

FRESHWATER CRABS PREYED ON BY THE EURASIAN OTTER *LUTRA LUTRA* IN A RIVER HABITAT OF SOUTHERN BULGARIA

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ABSTRACT - During spring and summer 2005-2006, 141 remains of crabs (*Potamon ibericum*) eaten by the Eurasian otter (*Lutra lutra*) were collected from an eight kilometre long stretch of the River Maritza (the largest river in southern Bulgaria). Measuring of the carapaces width was chosen, carapaces being the better preserved part of the exoskeleton (80% of occurrences). An equal sample of live crabs was measured in the study area to investigate otter size selection. Mean carapace width found in the remains was 28.6 mm. Otters showed a preference for crabs larger than 20 mm (adults and sub-adults), clearly selecting those larger than 30 mm.

Key words: Eurasian otter, *Lutra lutra*, diet, *Potamon ibericum*, size selection, prey remains, Bulgaria.

RIASSUNTO – *Granchi d'acqua dolce Potamon ibericum predati dalla Lontra Lutra lutra in un tratto fluviale della Bulgaria meridionale.* In primavera ed estate 2005-2006, lungo un tratto del fiume Maritza, presso Plovdiv (Bulgaria meridionale), sono stati raccolti 141 resti di predazione della Lontra sul granchio di acqua dolce (*Potamon ibericum*), costituiti per 80% da carapaci. Per indagare la selezione di taglia, si è quindi scelto di misurare la larghezza del carapace degli individui predati e di confrontarla con un campione equivalente di misure effettuate su crostacei vivi rinvenuti nel tratto fluviale indagato. La larghezza media del carapace degli individui predati dalla lontra è risultata pari a 28,6 mm. La lontra sembra selezionare i granchi di dimensioni maggiori (larghezza del carapace: > 30 mm), corrispondenti ad individui adulti di entrambi i sessi.

Key words: Lontra, *Lutra lutra*, dieta, *Potamon ibericum*, selezione di taglia, resti di predazione, Bulgaria.

INTRODUCTION

Crustaceans are mainly known as an additional food source for the Eurasian otter (*Lutra lutra*) in the freshwater habitats of Europe, varying on average from 0 % to 34.8 % of the diet (Chanin, 2003). Mediterranean otters behave more as generalist predators than

temperate otters, relying less on fish, and more on aquatic invertebrates and reptiles (Clavero *et al.*, 2003). At the same time a review of the literature on otter diet in Eurasia showed that the role of crustaceans increases in a gradient from coastal shores to rivers, lakes and streams (Jedrzejewska *et al.*, 2001).

Crayfish species are the most commonly preyed on crustaceans. *Austropotamobius pallipes* was found to be eaten in mountainous rivers in the north of Spain (Callejo and Delibes, 1987), in Sweden (Erlinge, 1967; Erlinge and Jensen, 1976) and in the Irish Limestone river system (Mcfadden and Fairley, 1984). *Astacus* species were dominant in Hungarian streams during summer (Lanszki and Molnar, 2003). Otter predation on the introduced *Procambarus clarkii* was reported for the Donana National Park in south-east Spain (Adrian, 1987; Adrian and Delibes, 1987). Beja (1991) for Portugal, Ruiz-Olmo and Palazon (1997) for Mediterranean freshwater habitats, Sulkava (1996) for Finland, and Sidorovich *et al.* (1998) for Belarus also reported crayfish species as a crucial prey. On the other hand, in riverine habitat of southern Italy and mainland Greece, crustaceans occurred in otter diet with a per cent frequency of 24.5% and 11.0% respectively (Macdonald and Mason, 1982; Prigioni *et al.*, 2006).

Crab size selection by otters and the metric characteristics of these crustaceans have been little studied in Europe. A method was devised to determine carapace length of individuals of *Austropotamobius pallipes* in spraints from the width of uropod endopodites, recording significant differences in otters' preference among sites (Mcfadden and Fairley, 1984).

Until now there have been no studies on the predator-prey relationship between the freshwater crab (*Potamon ibericum*) and the Eurasian otter. The crab's distribution in Europe is restricted mainly to the Balkans

(Brandis *et al.*, 2000). In Bulgaria, *P. ibericum* is the only species found (Bechev, 2004).

In this paper we investigate otter selection for crabs size, comparing otter food remains with a sample of live crustaceans collected in a stretch of the River Maritza (southern Bulgaria), where *P. ibericum* represents the main food source of otters (Georgiev, 2006).

STUDY AREA AND METHODS

Our study was carried out between 28.04.2005 and 12.07.2006. An eight kilometre long stretch of the River Maritza (the largest river in southern Bulgaria, UTM-grid: LG06 and LG16) was investigated. The stretch is situated in the city of Plovdiv and in its vicinity.

Fresh crab remains were gathered from feeding sites along the river bank three times in spring (2005: April 28 and May 17; 2006: May 30) and three times in summer (2005: September 12 and 14.; 2006: July 12). The feeding sites were determined as those of otters by the presence of foot prints on/around them and, more rarely, of spraints. Similar otter feeding sites, rich with crab remains, were reported also for the rivers of Strandza Mountain (Spasov, unpublished data). Substrates used as feeding platforms were mainly tree trunks, stones or sand surfaces in open habitats. A single feeding site was defined as a place with crab remains at least 1 meter from another site with remains. Food remains were dried and stored in plastic bags until processing. Four types of remains were observed: carapaces, pincers, legs, and abdomens. The per cent occurrence of the types of crab remains was evaluated for the first 40 feeding sites found in the area at the beginning of the research (N = 69).

To study the crab size preference of otters carapaces width was measured (Fig. 1),



Figure 1 - Measuring a live individual of *P. ibericum* captured from the studied stretch of the River Maritza. Photo by Slaveia Stoycheva.

carapaces being by far the better preserved part of the exoskeleton. To compare the sizes of crabs eaten by otters with the those in the population crabs were collected by hand throughout the study area. Bank sides were searched gradually, including all the holes among and under the stones, which are thought not to be accessible to otters. We tried to take a sample as consistent as possible gathering every individual seen from each examined segment. Very few individuals were missed as *P. ibericum* is a slow-moving crab compared, for example, with the fast running marine *Pachygrapsus marmoratus*, another otter prey in SE Bulgaria (Georgiev, 2006). A total of 141 carapaces was measured both from feeding remains and from living animals. Crabs were weighed to assess the relative weight of those in otter diet on the basis of carapace width.

To evaluate possible otter size selection Ivlev's formula was used (according to Lanszki *et al.*, 2001):

$$E_j = (r_j - n_j) / (r_j + n_j)$$

where r_j is the proportion of a given crab size group in the diet, and n_j is its percentage in the environment. Considering the maximum carapace width of 48.5 mm measured in Bulgaria (Bulgurkov, 1961), the size resolution scale was: 0-10 mm, 10-20 mm, 20-30 mm, and >30 mm in order to examine the strength of otter size selection. To support calculations, Simpson's diversity index was calculated (Begon *et al.*, 1986):

$$S = 1 / B \sum p_i^2$$

where p_i is the proportion of each size group, and B is the number of crabs size groups chosen.

Small crabs could be chewed and swallowed with their carapaces; to check for this eventuality, we gathered all spraints found and analysed them in the laboratory (N = 94). Crabs occurrence was expressed

as per cent frequency (F% = number of spraints containing crabs/total number of analysed spraints x 100).

RESULTS AND DISCUSSION

1. Crabs remains from otter prey

A mean of 1.7 (N = 96, min-max = 1.0-9.0, SD. = 1.5) crab specimens per feeding site (N = 40) was found. The most frequent prey remains were the carapaces, which occurred in 80.0% of feeding sites (Fig. 2). Crab legs represented 62.5% of occurrence, followed by pincers (40.0%). The abdomens were the rarest remains (2.5%). The most frequent remains combination was carapace with legs and pincers (30.0%) - i.e. almost the entire crab exoskeleton, except the abdomens. This is probably a consequence of the feeding behaviour of otters: otters avoid chewing and swallowing the hard parts of the exoskeleton and reach the soft internal organs located inside the carapace from

the underside, through the abdomen. The per cent frequency of crabs fragments in spraints was low (N = 8, F% = 8.5%). Carapace remains prevailed compared to other remain types (F% = 7.4%), followed by abdomen remains (F% = 4.3%) and by legs and pincers (F% = 2.1% for both). Remains from evidently small crabs were not found within any of the analyzed spraints. The analysis of prey remains seems to be a more useful method for the estimation of crab size selection by otters compared to spraint analysis.

2. Crab size preference and measurements

Mean crab carapace width in otter diet was 28.6 mm (N = 141, min-max = 10.7-42.2 mm, SD = 6.3) compared to 21.2 mm (N = 141, min-max = 4.0-37.7 mm, SD = 7.2) in the environment. Otters showed a preference for crabs larger than 20 mm (heavier than 6.7 g),

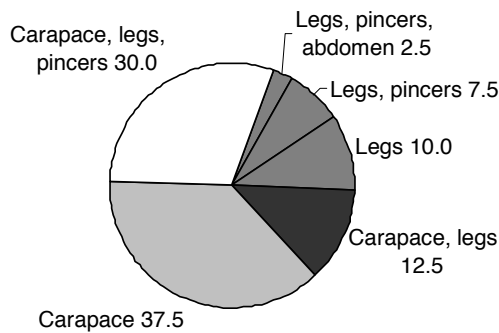


Figure 2 - Types and combinations of crab *P. ibericum* remains from otter feeding sites.

selecting particularly those larger than 30 mm (weight > 10.1 g) (Tab. 1, Fig. 3). Smaller crabs (carapace width < 10 mm) seem to be avoided, even considering sprints data (see above). They probably required more energy to capture - hidden in narrow holes and crevices - than they could provide as food. The diversity index reflected otter selection, showing lower values when considering feeding remains rather than

environmental availability. In the study area 48.9% of captured crabs were juveniles (with not well recognisable sexes), 24.8% were adult and sub-adult males, and 26.3% were females (overall 51.1% adult and sub-adult individuals). Considering that all live crabs over 24.0 mm in carapace width were adults or sub-adults, otters preyed predominantly on adult crabs.

Table 1 - Crab sizes in the study area and in crab remains from otter feeding sites; size diversity (S = Simpson's index) and otter prey selectivity (E_j = Ivlev's index) are given.

Crabs size	Environment		Crab remains		E_j
	n	%	n	%	
0-10 mm	9	6.4	0	0	-1
10-20 mm	56	39.7	13	9.2	-0.62
20-30 mm	54	38.3	71	50.4	0.14
>30 mm	22	15.6	57	40.4	0.44
	S = 0.75		S = 0.59		

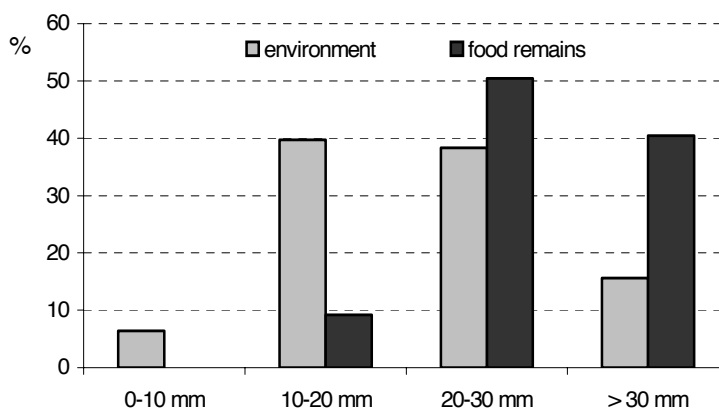


Figure 3 - Percentage occurrence of *P. ibericum* (considering carapace width) in the study area and in crab remains from otter feeding sites.

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