was verified throughout the year). On the other hand, in Casal Novo do Rio insects were considerable more important a amphibia probably as a result of a difference in prey availability. Birds were only recovered from spraints from the marshes, suggesting a higher availability and easier capture in these areas. On a seasonal approach, in Arzila's marsh, the decrease of fish consume in Autumn may be the result of a higher consumption of water birds, which were not consumed in Spring or Summer. These

were invernant species (Anseriforms and Ralliforms) that arrive on the marshes in Autumn, thus suggesting a higher availability on this season. This point out the opportunistic feeding behaviour of otter, and suggests capability to adapt to new prey community structures.

Since these diet studies were made, several modifications occurred on the habitats. Marujal's marsh was drained in the mid eighties. In the early nineties, Louisiana Crayfish (*Procambarus clarkii*) made its appearance in the Valley and on Arzila's marsh. Since then, amphibia populations are considered to be decreasing, by naturalists and the Nature Reserve staff. Another new exotic species, the fish *Lepomis gibbosus*, was also reported in Arzila's marsh (Batista 1997).

These factors must have strong influence on otter population and behaviour. The drainage of Marujal's marsh constitutes a serious loss of important otter habitat. The presence of crayfish may supply an increase of prey to otter, as the species quickly responds to crayfish availability (Delibes and Adrián 1987), spraints being commonly found with its remains.

Nevertheless this may prove negative to otters on the long-term as farmers increased pesticide use in an attempt to control crayfish (Jørgensen et al. 1997, Anastácio et al. 1995). Beside direct negative influences on otter and its prey (namely fish and amphibia), pesticides do accumulate on the surviving crayfish that may be preyed upon by otter.

The kind of diffuse stress factors and threats acting today demand, in short-term, a plan of periodic surveys over the otter population and conservative measures regarding the habitats and its quality. An integrated management policy, which attends the needs of the species as well as farming, industries and water supply, is needed.

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