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AMPHIBIAN AND REPTILE CONSUMPTION BY OTTERS (*LUTRA LUTRA*) IN A COASTAL AREA IN SOUTHERN IBERIAN PENINSULA

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Through the analysis of 1518 otter spraints we determined the importance of amphibians and reptiles in otter diet and the seasonal patterns of consumption of the different species in a heterogeneous coastal environment in southern Spain. Otters fed on a minimum of six amphibian and three reptile species. Amphibians were present in 13.2% and reptiles in 3.9% of the spraints analysed. Remains of amphibians and reptiles were significantly associated in otter spraints, but negatively associated with crayfish occurrences. Maximum reptile consumption occurred during the summer. Though terrapins have been rarely cited as otter prey, they were consumed more than twice as frequently as water snakes in the study area. The highest frequency of amphibians in the otter diet was recorded in late winter-spring surveys, coinciding with the spawning periods of most species. However, the frequency of amphibians remained high during summer months due to predation on the Iberian green frog (*Rana perezi*), a very aquatic frog that was almost the only amphibian species consumed in this season.

Key words: Bufo bufo, coastal otters, predation, Mediterranean streams, *Mauremys leprosa*, *Rana perezi*

INTRODUCTION

The otter (*Lutra lutra*, Carnivora, Mustelidae) is a top predator in freshwater ecosystems. Featuring both anatomical and physiological adaptations for semi-aquatic living, the otter is specialized in obtaining virtually all its food in the water (Carss, 1995). Fish are the main prey of otters, and are preferentially consumed whenever readily available (Erlinge, 1968; Mason & Macdonald, 1986). However, otter diet is very variable (both temporally and geographically) and may incorporate most kinds of aquatic animals, including amphibians and reptiles, as well as crayfish and other crustaceans, aquatic insects, birds and mammals (Jêdrzejewska *et al*., 2001; Clavero *et al*., 2003).

Amphibians are predated by the otter throughout the species' European range (Clavero *et al.*, 2003), constituting an important part of otter diet in many locations (Erlinge, 1972; Adrián & Delibes, 1987; Brzeziński *et al.*, 1993; Beja, 1996*a*; Sulkava, 1996). Reptiles are rarer in the otter's diet, since their consumption is usually restricted to lower latitudes (Ruiz-Olmo, 1995). However reptiles, specially water snakes (*Natrix* spp.), have been shown to be frequent otter prey in some Italian (Arcá & Prigioni, 1987) and Iberian studies (Simões-Graça & Ferrand de Almeida, 1983; López-Nieves & Hernando, 1984).

In this work we analyse the consumption of amphibians and reptiles by otters in the species' southernmost European location. Here, the diet of the otter has been described previously by Clavero *et al.* (2004). In particular we will try to answer the following questions: (1) what species of amphibians and reptiles are consumed and in what proportions? (2) Are there seasonal patterns in the consumption of the different species?

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STUDY AREA

The study was conducted in the surroundings of Tarifa (Cádiz, Spain), the southernmost European town. The area occupied by otters is very heterogeneous, including sandy and rocky coastal stretches, estuarine areas and four main streams (Fig. 1). Mean annual precipitation ranges from 1300 to 620 mm, while mean annual temperature is around 17.5ºC (Ibarra, 1993). Due to the oceanic influence, it is extremely rare that temperature falls below 0ºC, and the mean minimum temperature in January is 11ºC. More information on the study area's characteristics can be found in Clavero *et al.* (2004).

The area holds a very rich herpetofauna, with 20 reptile species – including four with semi-aquatic habits – and10 amphibian species (Pleguezuelos *et al.*, 2002).

METHODS

Otter diet was studied through the analysis of faeces (spraints). Otter spraints were collected in nine 600 m transects placed in lower and upper stretches of the four streams included in the study area and in the common estuary of two of them (Fig. 1). The different transects were classified as *lower* (coastal, numbers 2, 4, 5, 6 and 9 in Fig. 1) or *upper* (inland, numbers 1, 3, 7 and 8). Spraint collection was performed bimonthly from December 1999 to December 2001, with the exception of October 2001, due to heavy rains.

Spraint analysis followed standard procedures (Beja, 1997). Amphibian species were identified using the key for ilia bones by Felix & Montori (1986) and drawings of other bone structures provided by Boulenger (1897).

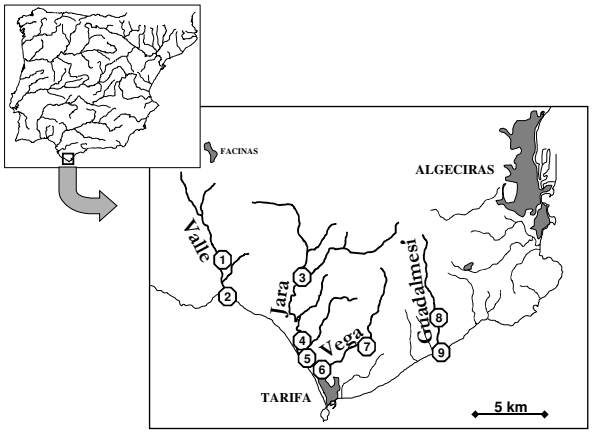

FIG 1. Map of the study area showing the nine transects in which otter spraints were collected.

Each prey type identified in a spraint was considered an *occurrence*, diet composition was then expressed either as Frequency of Occurrence (FO; number of occurrences of a certain prey type/number of spraints analysed) (Mason & Macdonald, 1986). Before being subject to statistical analysis, frequency data were arcsine transformed (Zar, 1984). The minimum number of individuals of a certain prey type present in a spraint was estimated from the number and position of ilia, tibia-fibulas and parasphenoid bones. Whenever these key structures did not appear in spraints, remains of a certain prey type were considered to belong to a single individual.

The association between amphibians and reptiles and other prey types was analysed using the χ^2 test. The prey types analysed were fish, crayfish (*Procambarus clarkii*) and insects. Eels (*Anguilla anguilla*) and freshwater fish (the pool of chub, *Squalius pyrenaicus*, and loach, *Cobitis paludica*) were also analysed separately, since these are the only three fish species which can be found far from the coast in the area (Clavero *et al.*, 2002). In coastal stretches other fishes, such as grey mullet (Mugilidae), flatfish (Soleidae) or wrasses (Labridae), are present and are important components of otter diet (Clavero *et al.*, 2004). Since coastal otters often feed in estuaries or in the open sea, where they are not supposed to find amphibians or reptiles, two different analyses of the association of prey types in spraints were performed. One was done considering all the spraints analysed, while in the second one we only considered spraints collected in upper stretches. The few samples that contained two or more pooled spraints were excluded from the association analyses.

RESULTS

Amphibian and Reptile Occurrence in Otter Diet

A total of 1518 otter spraints were analysed (Table 1). Amphibian remains were identified in 13.2% of the spraints while reptiles were present in 3.9%. The FOs of amphibians in the different transects ranged from 4.8% to 54.3% and that of reptiles from 0.5% to 30.0%. The FO of amphibian was significantly higher in upper stretches than in lower ones (t=2.9, df=7, P<0.05). Though reptiles were also more frequently found in otter spraints in upper stretches, differences were not significant.

Overall, a minimum of 319 amphibian and 60 reptile individuals were identified (Fig. 2). Over 95% of the identified amphibians were anurans, while the urodeles were poorly represented in otter diet. More than a third of the amphibians predated by the otter were Iberian green frogs (*Rana perezi*). Iberian parsley frogs (*Pelodytes ibericus*), common toads (*Bufo bufo*) and stripeless tree frogs (*Hyla meridionalis*) constituted between 10% and 15% of the consumed individuals. Around 20% of the anuran individuals reminded unidentified, as did the few urodeles that were found in spraints. Among reptiles, leprous terrapins (*Mauremys leprosa*) were the dominant prey. Around one third of the consumed reptiles were viperine snakes (*Natrix maura*), while only one lacertid – which remained unidentified – was found.

When the total number of spraints analysed was considered, amphibians and reptiles were shown to occur together in spraints more often than would be expected by chance (Table 2). Both amphibians and reptiles followed a similar pattern of association in spraints with another prey types, being positively associated with freshwater fish and insects and negatively associated with all fish included in otter diet. The occurrence of eels and crayfish in spraints was found to be independent of amphibians and reptiles. However, when only samples from upper stretches were considered, the patterns of association of the different prey types in spraints displayed clear changes. In freshwater habitats crayfish was the only prey type negatively associated both with amphibians and reptiles, while fish became independent of them. The positive association in spraints among amphibians, reptiles and insects remained significant in upper stretches.

Seasonal Variation in Amphibian and Reptile Consumption

The overall analysis of the occurrence of amphibians and reptiles in the otter diet must be treated carefully, since there were clear seasonal variations in their consumption by otters (Fig. 3).

An increase in reptile consumption was observed from winter to summer reaching its peak in June in upper transects, and in August in lower ones. However, predation upon the two reptiles consumed by the otter in the area followed different seasonal patterns (Fig. 4).

TABLE 1. Yearly variation of the number of otter spraints analysed in lower and upper transects of the study area.

	Dec.	Feb.	Apr.	Jun.	Aug.	Oct.
Upper transects	132	53	116	109	78	18
Lower transects	344	165	164	144	84	123

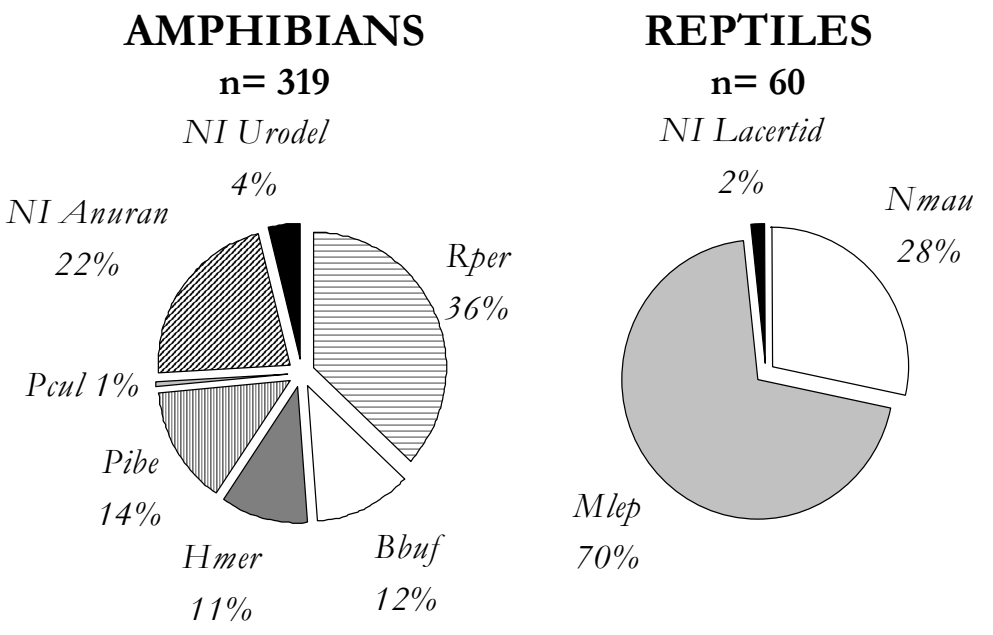

FIG. 2. Proportion of individuals of the different amphibian and reptile species identified. Amphibians: *Rper*, *Rana perezi*; *Bbuf*, *Bufo bufo*; *Hmer*, *Hyla meridionalis*; *Pibe*, *Pelodytes ibericus*; *Pcul*, *Pelobates cultripes*. Reptiles: *Nmau*, *Natrix maura*; *Mlep*, *Mauremys leprosa.*

Viperine snakes were consumed exclusively in spring-summer months with a marked peak in June. Consumption of terrapins showed a summer peak both in upper and lower transects, though we found their remains in otter spraints also during winter and spring. However there was a sharp decrease in terrapin occurrence in October.

Predation on amphibians reached its maximum between February and April, but was maintained at relatively high levels during the summer. This pattern was the result of the seasonal variation in consumption of the different anuran species (Fig. 5). Toads, stripeless tree frogs and Iberian parsley frogs were consumed almost exclusively during the breeding periods in late winter and the beginning of the spring. However, predation upon the Iberian green frog – the most frequent amphibian in the otter diet – reached its maximum in August, when it was almost the only amphibian consumed.

DISCUSSION

In the study area otters fed on a minimum of nine different amphibian and semi-aquatic reptile species. Though higher frequencies in otter diet have been previously reported for both amphibians and reptiles (i.e. Arcá & Prigioni, 1987; Brzeziñski *et al*., 1993), no other otter diet studies have yet recorded such diverse predation on these groups. The overall secondary role of amphibians and reptiles is undoubtedly influenced by the high proportion of marine and estuarine prey in otter diet in the area (Clavero *et al*., 2004), since coastal otters rarely feed on non-fish prey (Jêdrzejewska *et al.*, 2001).

The positive association of amphibians and reptiles in otter spraints suggests that they are frequently captured during the same foraging bouts. On the other hand, when only upper stretches were considered crayfish were negatively associated both with amphibians and reptiles. Crayfish are by far the most important freshwa-

TABLE 2. Association among different prey types in otter spraints assessed by χ^2 test (Pos- positively asociated; Neg- negatively associated; Ind- independent occurrence in spraints). Results are shown separately for all the spraints analysed and for spraints collected in upper stretches only. * $P< 0.05$; ** $P< 0.01$; *** $P< 0.001$.

	Fish (total)	Eels	Freshw. fish	Crayfish	Insects	Reptiles
ALL TRANSECTS (n=1470)						
Amphibians	Neg***	Ind	Pos***	Ind	Pos***	Pos***
Reptiles	Neg*	Ind	Pos**	Ind	Pos***	-
UPPER TRANSECTS ONLY (n=464)						
Amphibians	Ind	Ind	Pos**	Neg***	Pos***	Pos**
Reptiles	Ind	Ind	Ind	Neg***	Pos***	-

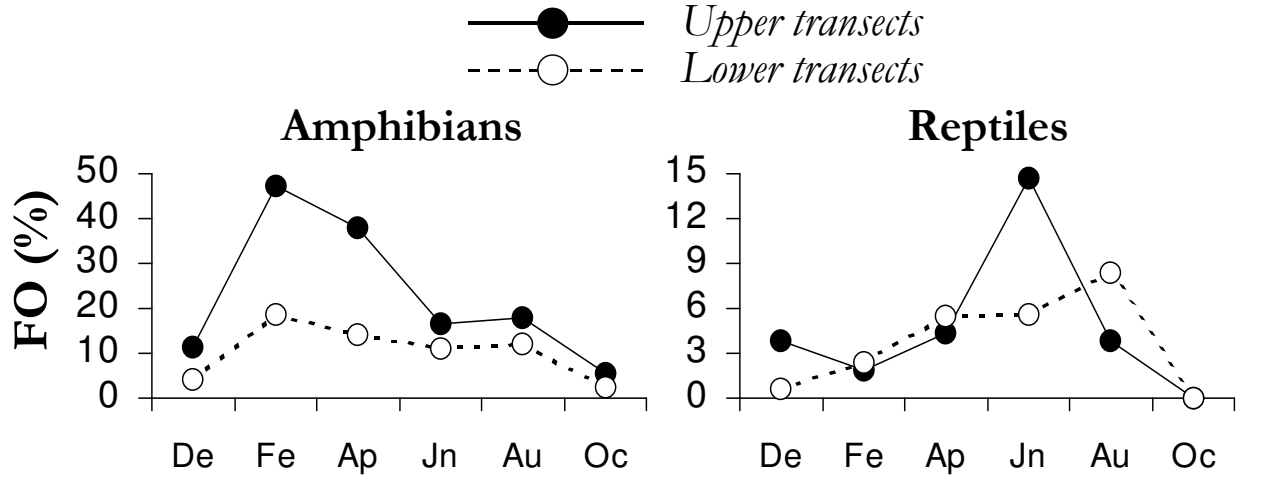

FIG 3. Yearly consumption of amphibian and reptiles by otters in upper and lower transects of the study area.

ter prey for the otter in the study area (Clavero *et al*., 2004) and amphibians and reptiles are apparently captured in different locations or using different techniques to those used for crayfish consumption. The strong association of these two prey types with insects could be explained by secondary ingestion. In fact Carss & Parkinson (1996) showed that the remains of small fish placed in the gut of larger ones could be identified in otter spraints. However, the same authors also proved that otters predate actively on aquatic insects such as *Dytiscus* beetles. In the study area small animals such as dragonfly nymphs or shrimps were frequent otter prey and were often the only prey types found in spraints (Clavero *et al*., 2004)

Reptile Consumption

Little attention has been paid to otter predation on reptiles, mainly due to its almost complete absence in otter diet in central and northern European studies. Ruiz-Olmo (1995) showed that reptiles were not included in the diet in Europe north of 43ºN, while Clavero *et al*. (2003) reported a clear increase in reptile consumption in Mediterranean European locations in relation to temperate ones. This inverse relation between latitude and reptile consumption is a common feature of many carnivore species which occupy a wide latitudinal range (Delibes *et al*., 1997; Zielinski *et al*., 1999).

Terrapins have been rarely cited as otter prey (Barrio & Bosch, 1997). In a review of 12 studies of reptile species consumed by the otter Ruiz-Olmo (1995) found a ratio of snakes to terrapins of 177.5:1, suggesting that the hard shell of terrapins would account for their low frequency of occurrence. However, Beja (1996*a*) reported a ratio snakes to terrapins of 2:1 in southern Portugal, while in this study terrapins were more frequent than snakes in the diet, with a ratio of 1:2.5. The analysis of otter spraints revealed that small terrapins were eaten entirely, since numerous fragments of the bony shell could be found in spraints. That was not the case for larger individuals, which were apparently mutilated by the otter (see Barrio & Bosch, 1997). Remains of large terrapins in spraints included legs, tails, jaws and marginal horny scutes, but not pieces of the bony shell.

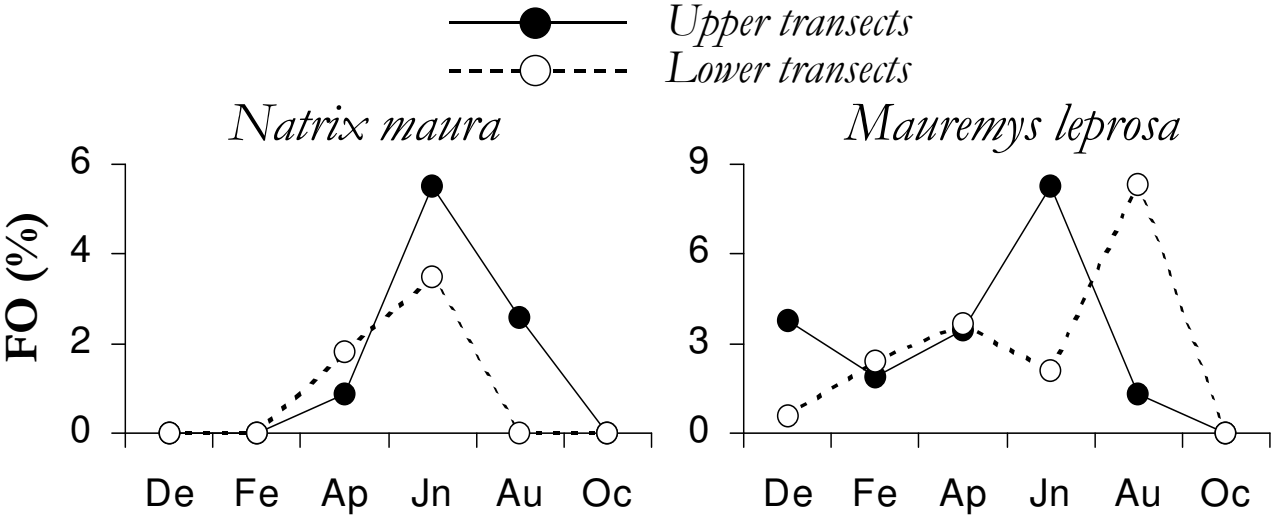

FIG 4. Yearly consumption of viperine snakes (*Natrix maura*) and leprous terrapins (*Mauremys leprosa*) by otters in upper and lower transects of the study area.

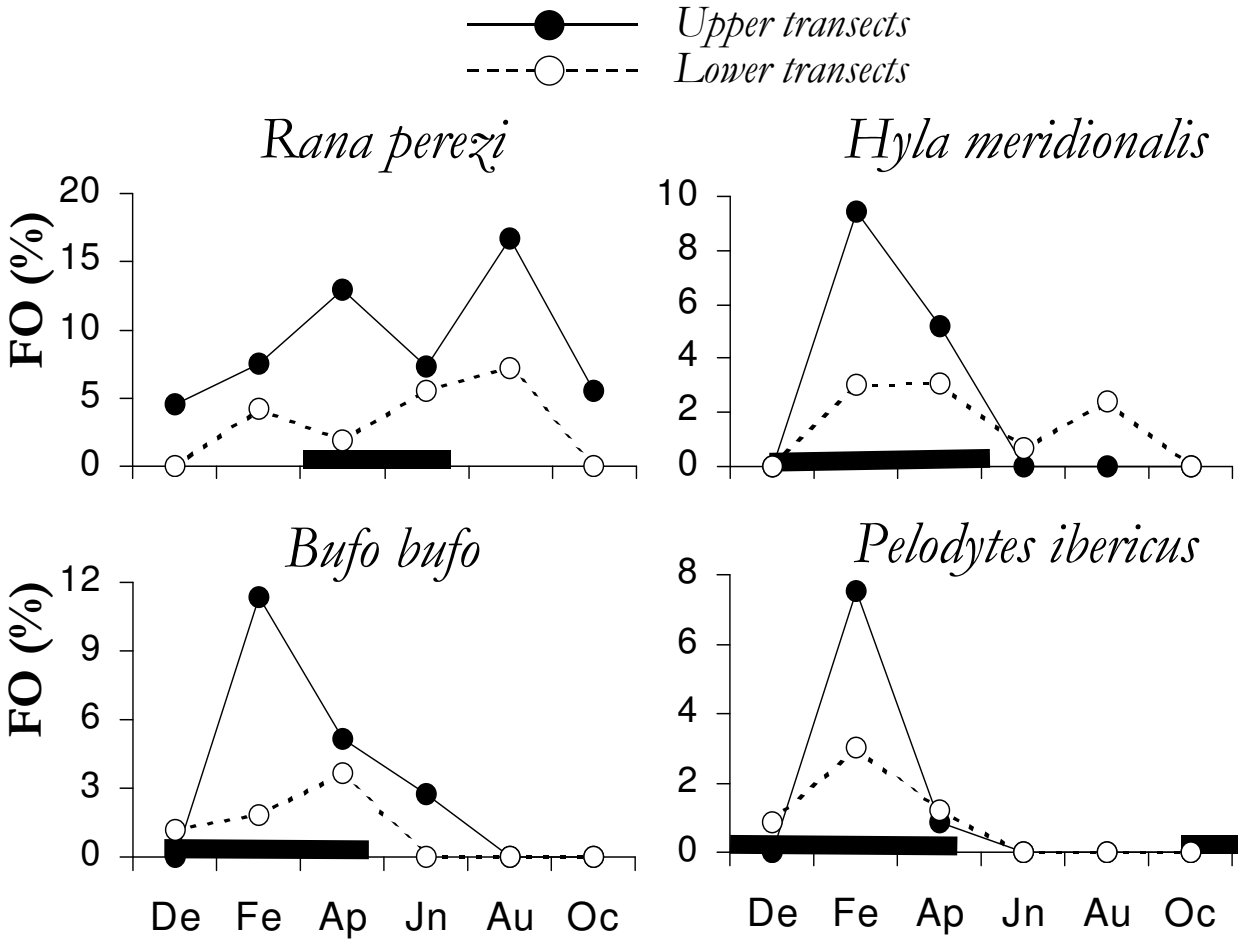

FIG. 5. Yearly consumption of Iberian green frogs (*Rana perezi*), stripeless tree frogs (*Hyla meridionalis*), common toads (*Bufo bufo*) and Iberian parsley frogs (*Pelodytes ibericus*) by otters in upper and lower transects of the study area. The thick lines on the x-axis mark the spawning period in southern Iberian Peninsula following Salvador & García París (2001).

Reptile consumption showed a continuous increase from winter to summer, following the increased activity of leprous terrapins and viperine snakes at higher temperatures (Salvador & Pleguezuelos, 2002). Nevertheless, the different activity periods and habitat use of both species is reflected in their consumption by otters. Due to the mild winter temperatures, terrapins maintain their activity throughout the whole year in southern Iberia, though it shows a clear increase in spring and summer (Andreu & López-Jurado, 1998). This yearly activity pattern would allow otters to predate upon terrapins even in the colder months, as is shown in Fig. 4. On the other hand, viperine snakes hibernate at least from November to March even in southern areas of the Iberian Peninsula. Moreover, snakes are mostly diurnal and spend an important proportion of the time on land in spring and autumn, being nocturnal and largely aquatic in the summer (Braña, 1998). Since south Iberian otters are almost exclusively nocturnal (Beja, 1996*b*), it is possible that the marked peak of viperine snake consumption in June coincides with the moment when encounters between otters and active snakes are more likely to occur.

AMPHIBIAN CONSUMPTION

Amphibians are important prey for the otter in many European locations, occurring independently of latitude (Jêdrzejewska *et al.*, 2001 and Clavero *et al.*, 2003). However, in most of the diet studies from central and northern Europe, common frogs (*Rana temporaria*) and occasionally common toads are the only amphibian species consumed by the otter (i.e. Weber, 1990; Brzeziński *et al.*, 1993; Sulkava, 1996). In our study area a minimum of six different amphibian species were preyed upon. The Iberian green frog was the most frequent amphibian in the diet, but the proportion of ranids in relation with other amphibians was much lower than in most published studies. The frequency of occurrence of stripeless tree frogs and Iberian parsley frogs was unusually high. Up to seven Iberian parsley frogs were found in a single spraint.

Though some authors proposed that otters do not eat toads due to their venomous skin (Jenkins *et al.*, 1979; Fairley, 1984; De Jongh, 1988), since the first description on otter predation on toads by Lizana & Pérez Mellado (1990) many studies have shown that toads can be common otter prey. Otters avoid the ingestion of the

toads' poisonous substances by skinning them, a behaviour that has been described in Portugal (Beja, 1996*a*), Spain (Lizana & Pérez Mellado, 1990), Belarus (Sidorovich & Pikulik, 1997) or Finland (Sulkava, 1996). Several common toad skins were observed in the study area during the spraint collection. The ratio of frogs to toads is nevertheless very high in most of the studies, with a clear preponderance of the former (Weber, 1990; Brzeziñski *et al.*, 1993; Sidorovich & Pikulik, 1997). However, in our study this ratio was 2.6:1, while Beja (1996*a*) reported less frequent predation on frogs than on toads, with a ratio of 1:1.2. The occurrence of toads in the diet could have been underestimated in some studies in which amphibians were identified mainly by jaw bones (see discussion in Sulkava, 1996), since skinned toads' skulls are rarely eaten by otters (Lizana & Pérez Mellado, 1990). This problem should be avoided using the ilia bone for specific identifications.

Most of the studies reporting annual patterns on amphibian consumption by otters (Weber, 1990; Brzeziñski *et al.*, 1993; Sulkava, 1996) show that the highest occurrence of amphibians occur in late winter and early spring, when common frogs are either hibernating or spawning. This seasonal pattern is related to the habitat use of common frogs, a species which is absent in southern Iberian Peninsula, and that after spawning moves to adjacent woodlands (Weber, 1990). In the study area most amphibian species do not hibernate, but remain active throughout the whole year (Salvador & García París, 2001). However, for most of the species the more intense predation events by otters do occur during spawning periods, in winter and early spring. This is the period when the diversity of amphibians preyed upon by the otter reaches its highest values. The exception to this pattern is the Iberian green frog, with a maximum occurrence in otter diet during the summer that does not overlap with spawning events. In fact, the Iberian green frog is practically the only amphibian consumed by the otter in summer months. This species is strictly aquatic, remaining in streams throughout the year, in contrast with the terrestrial habits of other anurans in the study area and the common frog in other European locations (Salvador & García París, 2001).

In October, with temperatures being still high, there was a sharp decrease in the consumption of all amphibian and reptile species (Fig. 4 and 5). In this period leprous terrapins and Iberian green frogs are still active and thus available for the otter. But at this time the frequency of occurrence of grey mullet, eels and flatfish experienced a pronounced increase. These fishes constitute the bulk of otter diet in the area (Clavero *et al.*, 2004) and are scarcely predated during the summer (Clavero, 2004). It is possible that the autumnal minimum in amphibian and reptile consumption is the result of a switch in otter predation, that during this period, would be centred on estuarine fishes.

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REFERENCES

Adrián, M. I. & Delibes, M. (1987). Food habits of the otter (*Lutra lutra*) in two habitats of the Doñana National Park, SW Spain. *Journal of Zoology, London* **12**, 399-406.

Andreu, A. C. & López-Jurado, L. F. (1998). *Mauremys leprosa* (Schweigger, 1812). In *Reptiles*, 102-108. Salvador, A. (Coor.). Fauna Ibérica, Vol. 10. Madrid: Museo Nacional de Ciencias Naturales.

Arcá, G. & Prigioni, C. (1987). Food of the otter on the Fiora River (central Italy). *Acta Theriologica* **32**, 134-140.

Barrio, C. & Bosch, J. (1997). *Mauremys leprosa* como presa de *Lutra lutra*. *Doñana, Acta Vertebrata* **24**, 191-192.

Beja, P. R. (1996*a*). An analysis on otter *Lutra lutra* predation on introduced American crayfish *Procambarus clarkii* in Iberian streams. *Journal of Applied Ecology* **33**, 1156-1170.

Beja, P. R. (1996*b*). Temporal and spatial patterns of rest-site use by four female otters *Lutra lutra* along the south-west coast of Portugal. *Journal of Zoology, London* **239**, 741-753.

Beja, P. R. (1997). Predation by marine-feeding otters (*Lutra lutra*) in south-west Portugal in relation to fluctuating food resources. *Journal of Zoology, London* **242**, 503-518.

Boulenger, G. A. (1897). *Tailless batrachians of Europe*. London: The Ray Society.

Braña, F. (1998). *Natrix maura* (Linnaeus, 1758). In: *Reptiles*, 440-454. Salvador, A. (Coor.). Fauna Ibérica. Vol. 10. Madrid: Museo Nacional de Ciencias Naturales.

Brzeziñski, M., Jêdrzejewski, W. & Jêdrzejewska, B. (1993). Diet of otters (*Lutra lutra*) inhabiting small rivers in the Bialowieza National Park, eastern Poland. *Journal of Zoology, London* **230**, 495-501.

Carss, D. N. (1995). Foraging behaviour and feeding ecology of the otter *Lutra lutra*: a selective review. *Hystrix* **7**, 179-194.

Carss, D. N. & Parkinson, S. G. (1996). Errors associated with otter *Lutra lutra* faecal analysis. I. Assessing general diet from spraints. *Journal of Zoology, London* **238**, 301-317.

Clavero, M. (2004). *Ecología y conservación de la nutria y los peces continentales en pequeños arroyos del*

Campo de Gibraltar. Huelva: PhD Thesis, Universidad de Huelva.

Clavero, M., Rebollo, A., Valle, J., Blanco, F., Narváez, M., Delibes, M. & Prenda, J. (2002). Distribución y conservación de la ictiofauna continental en pequeños cursos de agua del Campo de Gibraltar. *Almoraima*, **27**, 335-342.

Clavero, M., Prenda, J. & Delibes, M. (2003). Trophic diversity of the otter (*Lutra lutra* L.) in temperate and Mediterranean freshwater habitats. *Journal of Biogeography* **30**, 761-769.

Clavero, M., Prenda, J. & Delibes, M. (2004). The influence of spatial heterogeneity on coastal otters (*Lutra lutra*) prey consumption. *Annales Zoologici Fennici*, **41** 545-549.

De Jongh, A. W. J. J. (1988). The lack of toad remains in otter *Lutra lutra* spraints. *Lutra* **31**, 79-81.

Delibes, M., Blázquez, M. C., Rodríguez-Estrella, R. & Zapata, S. C. (1997). Seasonal food habits of bobcats (*Lynx rufus*) in subtropical Baja California Sur, Mexico. *Canadian Journal of Zoology* **74**, 478-483.

Erlinge, S. (1968). Food studies on captive otters *Lutra lutra* L. *Oikos.* **19**, 259-270.

Erlinge, S. (1972). Interspecific relations between otter (*Lutra lutra*) and mink (*Mustela vison*) in Sweden. *Oikos* **23**, 327-335.

Fairley, J. S. (1984). Otters feeding on breeding frogs. *Irish Naturalist* **21**, 372.

Felix, J. & Montori, A. (1986). Determinación de las especies de anfibios anuros del nordeste ibérico mediante el hueso ilion. *Miscelanea Zoologica* **10**, 239-246.

Ibarra, P. (1993). *Naturaleza y hombre en el Sur del Campo de Gibraltar: un análisis paisajístico integrado*. Junta de Andalucía, CMA, AMA, Sevilla.

Jêdrzejewska, B., Sidorovich, V. E., Pikulik, M. M. & Jêdrzejewski, W. (2001). Feeding habits of the otter and the American mink in Bialowieza Primeval Forest (Poland) compared to other Eurasian populations. *Ecography* **24**, 165-180.

Jenkins, D., Walker, J. G. K. & McCowan, D. (1979). Analyses of otter (*Lutra lutra*) faeces from Deeside, N. E. Scotland. *Journal of Zoology, London* **187**, 235-244.

Lizana, M. & Pérez Mellado, V. (1990). Depredación por la nutria (*Lutra lutra*) del sapo de la Sierra de Gredos (*Bufo bufo gredosicola*). *Doñana, Acta Vertebrata* **17**, 109-112.

López-Nieves, P. and Hernando, J. A. (1984). Food habits of the otter in central Sierra Morena (Córdoba, Spain). *Acta Theriologica* **29**, 383-401.

Mason, C. F. & Macdonald, S. M. (1986). *Otters: ecology and conservation*. Cambridge University Press, Cambridge.

Pleguezuelos, J. M., Márquez, R. & Lizana, M. (eds.) (2002). *Atlas y libro rojo de los anfibios y reptiles de España*. Dirección General de Conservación de la Naturaleza-Asociación Herpetológica Española, Madrid.

Ruiz-Olmo, J. (1995). The reptiles in the diet of the otter (*Lutra lutra* L., Carnivora, Mammalia) in Europe. In: *Scientia Herpetologica*. Llorente, G., Santos, X. & Carretero, M. A. (eds.). Asociación Herpetologica Española, Barcelona.

Salvador, A. & García París, M. (2001). *Anfibios españoles*. Canseco Editores, Talavera de la Reina, Spain.

Salvador, A. & Pleguezuelos, J. M.. (2002). *Reptiles españoles*. Canseco Editores, Talavera de la Reina, Spain.

Sidorovich, V. E. & Pikulik, M. M. (1997). Toads *Bufo* spp. in the diets of mustelid predators in Belarus. *Acta Theriologica* **42**, 105-108.

Simões-Graça, M. A. & Ferrand de Almeida, F. X. (1983). Contribução para o conhecimiento da lontra (*Lutra lutra* L.) num sector da bacia do Rio Mondego. *Cienc. Biol. Ecol. Syst.* **5**, 33-42.

Sulkava, R. (1996). Diet of otters *Lutra lutra* in central Finland. *Acta Theriologica* **41**, 395-408.

Weber, J. M. (1990). Seasonal exploitation of amphibians by otters (*Lutra lutra*) in north-east Scotland. *Journal of Zoology, London* **220**, 641-651.

Zar, J. H. (1984). *Biostatistical analysis, 2nd edn*. Prentice Hall, Englewood Cliffs.

Zielinski, W. J., Duncan, N. P., Farmer, E. C., Truex, R. L., Clevenger, A. P., & Barret, R. H. (1999). Diet of fishers (*Martes pennanti*) at the southernmost extent of their range. *Journal of Mammalogy* **80**, 961-971.

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