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Diet, ecology, and biosecurity: analysis of owl pellets from Skomer Island

Emily Compton[1*], Laura F. Daley[1], Ed M. Stubbings[2], Bee I. Büche[2] & Matt J. Wood[1]

[1] School of Natural and Social Sciences, University of Gloucestershire, Francis Close Hall, Cheltenham, GL50 4AZ
[2] Skomer Island, WildIlfe Trust for South and West Wales, c/o Lockley Lodge, Martinshaven, Pembrokeshire SA62 3BJ

[*] Corresponding author: emily-compton@hotmail.co.uk

Crynodeb

Mae tylluanod yn chwydu rhannau o'u bwyd na allant eu treulio fel pelenni, sy'n gallu rhoi gwybodaeth werthfawr am eu dulliau bwydo ac am boblogaeth eu hysglyfaethau. Archwiliwyd gweddillion ysglyfaethau ym mhelenni Tylluanod Bach *Athene noctua* a Thylluanod Clustiog *Asio flammeus* ar Ynys Skomer yn 2014, a chymharwyd ein canlyniadau ag astudiaethau blaenorol i chwilio am newidiadau ym mwyd y tylluanod o gyfnod cyn gynhared â 1970. Y prif grwpiau a ysglyfaethwyd oedd mamaliaid bychain; yn enwedig Llygoden Gota Skomer *Myodes glareolus skomerensis* (35.7% o fwyd y Dylluan Fach yn 2014; 36.7% o fwyd y Dylluan Glustiog) ac adar (29.8% o fwyd y Dylluan Glustiog yn 2014). Bwytawyd Llygoden y Maes *Apodemus sylvaticus*, Chwistlen *Sorex araneus*, Chwistlen Leiaf *Sorex minutus*, a'r Llyffant Cyffredin *Rana temporaria* gan y ddwy rywogaeth o ddylluan, a bwytawyd Llygoden Fach *Mus domesticus* a Chwningen *Oryctolagus cuniculus* gan Ddylluanod Clustiog. Gall archwilio pelenni fethu darganfod gweddillion ysglyfaethau bychain, megis anifeiliaid di-asgwrn-cefn. Yn fwyaf nodedig, cafwyd fod Tylluanod Clustiog yn teithio i'r tir mawr ac i ynys Skokholm i hela: cafwyd hyd i rywogaethau sy'n absennol o Skomer yn y pelenni, yn cynnwys y Llygoden Fach, Twrch Daear *Talpa europaea*, Llygoden Ffrengig *Rattus norvegicus* a hyd yn oed flew Mochyn Daear *Meles meles.* Gall hyn beryglu diogelwch biolegol yr ynys rhag mamaliaid bychain mewnlifol: rydym yn argymell archwilio pelenni tylluanod yn rheolaidd i gael rhybudd cynnar o'r posibilrwydd o rywogaethau mewnlifol, a chyfle i astudio deinameg ecolegol poblogaethau mamaliaid bychain.

Summary

Owls regurgitate indigestible components of their diet as pellets, which can provide valuable information on predator feeding behaviour and prey populations. We examined the prey remains in the pellets of Little Owls *Athene noctua* and Short-eared Owls *Asio flammeus* on Skomer Island in 2014, and compared our results to previous studies to investigate changes in owl diet from as early as 1970. The dominant prey groups were small mammals; particularly Skomer Voles *Myodes glareolus skomerensis* (35.7% of Little Owl diet in 2014; 36.7% of Short-eared Owl diet) and birds (29.8% of Short-eared Owl diet in 2014). Wood Mouse *Apodemus sylvaticus*, Common Shrew *Sorex araneus*, Pygmy Shrew *Sorex*

minutus, and Common Frog *Rana temporaria* were also consumed by both owl species, and House Mouse *Mus domesticus* and European Rabbit *Oryctolagus cuniculus* by Short-eared Owls. Pellet analysis may not be effective in detecting the predation of smaller prey items of owls, such as invertebrates. Most notably, we found that Short-eared Owls travel to the mainland and Skokholm Island to hunt: species not found on Skomer were found in pellets, including House Mouse, European Mole *Talpa europaea*, Brown Rat *Rattus norvegicus* and even hair from European Badger *Meles meles*; none of which are present on Skomer Island. This presents a potential risk to island biosecurity from invasive small mammals: we recommend regular monitoring of owl pellet remains as an early-warning indicator of the potential introduction of invasive species, and an opportunity to study ecological dynamics of small mammal populations.

Introduction

Pellet analysis is a non-invasive and inexpensive method of studying the feeding ecology of owls (Williams *et al*., 2012); as they regurgitate hair, feathers, bones and bone fragments to provide data on the diet of particular owl species and populations. The careful dissection and examination of pellets gives a true and full representation of all the vertebrate prey an owl has ingested, and no important part of their diet is overlooked (Southern, 1954). Studying pellets provides an accurate assessment of diet and the consumption of small mammals that is difficult to record solely through direct observation (Simmons *et al*., 1991). The biomass of each species is taken into account by multiplying the biomass of each species by the number of each prey present, giving an estimate of the total biomass of each species in owl diets, and thus the relative importance of each prey species. Assessing the presence of small mammals can be achieved by live-trapping and spotlighting, but these methods are labour-intensive and often incapable of detecting rare, trap-shy or elusive species (Laurance, 1992). Owl pellet analysis avoids these and other logistical problems including bait selection, and logistically challenging trapping schedules to maintain ethical standards (McDonald *et al*., 2013). Pellet analysis can also offer insights on a number of ecological questions; revealing predator-prey relationships and prey selection biases (Votier *et al*., 2001), as a source of DNA to gain further insight into conservation biology and behavioural ecology (Taberlet *et al*., 1999), and to monitor island biosecurity and the introduction of non-native species (Russell et al., 2008).

The diet of Little Owls has been studied extensively across Europe (Goutner & Alivizatos, 2003; Angelici *et al*., 1997), and more recently in Britain after reintroduction in the late 19th century (Hounsome *et al*., 2004). Although now widespread across England and Wales, breeding bird survey data suggest that Little Owl numbers are declining, with the UK population estimated to be down by 24 % between 1995 and 2008 (Balmer *et al*., 2013). A declining population emphasises the value of understanding their diet. Previous studies on Skomer Island examine Little Owl pellets between 1998 and 2004 (Hayden, 2004; Green *et al*., 2005), with particular interest being paid to their detrimental effect on local populations of European Storm Petrels *Hydrobates pelagicus*. In 1954, Little Owls were removed from neighbouring Skokholm Island and have since been blamed for Storm Petrel population declines on Skomer (Lockley, 1983), specifically for predation of breeding colonies at two sites, The Mew Stone and Tom's House, in the 1980s (S. Sutcliffe, pers. comm.). The diet

of Short-eared Owls is less well studied (Glue, 1977; Roberts & Bowman, 1986) perhaps due to a more limited breeding range and attraction to remote areas. Skomer Island is one of the most important breeding sites for the Short-eared Owl in southern Britain, with up to five pairs usually nesting each year (and as many as 13 pairs in 1993).

In this study, we aimed to examine the diet of Little Owls and Short-eared Owls on Skomer Island in 2014, and compare data to those in previous years between 1970 and 2014. We assessed the potential for biosecurity threats from invasive small mammals.

Methods

Study site and owl pellet collection

Skomer Island, Wales (51°40′N, 05°15′W) is a National Nature Reserve managed by the Wildlife Trust of South and West Wales under a lease from Natural Resources Wales. Pellets were collected systematically in April 2014 by LFD; island wardens, researchers and volunteers also collected further pellets between March and April from both species at scattered sites across the island. As the island is only inhabited from March to end of November, it can be expected these pellets were regurgitated between December 2013 and April 2014. Pellets were collected again in August 2014 (by EC) in a similar way. Potential old nest sites (no nests of schedule 1 species i.e Barn Owl *Tyto alba* were approached during this study) and current roosting sites were identified with advice on sightings from island staff, in addition to maps of pellet collection in April). By careful searching, pellets were collected particularly from rocks and on walls around the island. Pellets were placed into separate air-tight bags or paper envelopes labelled with the date and location, and stored at 4ºC in a refrigerator until dissection in the laboratory.

Pellet Analysis

54 pellets in total (22 Little Owl, 32 Short-eared Owl) were collected across 2014 in April and August and were analysed using the methods in Yalden (2009). Pellets were individually soaked for 48 hours in 200ml of 5% saline solution to ease dissection and act as a disinfectant prior to dissection. The matrix (basic material) of each pellet was noted to provide information on the species that may be present. Pellets were teased apart using tweezers, enabling species identification by examining jaw bones (Thomas, 2008; Yalden, 2009) – a hand lens was used where necessary. The matrix was retained and frozen for any later analysis, and bones were stored for further observation and reference. The total number of prey items from each species was recorded. The relative abundance of each species was first assessed to indicate whether identified species were as expected, and that no errors were made. The total biomass was calculated by multiplying the biomass of each individual species by the number of each prey type found (Hayden, 2004). This was converted to a percentage to show the importance of each prey species in the diet of both owls. Determining the contribution of invertebrates to total biomass is difficult, therefore the contribution of invertebrates in Little Owl diet is analysed in terms of percentage occurrence only (Romanowski *et al.*, 2013). Bone remains were counted as the same individual if a pellet contained the remains of the skull and the right and left lower jaw bones of the same species (Dupal & Chernyshov, 2013). Similarly, if only a fraction of a species was found

within a pellet, it was assumed only a fraction of that species was consumed. As in Hayden (2004), the biomass of each species consumed was calculated by multiplying by the number of each prey species present by the known biomass of an individual of that species, to estimate the total biomass contributed by all species in both owls' diet. Converting the individual species' biomass into a percentage shows the relative importance of each prey type in overall diet as opposed to the abundance alone (Yalden & Morris, 1990) so that diet is assessed more accurately. Some masses have been applied from previous research (Hayden, 1999; cited in Hayden, 2004). A jawbone identified from a Brown Rat was present in a Little Owl pellet in 2012. The percentage biomass of this species has been omitted from the results as it causes a unique skew in 2012 data that cannot be compared to other research years where Brown Rat was not a component of the diet. Biomass for *Aves* was calculated using the mean biomass for both Storm Petrel and Manx Shearwater *Puffinus puffinus* carcasses. Although a Little Owl is unlikely to kill and eat a whole shearwater, both seabird species have been recorded in the diets of both Little Owls and Short-eared Owls on Skomer, and we retain this method for comparison with Hayden (2004). Biomass values for stones and fish otoliths that were found in any pellets were individually weighed, used to calculate percentage biomass. Otoliths were identified according to Härkönen (1986). 'Total other' includes invertebrates, otoliths, stones and marine snails. We must bear in mind that individual specialisation in particular prey items and seasonal variation in the availability and choice of prey may influence diet studies.

Statistical analysis

Owl pellet biomass data from 2014 were not normally distributed, and so were subjected to non-parametric analyses for testing differences between groups, and Spearman's rank order correlation for testing relationships between Little Owl and Short-eared Owl diets. Changes in diet over time were tested using Chi-square tests using proportion of biomass. Statistical significance was set to $P<0.05$ and all analyses were carried out using SPSS 20.0 (IBM, New York, USA).

Results

In April 2014, a total of 28 pellets were collected: 16 Short-eared Owl pellets and 12 Little Owl pellets. In August 2014, a total of 26 pellets were collected: 16 Short-eared Owl and 10 Little Owl pellets. In all years, the diet of both owl species is comprised predominantly of Common Shrew, Pygmy Shrew, Wood Mouse and Skomer Vole (Tables 1a & b). European Rabbit also made a surprisingly large contribution to Short-eared Owl diet in 1973 and 2012. House Mouse remains were also present in Short-eared Owl diet in 2014, while in 2012 an Oystercatcher *Haematopus ostralegus* foot (most probably from a chick) and a single Brown Rat jawbone were found in Little Owl pellets. Badger hair was found in a Short-eared Owl pellet in 2012.

Table 2 shows the estimates of biomass for each species present in the pellets analysed. The most abundant species in the diets of both owl species was the Skomer Vole, accounting for 35.7% of the diet of Little Owls (Figure 1a) and 36.7% of the diet of Short-eared Owls (Figure 1b). The percentage biomass of small mammals and birds present in Little Owl diet did not differ significantly between 1973, 2003 and 2014 (Kruskal-Wallis test:

χ^2=0.764, df=4, P=0.943; Figure 2), groups of species that accounted for between 81% and 98% of the total Little Owl diet in these years. There was a large decrease in the biomass of birds in the Short-eared Owl diet in 2014 (10.3%) in comparison with 1970-71 (41.0%). The particularly low biomass in 2014 may be due to the particularly low levels recorded in August 2014 (4.7%). Despite the variability, the percentage biomass of Skomer Vole and European Rabbit did not differ significantly between 1970-71, 2012 and April and August 2014 (Kruskal-Wallis test: χ^2=2.833, df=3, P=0.418; Figure 3). Figure 3 shows a change in both owl diets between 2012 and 2014. However, the changes in both owl diets are not significant. Little Owl diet (Mann-Whitney U test: U=24, n_1=7, n_2=7, P=0.951), Short-eared Owl diet (Mann-Whitney U test: U=18, n_1=7, n_2=7, P=0.455) between 2012 and 2014. Little Owl diet did not vary seasonally (Wilcoxon signed rank test: T=3, n=2, N=2, P=0.180; Figure 4). The biomass of species present in Little Owl and Short-eared Owl diets across 2014 differed significantly between owl species (χ^2=121.47, df=7, P<0.001).

Other prey species

Fish otoliths (Figure 5) were present in both Little Owl pellets and Short-eared Owl pellets, but occurred more frequently with higher biomass in Little Owl diet (+1.46% compared with Short-eared Owl pellets). All otoliths present were approximately the same size and seemed to be from the same few species. The otoliths present in the owl pellets (Figure 5) were identified as Haddock *Melanogrammus aeglefinus* (5A) and Round Herring *Etrumeus teres* (5B) (Härkönen, 1986).

Discussion

We found that the diets of Little Owls and Short-eared Owls were markedly different, but that diets did not vary between Spring and Summer, or between studies in different years: small mammals including Skomer Vole, Wood Mouse, Common Shrew, Pygmy Shrew and European Rabbit and birds have consistently dominated the diets of both owls diets on Skomer Island since the 1970s, and invertebrates were also an important prey species in Little Owl diets. Prey items of marine origin were consumed by both owl species in 2014: otoliths from Round Herring and Haddock were found in owl pellets. We also found evidence that Short-eared and Little Owls hunt on the mainland or neighbouring islands; with the remains of House Mice, Brown Rat and even Badger being found in pellets, even though none of these species are found on Skomer. The number of pellets collected is large enough that diet should be accurately represented in this study (Hayden, 2004).

Patterns in owl diets

Although both owl species preyed predominantly on small mammals, there was a highly significant difference in the biomass of prey consumed by each owl species. This apparent lack of dietary overlap may indicate that there is relatively little competition between both species, which are able to coexist largely due to their different habitat preferences, nesting requirements, hunting styles and movements to the mainland (Lynch, 2007).

Little Owl diet showed greater seasonal variation (April to August) than Short-eared Owl diet, although the differences were not statistically significant. This was similar to previous

work on Skomer (Hayden, 2004) and may reflect Little Owls' opportunistic ability to exploit changing food resources (Hibbert-Ware, 1938; Heaver, 1987, Cramp 1985; Mikkola, 1983; Goutner & Alivizatos, 2003). Invertebrates were an important prey for Little Owls, present in over 90% of pellets (Romanowski *et al.*, 2013; Mikkola, 1983), however, in terms of biomass this accounted for very little of the diet. Several previous studies have also shown insect prey, including *Coleoptera* to be an important food source for the Little Owl (Hibbert-Ware, 1938; Collinge, 1922). Whereas insect remains were present in 19 Little Owl pellets, they were only present in three Short-eared Owl pellets. Small mammals were the staple food of Little Owls (as in Gotta & Pigozzi, 1997), primarily Skomer Voles. Birds were also common in the diet, comprising (as in Hayden, 2004) nearly 50% of prey biomass.

Previous concerns about the predation of breeding Storm Petrels by Little Owls (Green *et al.*, 2005) is unclear, as this study found no pellets consisting of Storm Petrel remains. However, Storm Petrels have been regularly found in recent years around Little Owl nest sites on the Island (D. Boyle, per comm.), and pellets were collected from these nest sites. Pellet analysis alone may not be effective in monitoring the numbers of Storm Petrels predated by Little Owls, and individual predators may specialise in certain prey items for distinct periods of time: Storm Petrels remains have certainly been recovered from owl pellets on Skomer in the past, and around Little Owl nest sites during pellet collection for this study in 2012-13 (MJW, pers. obs.). As might be expected for a larger owl, the total biomass of prey consumed by Short-eared Owls is much higher than that of the Little Owl over the whole year. Again, Skomer Voles were the most common prey species although birds made up more than a third of Short-eared Owl diet in August. Yalden (1985) also found that voles were the predominant prey item of this owl species, with birds being of secondary importance. In 1970-71, Short-eared Owl diet mainly consisted of Skomer Voles and European Rabbits (Figure 4), with Wood Mice and birds being of secondary importance (Glue, 1977).

The presence of otoliths in both species' pellets is interesting in apparently terrestrial predators, and previously unrecorded to our knowledge. Van Damme (2005) suggests owls may feed on fish when more common prey such as voles are less accessible. Otolith presence may provide details on the birds they are preying on and their diet, as opposed to the owl's preying on fish themselves. For example, the owls are known to prey on Manx Shearwaters, which have a diet of fish including clupeids, sandeels and squid (Brooke, 2010). The owls may be feeding on the stomach contents of seabirds through predation, or scavenging regurgitated remains e.g. from gulls. This seems more likely than kleptoparasitism of seabirds by owls causing regurgitation of fish, and we presume that the hunting of fish by owls at sea is even less likely. Unfortunately, otoliths recovered from pellets are not a reliable indication on of the size of the original fish, as they can be reduced in length, becoming fragile in the digestive tract (Duffy & Laurenson, 1983; Votier e*t al.*, 2001), so we cannot speculate on the size of fish consumed, which may indicate the species of seabird that captured the fish.

Off-island prey items and biosecurity

This and previous studies have shown that both island species hunt away from Skomer Island, because prey items not found on the island have been found in owl pellets collected

on Skomer. Remains of House Mice (found on the mainland and nearby Skokholm Island) were identified in Short-eared Owl pellets. Pellets collected from Skomer in winter 2014-15 have been found to contain Field Vole *Microtus agrestis* remains (Jason Moss, pers. obs.), another small mammal species not native to the island (Davis & Saunders, 1965). This comes as no surprise, as Short-eared Owls travel from Skomer to hunt Storm Petrels on Skokholm Island, where neither owl species breeds, and where the remains of Storm Petrels have been found in Short-eared Owl pellets (MJW pers. obs; R. Brown & G. Eagle, pers. comm.): this owl species clearly has the capacity to hunt across a wide range. A surprising mammal remain came in the form of a Badger hair, found in a Short-eared Owl pellet in 2012. This raises questions about the foraging behaviour of Short-eared Owls, which are assumed to be exclusively predatory and not carrion eaters (Cramp, 1985).

The presence of Brown Rat in Little Owl pellets may appear, at first glance, to be of concern. A single Brown Rat jaw was found amongst a number of Little Owl pellets in a small cave in 2012, in close proximity to a Little Owl roosting site, and Glue (1977) found Brown Rat remains in Short-eared Owl pellets on Skomer between 1964 and 1973. Rats are commonly recorded as prey of Little Owls on the mainland (Hounsome *et al*., 2004). The movement of owls to the mainland to hunt is notable, and perhaps unsurprising (in 1973 on Skomer this included European Mole). The transportation of Brown Rats by owls from the mainland to Skomer presents a theoretical biosecurity risk for a currently rat-free seabird island (requiring the transport of multiple live or a pregnant female rat), but we consider this to be highly unlikely. It is possible that gulls brought the rat jaw to the island, which was subsequently moved by a scavenger. The introduction of rats to Skomer Island by owls is highly improbable compared to the risk of introduction of ground predators through human activities, for example in the transport of luggage, food and materials to the island. To safeguard Skomer against natural or anthropogenic introduction of rats a robust system of hazard alerts and quarantine procedures is in place and implemented fully. Skomer holds an emergency rodent kit comprising chew-sticks and break-back traps. Of the 'non-native' prey species discovered in pellets, the introduction of House Mouse, although known to be a problem on seabird islands elsewhere in the world (Wanless *et al.*, 2007), is thought to be of low risk, as competition from the already present Wood Mouse and evidence from Skokholm Island on the diet of House Mice suggest that an introduced population of this species would be unlikely to persist to the levels where eating seabirds would become problematic (Berry 1968).

Continued monitoring of owl diets by pellet analysis might be considered on Skomer, to build up a long-term data set that could be used to study predator-prey interactions. For example the associations between the size of small mammal and Short-eared Owl populations may be of interest, with long-term data available in island bird records and from small mammal monitoring data dating back to the 1970s (Healing et al. 1983). As a biosecurity measure, systematic pellet analyses (Russell et al., 2008) to complement the rat-eradication plan described above may be useful, as the early detection of an invasion would be crucial to enable an effective response. Conservation management and the ecological study of island wildlife are clearly closely intertwined.

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	% Total Biomass			
Prey species	**2003**	**2012**	**2014 April**	**2014 August**
European Rabbit	0.0	37.3	0.0	0.0
Common Shrew	0.0	1.1	1.6	5.6
Pygmy Shrew	0.0	1.1	1.7	0.0
Wood Mouse	20.0	15.5	31.5	12.5
Skomer Vole	21.7	13.6	37.5	29.7
Total mammals	41.7	68.6	72.3	47.8
Total birds	43.5	29.8	4.7	47.2
Total herptiles	2.9	0.3	22.2	4.1
Total other	11.9	1.3	0.8	0.9

Table 1a. Little Owl diet on Skomer Island in 2003, 2012 and 2014.

	% Total Biomass			
Prey species	**1973**	**2012**	**2014 April**	**2014 August**
European Rabbit	78.9	70.4	14.7	4.7
Common Shrew	2.1	0.0	2.0	0.3
Pygmy Shrew	0.0	0.0	0.6	0.6
Wood Mouse	2.3	8.7	9.6	3.7
House Mouse	0.0	0.0	3.3	17.3
Skomer Vole	6.4	8.6	37.1	36.1
Total mammals	89.7	87.7	67.3	62.7
Total birds	9.0	12.2	24.5	36.8
Total herptiles	1.3	0.1	8.1	0.4
Total other	0.0	0.0	0.1	0.1

Table 1b. Short-Eared Owl diet on Skomer Island in 1973, 2012 and 2014.

Species	Biomass (g)	Reference
Skomer Vole *Myodes glareolus*	25	Fullager *et al.* (1963)
Wood Mouse *Apodemus sylvaticus*	18	Yalden (2009)
House Mouse *Mus domesticus*	12	Yalden (2009)
Common Shrew *Sorex araneus*	8	Yalden (2009)
Pygmy Shrew *Sorex minutus*	4	Yalden (2009)
European Rabbit *Oryctolagus cuniculus*	50-1100	Graham (2012)
Birds *Aves*	226	
Storm Petrel *Hydrobates pelagicus*	28	Cramp and Simmons (1977)
Manx Shearwater *Puffinus puffinus*	350-535	Cramp and Simmons (1977)
Common Frog *Rana temporaria*	30	Graham,(2012)
Brown Rat *Rattus norvegicus**	100	Morris (1979)
Ground Beetles *Carabidae*	0.2	Yalden & Warburton (1979)
Dor Beetles *Geotrupes*	1	Yalden & Warburton (1979)
Leaf Beetle *Chrysomelidae*	0.1	Hayden (1999)
Ants *Formicidae*	0.1	Hayden (1999)
Woodlice *Oniscidea*	0.3	Hayden (1999)

Table 2. Individual biomass estimates of prey species present in pellets collected from Little Owls and Short-Eared Owls on Skomer Island 2012-2014. * Brown Rat was present in one pellet in 2012 but is omitted from biomass calculations (along with other sporadic prey items such as Oystercatcher) to avoid skew of diet composition

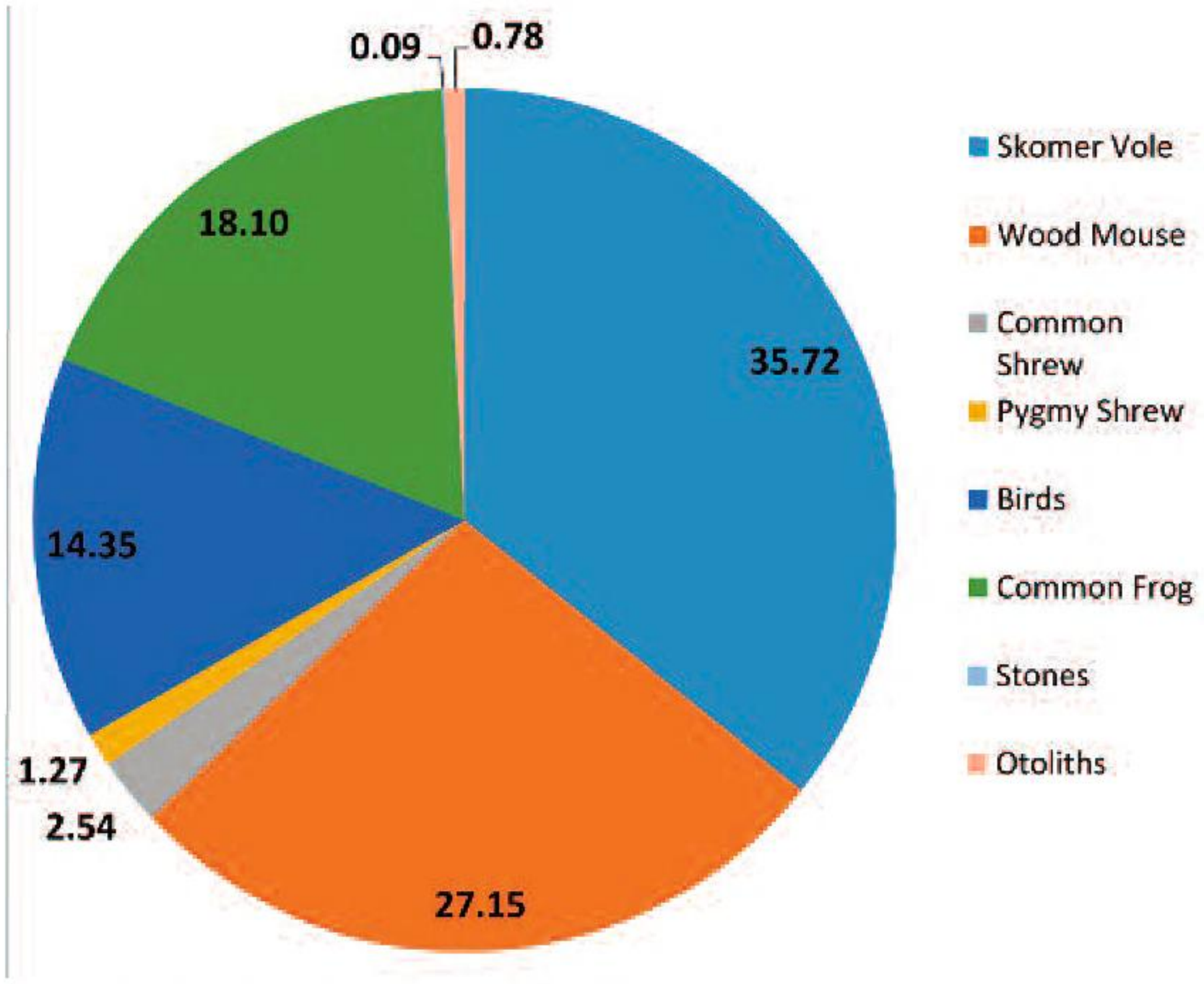

Figure 1a. The relative biomass of prey species in the diet of Little Owls on Skomer Island in 2014.

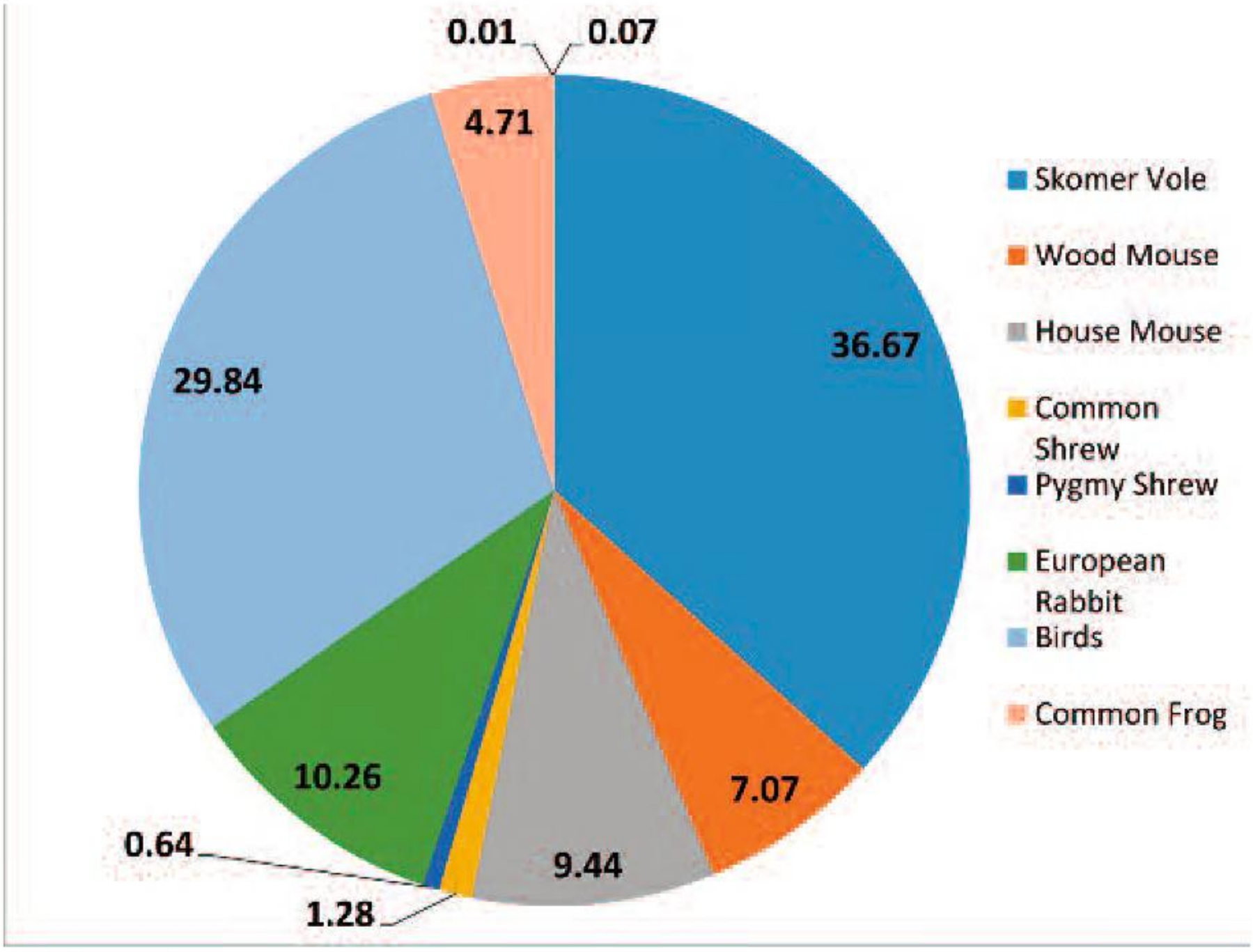

Figure 1b. The relative biomass of each prey species in the diet of Short-Eared Owls on Skomer Island in 2014.

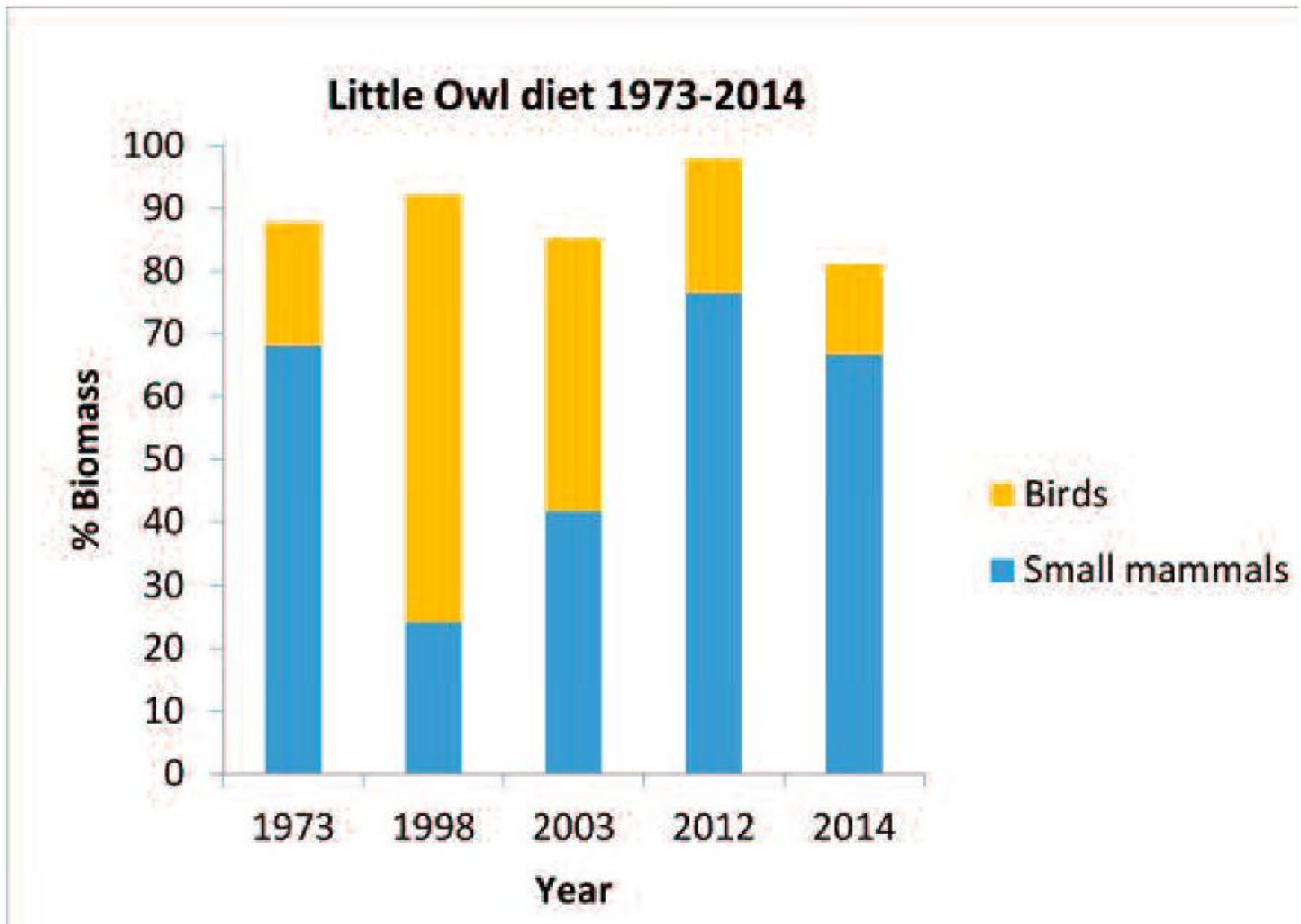

Figure 2a. The percentage biomass of small mammals and birds found in Little Owl pellets between 1973-2014 (Hayden, 1999; Daley, 2012). Brown Rat *Rattus norvegicus* omitted.

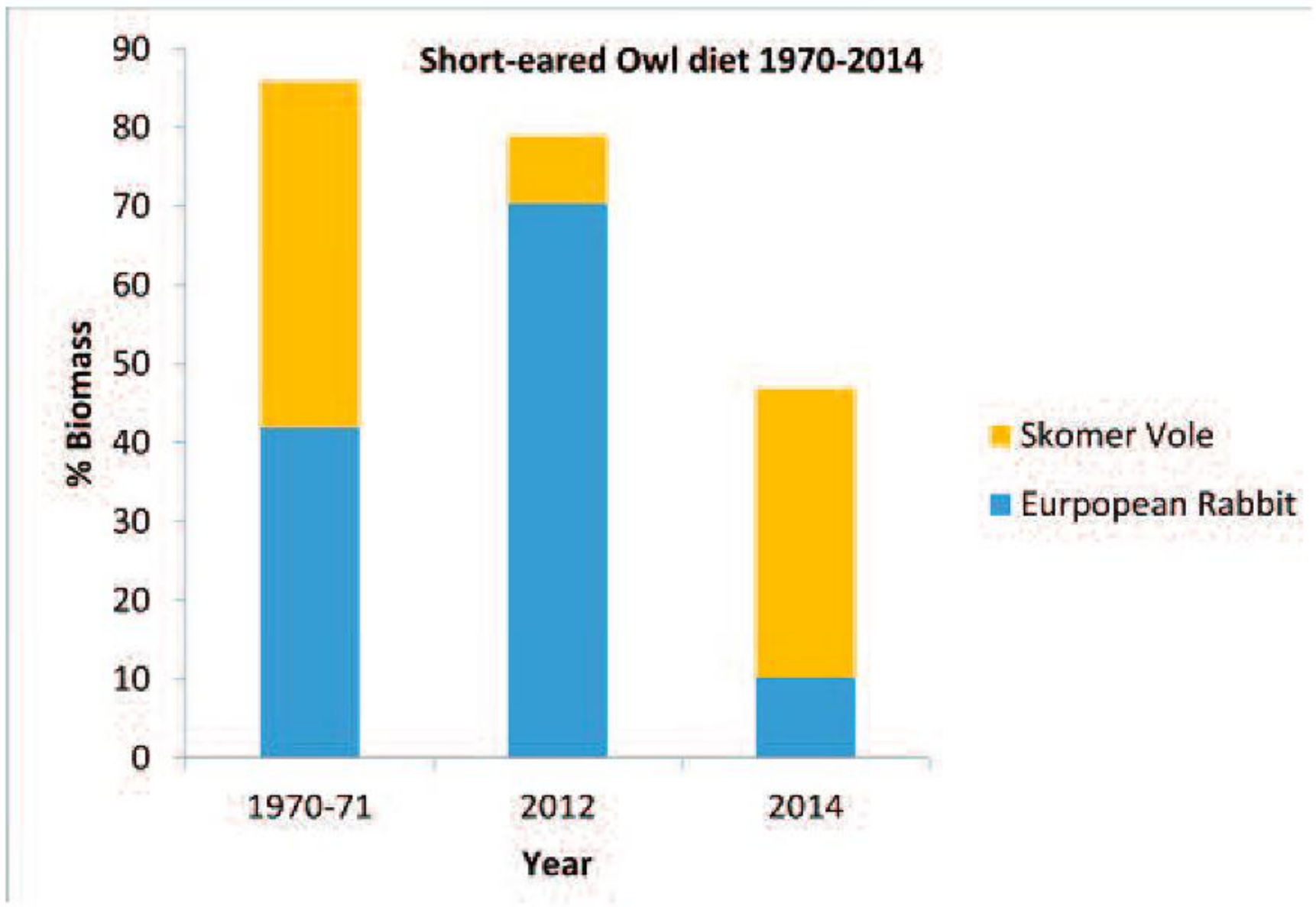

Figure 2b. Percentage biomass of Skomer Voles and European Rabbit found in Short-Eared Owl pellets 1970-71 (5 pairs: Glue, 1977), 2012 (2 pairs: Daley, 2012) and 2014 (3-4 pairs).

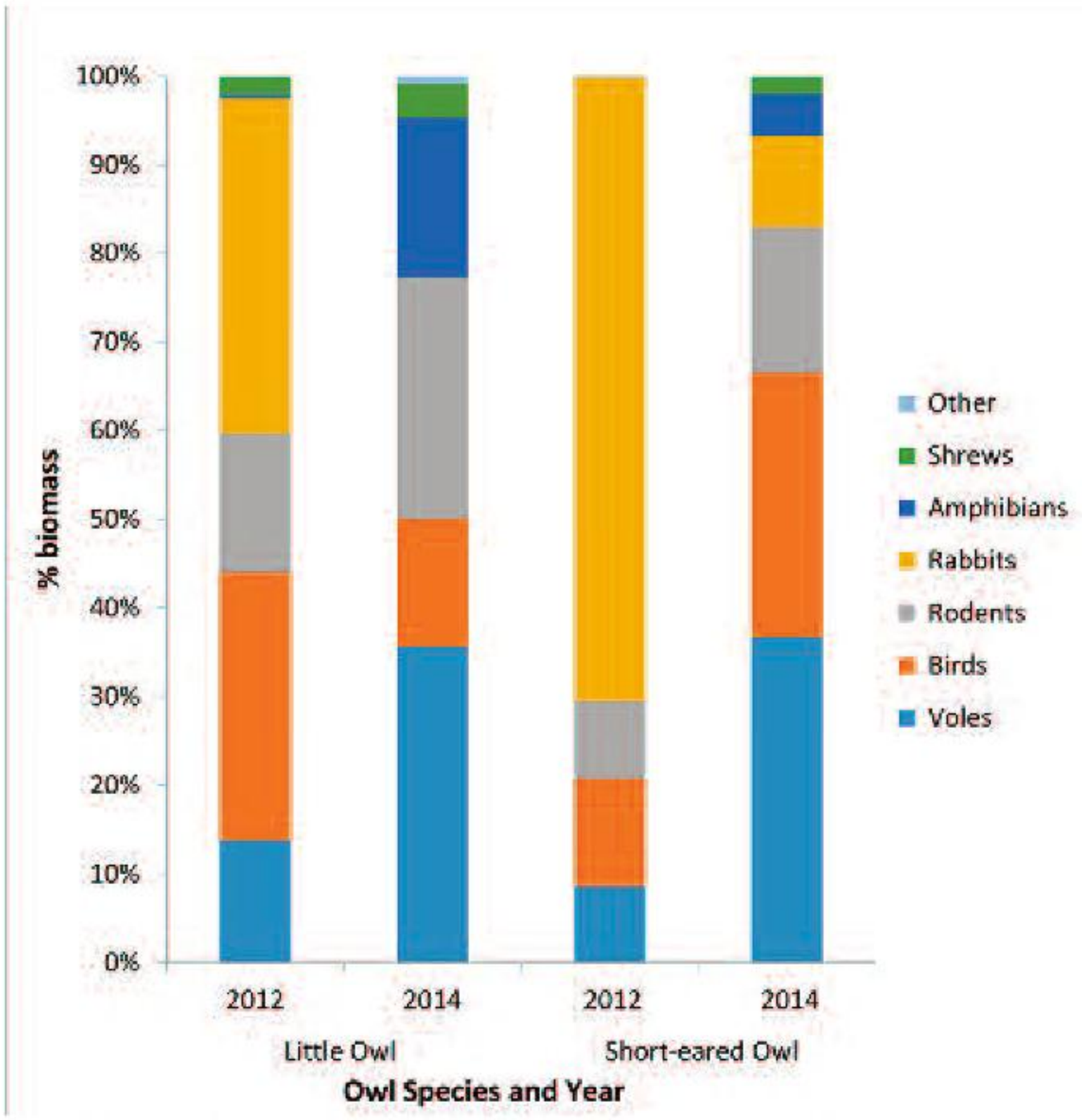

Figure 3. Variation of Little Owl and Short-Eared Owl diets by % biomass of prey in 2012 and 2014.

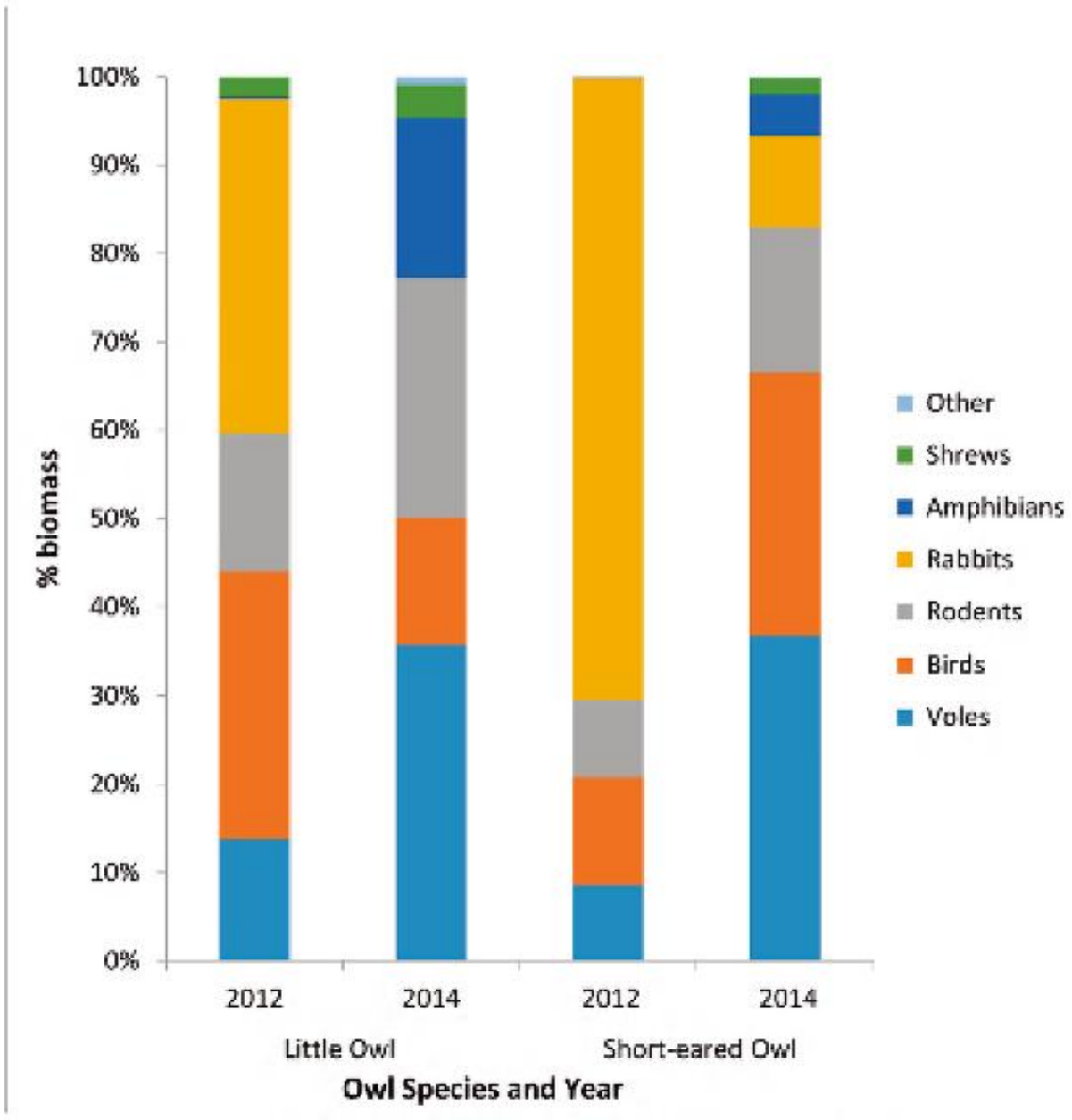

Figure 4. Seasonal variation of the diets of Little Owl and Short-Eared Owl diets in 2014 by % biomass of prey.

Figure 5. Examples of fish otoliths found in Little Owl and Short-Eared Owl pellets in 2014. A: Haddock *Melanogrammus aeglefinus* and B: Round Herring *Etrumeus teres.*