

THE ROLE OF COMMON TOADS IN THE WINTER DIET OF RECOLONISING EURASIAN OTTERS (*LUTRA LUTRA*)

PABLO GARCÍA-DÍAZ^{1*}, CÉSAR AYRES²

¹Society for the Conservation of Vertebrates (SCV). Box 270, 27007 Majadahonda, Spain.

*Corresponding author, E-mail: garciap@usal.es

²ASHEGA, C/Barcelona 86 6°C, CP 36211, Vigo, Pontevedra, Spain

Received 6 September 2010; accepted 23 December 2010

RIASSUNTO - *Importanza del rospo comune nella dieta invernale di una popolazione di lontra (*Lutra lutra*) in espansione.* Tramite analisi dei resti fecali, abbiamo evidenziato il ruolo fondamentale degli anfibi nella dieta invernale della lontra *Lutra lutra* in stagni artificiali della Spagna nord-occidentale. I numerosi “laghi di cava” presenti nell’area umida di Ribeiras do Louro e Gandaras de Budiño sono stati monitorati nel 2007-2009. Il rospo comune (*Bufo bufo*) era la principale preda della lontra, costituendo l’88% della biomassa consumata, mentre il gambero americano *Procambarus clarkii* e i pesci erano prede secondarie. I nostri risultati contrastano con la ben nota preferenza della lontra per le rane rispetto al rospo. Il mantenimento della popolazione di lontra nel bacino del fiume Louro dipende strettamente dalla corretta gestione degli stagni artificiali.

Key words: *Bufo bufo*, dieta, conservazione, *Lutra lutra*, Spagna

DOI: 10.4404/Hystrix-21.2-4497

The Eurasian otter (*Lutra lutra*) is considered to be a fish-feeding mammal (Clavero et al. 2003; Kruuk 2006), whose population dynamics are highly dependent upon this resource (Mason and Macdonald 1986; Kruuk 1995, 2006). However, otters also inhabit and even breed in areas without sufficient fish resources. In these sites, the basic otter prey items are amphibians, which seem to assume the key role generally played by fish in the feeding ecology of otters (Weber 1990; Jedrze-jewska et al., 2001; Clavero et al., 2005; Remonti et al., 2009).

Understanding the underlying ecology of recolonisation is fundamental for otter management and conservation (Remonti et al. 2008). For several recovering populations throughout the otter’s widespread European range, and especially in the Iberian Peninsula (Delibes, 1990), prey avail-

ability may represent a crucial factor in the process of population establishment (Kruuk 1995, 2006).

In an area of NW Spain, the recent detection of otters has been related to the massive breeding of common toads (*Bufo bufo*), which are preyed upon by the mustelid (Ayres and García, 2007, 2009). This resource was not sufficient to assure the presence of the species throughout the year and otters left the area after exploiting the aggregations of toads (García et al., 2009). However, otter presence during the toad breeding period may constitute the first stage of recolonisation of the area. When preying upon toads, the otter adopts a specific technique to avoid the poisonous glands of toads, the so-called “progressive skinning” (Slater, 2002). First, the predator makes an incision in the abdomen and then turns the toad’s skin inside-out (Lodé, 1996;

Table 1 - Prey items in the winter diet of the otter expressed as relative frequency of biomass (%RB).

Prey items	%RB 2007-08	%RB 2008-09
Invertebrates	4.9	2.6
<i>Procambarus clarkii</i>	4.9	2.6
Fish	2.3	2.8
<i>Anguilla anguilla</i>	0.0	0.6
<i>Salmo trutta</i>	0.0	1.2
<i>Achondrostoma arcasii</i>	0.8	0.0
<i>Cyprinus carpio</i>	1.6	0.0
<i>Gobio lozanoi</i>	0.0	0.2
<i>Micropterus salmoides</i>	0.0	0.9
Amphibians	85.5	92.9
<i>Bufo bufo</i>	85.5	88.5
<i>Pelophylax perezi</i>	0.0	4.3
Reptiles	1.7	1.7
<i>Timon lepidus</i>	1.7	0.0
<i>Natrix</i> sp.	0.0	1.7
Undetermined rodents	5.5	0.0
H' (Shannon's diversity index)	0.5	0.4
D (Simpson's dominance index)	0.9	0.9

Slater, 2002). Interestingly, this behaviour has been reported for a large number of sites across Europe (Ruiz-Olmo *et al.*, 1998; Slater, 2002; Ayres and Garcia, 2007, 2009, 2011).

The aim of this note is to provide insights into the winter food habits of this recovering otter population of NW Spain.

The study was conducted in the Gándaras de Budiño e Ribeiras do Louro (GBRL), a 747 ha wide wetland including ponds, swamps and gallery forests associated with the basin of the River Louro. There are also many ponds created by clay extraction (for further details see Ayres and Garcia 2007, 2009, 2011). Common toads (*Bufo bufo*) and Iberian green frogs (*Pelophylax perezi*) occur in the ponds, while Iberian painted frogs (*Discoglossus galganoi*) can be found in their surroundings.

The shore of the water bodies was monitored looking for otter spraints in winter 2007-08 and 2008-09. Spraints found during the surveys (N = 21 and N = 32, respectively) were collected and stored to assess dietary patterns. In the laboratory, spraints were broken up through a sieve of 1mm mesh by pressurized water. Remains were then weighed with a digital scale (precision: ± 0.1 g), and prey were identified using keys (Felix and Montori, 1986; Conroy *et al.*, 1993; Miranda and Escala, 2002). Amphibians were identified by the ilium (Felix and Montori, 1986), which allowed us to confidently identify them to the species level. The biomass of each prey item was estimated by the correction factors proposed by Jedrzejewska and Jedrzejewski (1998). Results were expressed as percent relative biomass [%RB = (biomass of each

food item / overall estimated biomass) x 100]. Shannon's diversity index (H') and Simpson's dominance index (D') were calculated from RB values, by EcoSim 7.0 software (Gotelli and Entsminger, 2009).

Diet analysis showed that in GBRL common toads are the main prey of otters, representing 85.5-88.5 % of the biomass consumed (Tab. 1). Crayfish (*Procambarus clarkii*) and fish were food resources of minor importance in the diet of otters. Accordingly, diet diversity was very low ($H'_{2007-08} = 0.5$; $H'_{2008-09} = 0.4$), while Simpson's dominance index showed high values for both years ($D'_{2007-08} = 0.9$; $D'_{2008-09} = 0.9$).

Amphibians have been reported to be a valuable resource for Eurasian otters in several areas (Weber, 1990; Pikulik and Sidorovich, 1996; Clavero *et al.*, 2005; Remonti *et al.*, 2009).

With rare exceptions, among available species, otters prey upon frogs rather than toads (Weber 1990; Sidorovich and Pikulik, 1997; Clavero *et al.*, 2005). Observations on captive otters (Field D., comm. pers.) suggest that they do not consume the toads even though they play with them. This is not the case in GBRL (but see also Slater, 2002), where massive otter predation on toads may depend on both fish shortage (Ayes and Cordero, 2007) and exceptional toad availability during their breeding period. As pointed out by Ayres and García (2011), otter feeding behaviour in our study area fits well with optimal foraging theory (i.e. Stephens *et al.*, 2007), otters foraging most frequently on the larger female toads.

The River Louro is one of the most polluted rivers in Spain, and currently, otter recolonisation of the catchment involves only the northern parts of the wetland, including small streams and clay pits. Until the quality of the watercourse increases and fish recolonise it, the achievement of stable otter populations will depend on the correct

management of artificial ponds and restocking of autochthonous fish populations in the wetlands.

ACKNOWLEDGEMENTS

PG-D wants to thank the collaboration of P. García, D. Díaz, V. Arévalo and M. Querejeta. To D. Field (Dartmoor Otters and Buckfast Butterflies centre, UK) for his comments about the behaviour of otters toward toads in captivity. We also are grateful to D. Bird and Dr. H. Kruuk, for their valuable comments on a previous draft of the manuscript which improved our work.

REFERENCES

- Ayres C. and Cordero A. 2007. Site tenacity in European pond turtle (*Emys orbicularis*) hatchlings in North-western Spain. *Amph.-Rept.*, 28 (1): 144-147.
- Ayres C. and García P. 2007. Depredación de nutria *Lutra lutra* (Linnaeus, 1758) sobre sapo común *Bufo bufo* (Linnaeus, 1758) en el LIC Gándaras de Budiño (Galicia). *Galemys*, 19: 45-50.
- Ayres C. and García P. 2009. Abandoned clay mines: an opportunity for Eurasian otters in NW Spain. *IUCN Otter Spec. Group Bull.*, 26(2): 67-72.
- Ayres C. and García P. 2011. Features of the predation of the Eurasian otter upon toads in north-western Spain. *Mammal. Biol.*, 76: 90-92.
- Clavero M., Prenda J. and Delibes M. 2003. Trophic diversity of the otter (*Lutra lutra* L.) in temperate and Mediterranean freshwater habitats. *J. Biogeog.*, 30: 761-769.
- Clavero M., Prenda J. and Delibes M. 2005. Amphibian and reptile consumption by otters (*Lutra lutra*) in a coastal area in southern Iberian Peninsula. *Herpetol. J.*, 15: 125-131.
- Conroy J.W.H., Watt J. and Weeb, J.B., Jones A. 1993. A guide to identifica-

- tion of prey remains in otter spraint. An Occasional publication of the Mammal Society, 16. The Mammal Society, London.
- Delibes M. 1990. La nutria (*Lutra lutra*) en España. Serie Técnica. ICONA, Madrid.
- Felix J. and Montori A. 1986. Determinación de las especies de anfibios anuros del nordeste ibérico mediante el hueso ileon. *Misc. Zool.*, 10: 239-246.
- García P., Ayres C. and Mateos I. 2009. Seasonal changes in American mink (*Neovison vison*) signs related to Eurasian otter (*Lutra lutra*) presence. *Mammalia*, 73: 253-256.
- Gotelli N.J. and Enstminger G.L. 2009. EcoSim: Null models software for ecology. Version 7. Acquired Intelligence Inc. & Kesey-Bear. Jericho, VT 05465, <http://garyentsminger.com/ecosim.htm>.
- Jedrzejewska B. and Jedrzejewski W. 1998. Predation in vertebrate communities. The Bialoweza Primeval Forest. Springer-Verlag, Berlín.
- Jedrzejewska B., Sidorovich V.E., Pikulik M.M. and Jedrzejewski W. 2001. Feeding habits of the otter and the American mink in Bialoweza Primeval Forest (Poland) compared to other Eurasian populations. *Ecography*, 24: 165-180.
- Kruuk H. 1995. Wild otters, predation and populations. Oxford University Press, Oxford.
- Kruuk H. 2006. Otters. Ecology, behaviour and conservation. Oxford University Press, Oxford.
- Lodé T. 1996. Polecat predation on frogs and toads at breeding sites in western France. *Ethol. Ecol. Evol.*, 8: 115-124.
- Mason C.F. and Macdonald S.M. 1986. Otters: ecology and conservation. Cambridge University Press, Cambridge.
- Miranda R. And Escala M.C. 2002. Guía de identificación de restos óseos de los Ciprínidos presentes en España. Escamas, opérculos, cleitros y arcos faríngeos. *Ser. Zool.*, 28: 1-239.
- Pikulik M.M. and Sidorovich V.E. 1996. Seasonal prevalence in otter reproduction and amphibian availability. *Akademii Nauk Belarusi*, 40(6): 80-83.
- Remonti L., Prigioni C., Balestrieri A., Sgrosso S. and Priore G. 2008. Distribution of a recolonising species may not reflect habitat suitability alone: the case of the Eurasian otter (*Lutra lutra*) in southern Italy. *Wildl. Res.*, 35(8): 798-805.
- Remonti L., Balestrieri A. and Prigioni C. 2009. Altitudinal gradient of Eurasian otter (*Lutra lutra*) food niche in Mediterranean habitats. *Can. J. Zool.*, 87: 285-291.
- Ruiz-Olmo J., Jiménez J. and Margalida A. 1998. Capture and consumption of prey of the otter (*Lutra lutra*) in Mediterranean freshwater habitats of the Iberian peninsula. *Galemys*, (N.E.) 10: 209-226.
- Sidorovich V.E. and Pikulik M.M. 1997. Toads *Bufo* spp. in the diets of mustelid predator in Belarus. *Acta Theriol.*, 42: 105-108.
- Slater F. 2002. Progressive skinning of toads (*Bufo bufo*) by the Eurasian otter (*Lutra lutra*). *IUCN OSG Bull.*, 19: 25-29.
- Stephens D.W., Brown J.S. and Ydenberg R.C. (eds) 2007. Foraging. Behavior and ecology. University of Chicago Press, Chicago.
- Weber J. M. 1990. Seasonal exploitation of amphibians by otters (*Lutra lutra*) in north-east Scotland. *J. Zool.*, 220: 641-651.