Short note

Evidence of lesser horseshoe bat (*Rhinolophus hipposideros*) predation by otter (*Lutra lutra*) in a Welsh cave system

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Introduction

A significant number of studies have demonstrated unequivocally that the diet of otters (*Lutra lutra*) is strongly biased towards fish species (Jenkins et al. 1979, Kruuk 2001). A variable and occasionally significant proportion of this species' diet can, however, be derived from non-fish prey types. The relative importance of these non-fish inputs to the overall dietary intake of otters can vary considerably, seasonally and between locations (Beja 1991, Beja 1997).

It is well documented that otters regularly predate amphibians at specific times of the year (e.g. Sidorovich et al. 1998). It is also noted that otters are not averse to opportunistically and selectively pursuing mammalian prey on occasions. For example, in a two-year study on the seasonal diet of otters in north-east Scotland, Jenkins et al. (1979) found that otters actively preyed upon a wide range of mammals including lagomorphs and rodents.

The following short paper reports the first known occurrence of otter predation of a bat species.

Methodology

Between October 2003 and March 2004, a total of five spraints were recovered from a mine adit (horizontal mining tunnel) in northern Wales at an undisclosed location. In addition to these spraints, a significant (>1 kg in mass) amalgamated pile of spraints was located some 100 m within the adit adjacent to an established and recently used couch. The spraints and couch prey remains were collected (under licence from the Countryside Council for Wales), placed into labelled plastic bags and stored at -17 °C at the University of Wales Swansea until analysis could be conducted. Spraints were subsequently prepared using a standard protocol (see Conroy et al. 1993) and prey species identified using keys produced by Corbet (1964), Conroy et al. (1993), Yalden (1993) and by the use of a previously amassed reference collection of fish and mammalian remains.

Results

Prey within the five spraint samples was identified to species level for fish, and family for other groups (table 1). Due to the low sample size (n=5 + 1), and the specific aim of this paper, i.e. to report on the presence of a new dietary species, it was deemed inappropriate to present the data gathered as frequency of occurrence (%).

Table 1. The presence of different categories of prey in the mine adit spraints. X = prey remain present in spraint.

Prey category	Spraint				
	1	2	3	4	5
Anguilla anguilla	X	X	X	X	
Salmo spp.	X	X	X	X	X
Cyprinidae	X			X	
Percidae		X	X	X	
Gasterosteidae	X				
Pleuronectidae	X			X	X
Amphibia	X	X	X	X	X
Chriroptera					X

A total of three chiroptera scapulae were recovered from one of the spraints. These scapulae were subsequently identified as those of the lesser horseshoe bat (*Rhinolophus hipposideros*). Vertebrae were used to identify fish remains from the spraint mass found near the couch. All remains were identified to species level where possible (table 2). Whilst the number of vertebrae is given in the table to give an indication of relative importance of each fish species, the varying number of vertebrae in different species makes this a very general indication at best. Two incomplete lesser horseshoe skulls (but with upper jaws), a number of vertebrae and several broken humerus (with styloid processes intact) were recovered from this large deposit of spraints.

Discussion

To our knowledge, this is the first documented case of bat predation by otters in the United Kingdom or, indeed, anywhere else. Previous studies elsewhere have noted that generalist carnivores such as raccoons (*Procyon lotor*) and beech martens (*Martes foina*) will opportunistically exploit accessible and localised congregations of bats (Roer & Gudendorf 1994, Sparks et al. 2003). The cave adit at the focus of this baseline study supports a variable number of lesser horseshoe bats over the winter months (D.W. Forman, unpublished data). As the height of the roof within the adit is highly variable, it is not unfeasible that otters passing through these caves might opportunistically predate any bat within easy reach. We acknowledge that there is the possibility that otters were consuming bat carcasses located on the adit floors. Given that the energetic benefit of consuming dead bats is presumably relatively low, the likelihood of this occurring is, on balance, slight. The data presented here reveal that the presumed single otter using the site had consumed at least four lesser horseshoe bats. Individual reinforcement of this predatory behaviour could feasibly occur over time, potentially leading to selection of individual prey preferences within the otter meta-population of northern Wales. Furthermore, there is the potential opportunity for this foraging behaviour to be learnt by offspring observing their mothers feeding in this particular manner (Kitchener 1999). Such suggestions clearly need further, more detailed investigation. The results of such studies would begin to fill the considerable gap in our knowledge of prey selection, foraging strategies and social learning in carnivores.

Whilst the finding of this study is potentially problematic with respect to horseshoe bat conservation efforts, it is hard to imagine that otter predation could be a serious threat to the persistence of specific bat colonies due to the large number of available roost sites in the area. Indeed, it is more probable that human intrusion into such sites during certain times of the year is more of a threat to bats than the natural predatory behaviour of otters. Unpublished data collected over the last six months strongly suggests that otters regularly frequent mine adits in northern Wales. A study is currently underway, therefore, to determine the potential impacts and frequency

Table 2. Prey categories and number of vertebrae recorded from the adit couch prey mass.

Prey category	Number of vertebrae recorded	Notes
Anguilla anguilla (eel)	6071	
Salmo spp.	912	Both trout (*Salmo trutta*) and salmon (*Salmo salar*)
Rockling (Gadidae) spp.	539	Three-, four-, and five-bearded rockling (*Gaidropsarus vulgaris, Rhinonemus cimbruis, Ciliata mustela*)
Hetersomata (flatfish)	335	Flounder (*Platichthys flesus*), plaice (*Pleurinectes platessa*), dab (*Limanda limanda*) and sole (*Micostomus kitt*)
Percidae (perch)	318	Perch (*Percha fluviatilis*) and ruff (*Gymnocephalus cernua*)
Gasterosteus aculeatus	194	Three-spine stickleback (*Gasterosteus aculeatus*)
Non-rockling Gadidae spp.	165	Saithe (*Pollachius virens*) and cod (*Gadus morhua*)
Esox lucius (pike)	160	
Cyprinidae (cyprids)	156	Minnow (*Phoxinus phoxinus*), roach (*Rutilus rutilus*) and gudgeon (*Gobio gobio*)
Mugilidae (mullets)	47	Thick (*Crenimugil labrosus*) and thin-lipped (*Liza ramada*) mullet
Cottidae (bullheads)	35	Miller's thumb (*Cottus gobio*)
Gobiidae (gobies)	24	
Sparidae (sea breams)	19	
Labridae (wrasses)	15	
Callionymidae (dragonets)	9	
Serranidae (bass)	2	
Unidentified fish vertebrae	121	
Amphibia (anura)		67 *Rana temporaria* skulls or partial skulls recovered
Aves (birds)		Rail (Rallidae) remains
Rodentia		Field-vole (*Microtus agrestis*)
Chiroptera		two lesser horseshoe bats (*Rhinolophus hipposideros*)

of bat predation by otters in a larger number of mine adits. Moreover, this study should also highlight the conservation significance of maintaining adit access suitable for otters (as well as bats) within Britain.

The results of this study also provide an interesting 'snap-shot' of the diet of otters in this area of northern Wales. It is apparent that a significant proportion of the diet of otters in this area could be derived from estuarine or marine species, as well as from freshwater. Since the occurrence of some marine/estuarine prey groups is relatively high (although we note the low sample size), it is clear that the coastal zone is an important foraging habitat for otters in northern Wales. Previous anecdotal observations made in mine adits suggest that significant numbers of amphibians inhabit these sites. It is perhaps unsurprising, therefore, to find such a large number of frog skulls within the couch faecal mass. The presence of such prey (as well as the secluded nature of many of these sites) might also explain the willingness of otters to regularly enter adits, although this has yet to be formerly studied.

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Samenvatting

Aanwijzingen voor predatie van kleine hoefijzerneus (*Rhinolophus hipposideros*) door otter (*Lutra lutra*) in een mijn in Wales (Groot-Brittannië)

Uit een analyse van vijf spraints (uitwerpselen) van de otter (*Lutra lutra*) bleek dat deze vooral resten bevatten van verschillende soorten vis en amfibieën. In één van de spraints werden daarnaast drie schouderbladen van de kleine hoefijzerneus (*Rhinolophus hipposideros*) aangetroffen. Dit zijn, voor zover bekend, de eerste aanwijzingen voor predatie van vleermuizen door de otter. Op ongeveer 100 m van de vindplaats werd, dichtbij de ingang van een leger, een grote hoeveelheid samengeklonterde spraints gevonden. Na analyse bleken deze uitwerpselen, naast resten van vissen, amfibieën, vogels en veldmuizen, twee schedels van de kleine hoefijzerneus te bevatten. Vermoedelijk gaat het hier om één otter die tenminste vier individuen van de kleine hoefijzerneus heeft gepredeerd.

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