

Sprainting sites and feeding habits of the otter (*Lutra lutra*) in the Douro River estuary, Portugal

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Introduction

Although the ecology of the Eurasian otter (*Lutra lutra*) is best known in freshwater habitats, different aspects of its biology have been also assessed in European coastal environments, including the Iberian Peninsula. Besides the seminal studies by Kruuk and his collaborators in the Shetlands Islands (most of them summarized in Kruuk 1995), feeding habits, patterns of marking activity and habitat use by the species have been studied in different seashore habitats within the Iberian Peninsula (Beja 1991, Clavero *et al.* 2006, Freitas *et al.* 2007), Scotland (Macdonald & Mason 1980, McMahon & McCafferty 2006), Wales (Parry *et al.* 2011), Ireland (Murphy & Fairley 1985), Norway (Heggberget 1993), etc. However, there is a general lack of information about the ecology of the otter at the mouth and the low course of large rivers, which are frequently navigable and have often urban and industrial developments at the banks.

This lack of data could be because otters may be uncommon or absent in large estuaries, but it could be also attributable to the difficulties of finding otter faeces (spraints) in tidal areas of large rivers. Spraints have been extensively used to analyze otter presence, density, feeding patterns or habitat use (Mason & Macdonald 1986), but finding them in some habitats or seasons is difficult. As spraints are usually deposited on conspicuous points, a low availability of “spraintable” sites can severely reduce the detectability of otter signs. So, Romanowski *et al.* (1996) underlined the difficulty to detect otter spraints in banks of rivers over 30 m wide or in

canalized ones. On the other hand, Fusillo *et al.* (2007) suggested that wintering surveys in southern Italy strongly underestimated otter occupancy, because spraints were frequently removed by rains and floods. The estuaries of large rivers are often characterized by wide channels subject to tide fluctuations and intensive traffic of boats, which may remove spraints. In these cases the use of new methodological approaches to locate sprainting places becomes important. In this study, we searched spraints at the Douro estuary (Portugal) from the water, using kayaks, in the first days of September 2013. Here we describe the result and the food habits of the otter there, as information relative to otter ecology in the main channel of large estuaries is scarce.

Study site and methods

The 930 km-long Douro River drains 98,000 square kilometers of the Iberian Peninsula before flowing in the Atlantic Ocean in northern Portugal. It is heavily dammed throughout its course for hydroelectric power generation and irrigation. The Douro forms a salt-wedge mesotidal estuary in its last 21.6 km, between the Crestuma-Lever hydroelectric dam, constructed in 1985, and the sea (Vieira & Bordalo 2000). Usually three stretches are recognized, mainly based on salinity conditions: the upper estuary is about 13 km long and, on the average, 333 m wide and 7 m deep; the middle estuary is 6 km long, 271 m wide and 10 m deep; and the lower estuary, partially separated from the sea by a sand bar, is 3 km long, 645 m wide and

7.8 m deep (Vieira & Bordalo 2000). Water salinity is very dependent on the river seasonal flow; at spring, when flow is usually high, ocean water (with salinity equal to or higher than 30) is restricted to the estuary entrance, but in summer it reaches all the middle estuary and the lower half of the upper estuary (Vieira & Bordalo 2000). All the area is heavily populated and industrialized, with the cities of Porto, on the right margin, and Vila Nova de Gaia, on the left one, housing more than 700,000 inhabitants. Effluents of 8 wastewater treatment plants drain into the estuary without nutrient removal (Azevedo *et al.* 2008).

We kayaked from the entrance of the lock of the Crestuma dam to the beginning of the middle estuary (a few more than 13 km), interrupting the search downwards because the high traffic of boats made our navigation difficult. In order to estimate the diet of otters at the estuary, we analyzed the content of the collected spraints following the standard methodology (e.g. Blanco-Garrido *et al.* 2008). The minimum number of individual prey items per spraint was estimated from the number and size of identifiable bones. The original size and biomass of consumed fishes was estimated from the size of key bones (mainly vertebrae, but also mouth bones such as maxillae and dentary).

Results and discussion

We found a small accumulation of otter faeces in an alcove at the lateral wall of the Crestuma dam lock used for boat mooring, another small

accumulation in a floating dock by the dyke, and 20 individual spraints in the red and green lateral marker buoys delimiting the navigation channel (Fig. 1). Excepting the dock (accessible through a wall stairs), all the remaining sites were inaccessible from land. Lateral buoys were floating platforms made on polyethylene of about 2m long and 0.9 m wide with a cylinder above. About one third of the visited buoys were sprainted, but probably this proportion was underestimated, because stains suggesting old spraints (probably washed by the waves made by boats) were visible in some others. Buoys are probably used by otters also as platforms for handling and eating prey; we found on one of them a fresh partially eaten grey mullet (*Mugilidae*) of about 25 cm long apparently predated by an otter. Given that the estuaries of many large rivers are navigable, we think that searching for otter signs at these buoys can be an easy and fast method to detect the occurrence of the species.

According to a Portugal nation-wide otter survey conducted in 1995 (Trindade & Farinha, 1998), the species would be rare in the Douro River estuary, which was considered “a critical area (...) from where otters are expected to disappear in the very near future if nothing is done...”. Certainly, the recovery of the otter across Europe during the last 20 years could have resulted in an increase of the species occurrence in this area, but we think that a low detection rate by traditional searching methods could be also partially responsible for the poor results obtained in the 1995 survey.



Figure 1. Otter spraints and bird faeces in a buoy delimiting the navigation channel in the Douro River estuary.

Table 1. Prey types consumed by otters in the Douro River estuary (small accumulations of faeces were considered as individual ones). Data are presented as the percentage of occurrence of each type of prey and the percentage of the minimum number of individual prey items.

Prey types	% of occurrences (n=22)	% of individual prey (n=43)
Grey mullet (<i>Mugilidae</i>)	86.36	53.48
Eel (<i>Anguilla anguilla</i>)	36.36	20.93
Sea bass (<i>Dicentrarchus labrax</i>)	9.09	4.65
Pumpkinseed sunfish (<i>Lepomis gibbosus</i>)	9.09	4.65
Sole (<i>Solea</i> sp.)	4.54	2.32
Unidentified fish	9.09	4.65
Unidentified amphibian	4.54	2.32
Crab (prob. <i>Carcinus maenas</i>)	13.61	6.97

At least five species of fish, one amphibian and one crab were identified as summer prey of the otter at the Douro estuary. All species can be considered typical of estuarine habitats, from the more saline to rather fresh environments. Grey mullets (*Mugilidae*) were clearly the most important prey, both in occurrences and numbers, followed by eels (*Anguilla anguilla*) and, in a lesser extent, crabs (probably *Carcinus maenas*); all the remaining prey were occasionally captured (Table 1). We did not find any remain of the North-American red swamp crayfish (*Procambarus clarkii*), although this species was apparently a frequent prey of the otter in upstream sectors of the Douro River (own observation). Most grey mullets were between 20 and 30 cm long (with an estimated weight between 80 and 240 g), but one individual measured only 14 cm and another one 39 cm (weighing about 500 g). Estimated lengths of consumed eels were between 18 and 26 cm, except one individual that reached 62 cm (about 400 g in weight). When considering all fish species pooled, most consumed individuals were longer than 20 cm and almost half of them were heavier than 100 g (Fig. 2). These prey sizes are rather big for otters feeding at the sea coast; for example, Kruuk & Moorhouse (1990) stated that the mean mass of fish caught by otters in the Shetland islands was 28 g, and Clavero *et al.* (2004) found that more than 80% of the otter prey in the coast close to Gibraltar were below 30 g.

About three quarters of the otter prey in the Douro estuary during the summer, and indeed a higher proportion of the ingested biomass, corresponded to grey mullets and eels. While eels, where they are present, are a frequent prey of

otters (Mason & Macdonald 1986), grey mullets rarely reach so much importance in the species diet. However, they have a significant role as otter prey in some coastal areas of Portugal and southwestern Spain, such as Ria de Aveiro (Gomes 1998), the Odeceixe estuary (Beja 1991), Ria

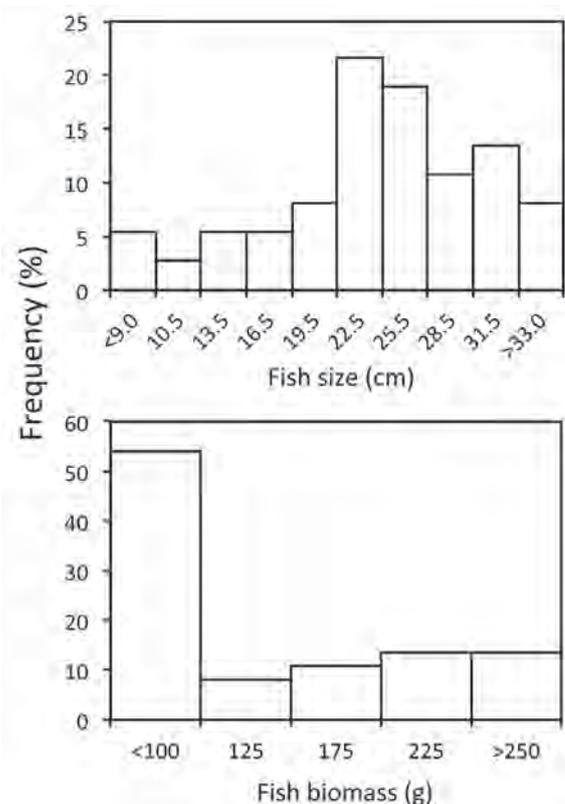


Figure 2. Frequency distribution of fish size and biomass consumed by otters in the Douro River estuary (all species pooled; n=37 individuals). Numbers in X-axis represent the mid-point of the ranges.

Formosa (Cerqueira 2005), the Odiel River estuary (Blanco-Garrido *et al.* 2009) and the sandy coast close to Gibraltar (Clavero *et al.* 2006). Thus, our data support the point of view of Beja (1991), who consider that grey mullets are “the typical prey for otters inhabiting Iberian brackish water habitats”. The high levels of organochlorine contaminants detected by several authors (e.g. Ferreira *et al.* 2004) in grey mullets and other fish species of the Douro estuary could be a serious long-term risk for the otter in the area.

To conclude, otters seem to be common at the Douro River estuary, where scarcely twenty years ago they were considered at the border of the extinction. In addition, our findings show that they use frequently the buoys delimiting the navigable channel for sprainting, so their occurrence can be easily detected searching at these points. In the Douro River estuary, otter diet is based on grey mullets and eels, at least during the summer, as it occurs in some other coastal areas of the Iberian Peninsula dominated by sandy substrate and brackish water habitats.

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