

Food of the Long-eared Owl *Asio otus* in Sweden

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The paper describes the diet of the Long-eared Owl, as determined from analyses of pellets (ca. 14 000 prey items) collected at various localities in southern Sweden. The results of this and other Swedish investigations show a strong dominance of *Microtus* and *Apodemus* in the diet. The breadth of the food niche is similar in Scandinavia and central Europe.

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Introduction

Considering the ease with which pellets of the Long-eared Owl *Asio otus* can be collected and analysed, it is hardly surprising that information on its diet is available from such different areas as a garden with date palms in Iraq (HARTLEY 1947) and timber-line regions in Norway (HAGEN 1965). Several papers have dealt with its food in Fennoscandia (see references in HAGEN 1965; SOIKKELI 1964, SULKAVA 1965, GERELL 1968, JENSEN 1968, JÖNSSON & SCHAAR 1970, HILLARP 1971) and elsewhere (for references see SMEENK 1972). This paper on the diet of the Long-eared Owl in Sweden presents analyses of pellets collected both in the breeding season and in winter, and compares them with the results of other Swedish studies.

Material and methods

About 14 000 prey items were identified in pellets collected rather unsystematically in various parts of Sweden

during 1961—1974. The pellets were usually moistened before analysis. Identification of vertebrate prey was based upon jaws of mammals, and bills and sometimes feet of birds. For *Coeloptera*, elytra, head capsules and legs were used. In each sample the highest number of jaws of each mammal species (whether left, right, or upper) was taken to represent the proportion of that species in the diet. Of course, certain prey animals may be better represented than others in the pellets (SOUTHERN 1970, RACZYŃSKI & RUPRECHT 1974), or more easily found, but on the whole pellet analysis probably gives fairly reliable information.

The sample localities were as follows (see also Fig. 1).

1. The island of Sladö, N of Västervik. A breeding site in a stand of Scots Pine surrounded by grassy areas that had probably been grazed a few years earlier. Voles very abundant as judged from the numbers seen each day. May 1962.
2. Åbydalen, Gothenburg. A breeding site in a 18-ha pine wood, fields and meadows in the surroundings. a = 1965, b = 1967.
3. Kongsmarken, E of Lund. A golf-course bordered by fairly overgrown meadows; several spruce stands were used by Long-eared Owls in



FIG. 1. The localities in the southern third of Sweden where pellets of the Long-eared Owl *Asio otus* were collected.

winter and for breeding. a = breeding season 1966, b = breeding season 1967, c = winter 1965—66, d = winter 1966—67, and e = winter 1967—68. Data from this locality have been presented by GERELL (1968).

4. A breeding site on an island off Kristianopel. 1969.

5. Various breeding sites around the former lakes of Kvismaren. Pellets collected by Kvismare Bird Observatory 1961—70. Low-lying agricultural land, dominated by fields but with patches of overgrown meadows left, which, together with some likewise overgrown dikes probably constituted the main hunting areas of the Long-eared Owls. Most nests in stands of Scots Pine.

6. Revinge. A military training field; grassland on sandy soil with scattered stands and plantations of Scots Pine. Also low-lying, wet meadows. a = material collected around some 20 nests in 1972, b = a winter roost in 1968—69.

7. A winter roost of six owls in tall Junipers surrounded by agricultural land near Köping; pellets collected in March 1964. An unusually northerly wintering locality for Long-eared Owls in Sweden.

8. A winter roost in a small spruce plantation W of Lund; close to sewage works with grassy areas, but most owls were seen dispersing into agricultural land and perhaps into suburban habitats at dusk. a = winter 1964—65, b = winter 1965—66, c = winter 1967—68.

9. A winter roost in 1965—66 in a pine stand near Bjärred, surrounded by fields and meadows.

10. A winter roost in a small pine stand between the Sound and a golf-course at Borstahusen in 1966—67.

11. A fairly big winter roost in a small pine plantation near Lomma in 1973—74. Surrounded by fairly extensive grassland and very young pine plantations; only a few hundred metres from a rubbish dump.

Results

The data, excluding beetles, are shown in Table 1. *Microtus agrestis* dominates numerically in most samples (45—90 % in summer, 40—80 % in winter). In three samples, wood-mice (*Apodemus sylvaticus* and *A. flavicollis*) are slightly more numerous. Although the wood-mice were not determined to species, *A. sylvaticus* was no doubt the more common species in all the samples. Therefore, the dominance of *M. agrestis* is even more pronounced on a weight basis. The shrews *Soricidae* seem to be rather unimportant, as do also *Clethrionomys glareolus*, *Arvicola terrestris* and *Rattus norvegicus*, although the two last species play a larger role on a weight basis. Numerically both reach 5 % at most.

In every sample, birds represent only a few per cent. Most of them are small passerines, particularly finches and *Passer* spp. Young Starlings *Sturnus vulgaris* occur in early summer samples and constitute some 40 % of the birds in 6a. In the winter total, Bullfinches *Pyrrhula pyrrhula* amount to 14 % of the birds, which seems to be much higher than their proportion of the passerine winter community. In 8a, Blackbirds *Turdus merula* constitute about a third of the birds, having presumably been taken at a nearby roost, while in sample 11, collected close to a rubbish dump, about 75 % of the birds were *Passer* spp.

TABLE 1. Food of the Long-eared Owl *Asio otus* in the southern third of Sweden. The localities (Fig. 1) are referred to by numbers. For details, see text. Numbers in italics give the percentage of each prey animal.

	Locality																		Total	
	1	2a	2b	3a	3b	4	5	6a	7	8a	8b	8c	9	3c	3d	3e	10	6b		11
<i>Sorex araneus</i>	—	1	1	18	—	—	39	29	4	31	16	—	25	11	20	—	6	47	1	249
	—	0.6	1.7	1.2	—	—	2.6	1.8	0.7	4.0	2.7	—	6.2	2.4	1.3	—	5.3	1.5	0.1	1.8
<i>Sorex minutus</i>	—	—	—	4	—	—	14	17	1	—	—	—	—	—	3	—	—	23	—	62
	—	—	—	0.3	—	—	0.9	1.0	0.2	—	—	—	—	—	0.2	—	—	0.8	—	0.4
<i>Sorex</i> sp.	—	—	—	—	—	—	5	—	—	—	—	—	—	—	—	—	—	—	—	5
	—	—	—	—	—	—	0.3	—	—	—	—	—	—	—	—	—	—	—	—	0.0
<i>Neomys fodiens</i>	—	1	—	—	—	—	—	—	—	—	1	—	—	—	—	—	1	1	—	4
	—	0.6	—	—	—	—	—	—	—	—	0.2	—	—	—	—	—	0.9	0.0	—	0.0
Bats	—	—	—	1	—	—	1	1	—	—	—	—	—	—	—	—	—	—	—	3
	—	—	—	0.1	—	—	0.1	0.1	—	—	—	—	—	—	—	—	—	—	—	0.0
<i>Clethrionomys glareolus</i>	—	—	—	17	1	—	54	14	1	12	11	—	4	4	23	—	2	40	19	202
	—	—	—	1.1	0.5	—	3.7	0.9	0.2	1.6	1.8	—	1.0	0.9	1.5	—	1.8	1.3	1.8	1.5
<i>Arvicola terrestris</i>	—	—	—	2	1	—	4	84	—	2	2	—	—	—	—	—	2	1	1	99
	—	—	—	0.1	0.5	—	0.3	5.1	—	0.3	0.3	—	—	—	—	—	1.8	0.0	0.1	0.7
<i>Microtus agrestis</i>	50	121	43	683	127	18	908	1139	443	382	413	27	175	257	884	144	46	2603	609	9072
	87.7	77.6	72.9	44.7	59.9	(90)	61.5	69.5	80.1	49.5	69.1	52.9	43.5	55.6	59.3	62.9	40.7	85.6	57.5	65.2
<i>Mus musculus</i>	—	1	1	13	2	—	16	15	20	12	4	—	3	2	5	—	—	2	3	99
	—	0.6	1.7	0.9	0.9	—	1.1	0.9	3.6	1.6	0.7	—	0.7	0.4	0.3	—	—	0.0	0.3	0.7
<i>Apodemus</i> sp.	—	32	13	735	69	2	119	297	83	312	139	23	189	180	526	84	49	313	357	3522
	—	20.5	22.0	48.1	32.5	(10)	8.1	18.1	15.0	40.5	23.2	45.1	47.0	39.0	35.3	36.7	43.4	10.3	33.7	25.3
<i>Mus/ Apodemus</i>	7	—	—	3	1	—	276	—	1	1	1	—	—	—	—	—	—	—	—	290
	12.3	—	—	0.2	0.5	—	18.7	—	0.2	0.1	0.2	—	—	—	—	—	—	—	—	2.1
<i>Rattus norvegicus</i>	—	—	1	2	1	—	1	—	—	2	1	—	1	1	1	—	2	2	27	42
	—	—	1.7	0.1	0.5	—	0.1	—	—	0.3	0.2	—	0.2	0.2	0.1	—	1.8	0.0	2.5	0.3
Birds	—	—	—	50	10	—	40	43	—	17	10	1	5	7	28	1	5	8	43	268
	—	—	—	3.3	4.7	—	2.7	2.6	—	2.2	1.7	2.0	1.2	1.5	1.9	0.4	4.4	0.3	4.1	1.9
Total	57	156	59	1528	212	20	1477	1639	553	771	598	51	402	462	1490	229	113	3040	1060	13917

TABLE 2. Food of the Long-eared Owl *Asio otus* in Sweden according to published studies. Numbers in italics give the percentage of each prey animal.

	Summer			Winter			
	LUNDIN (1960)	GERELL (1968)	Present study	GERELL (1968)	HILLARP (1971)	JÖNSSON & SCHAAR (1970)	Present study
<i>Talpa</i>	—	2	—	—	—	1	—
<i>europaea</i>	—	0.2	—	—	—	0.2	—
Soricidae	40	22	129	—	11	4	191
	1.5	1.8	2.5	—	1.8	0.8	2.1
Bats	—	—	3	—	2	—	—
	—	—	0.0	—	0.3	—	—
<i>Sciurus</i>	2	—	—	—	—	—	—
<i>vulgaris</i>	0.1	—	—	—	—	—	—
<i>Clethrionomys</i>	15	14	86	1	4	—	116
<i>glareolus</i>	0.6	1.2	1.7	0.1	0.6	—	1.3
<i>Arvicola</i>	11	1	91	—	—	1	8
<i>terrestris</i>	0.4	0.1	1.8	—	—	0.2	0.1
<i>Microtus</i>	1332	559	3089	423	328	164	5983
<i>agrestis</i>	49.9	47.2	60.0	62.3	52.6	32.5	68.2
<i>Mus</i> and	1194	564	1602	253	238	209	2309
<i>Apodemus</i>	44.8	47.6	31.1	37.2	38.2	41.4	26.3
<i>Rattus</i>	40	7	5	1	4	4	37
<i>norvegicus</i>	1.5	0.6	0.0	0.1	0.6	0.8	0.4
Birds	33	16	143	2	36	122	125
	1.2	1.4	2.8	0.3	5.8	24.2	1.4
Total	2667	1185	5148	680	623	505	8769

Although big dytiscids like *Dytiscus marginalis* are sometimes found in pellets in early spring, most beetles occur in summer, particularly around mid-summer, when *Geotrupes*, *Amphimallon* and *Melolontha* occur fairly commonly. Most *Amphimallon* and *Melolontha* were probably taken on a few nights with heavy emergence, when they may temporarily be the most economical prey, as judged from their highly clumped distribution in the pellets. In the breeding season sample from Revinge (6a), about 60 beetles in all were present, against 1600 vertebrates. Thus, on a weight basis, the insects play a minor role.

Discussion

Comparison with other investigations. In Table 2 the present data are com-

pared with the results of other published Swedish investigations of the diet of the Long-eared Owl. The proportions of the various prey animals are similar, except in the material of HILLARP (1971), which contains a higher proportion of birds than the others. The bulk of his material came from a park in central Malmö and thus originates from an urban environment (see also TINBERGEN's, 1933, data from Rotterdam, where birds totalled no less than 80 %).

The staple food of the Long-eared Owl in Sweden is *Microtus agrestis* and *Apodemus* spp. The proportion of the former species is higher in the present study than in others. Since my samples were collected rather unsystematically, more and bigger samples may have been obtained in vole years, which could explain this difference (cf. Table

TABLE 3. Breadth of the food niche of the Long-eared Owl *Asio otus* in Fennoscandia, measured with the diversity index *H*. Sources in parentheses.

	Finland	Sweden	Denmark
Summer	0.75 (SULKAVA 1965)	0.94 (GERELL 1968) 0.95 (LUNDIN 1960) 1.00 (present study)	—
Summer and winter	—	—	1.16 (SKOVGAARD 1920)
Winter	0.47 (SOIKKELI 1964) 0.86 (SULKAVA 1965)	0.69 (GERELL 1968) 0.84 (present study) 1.02 (JÖNSSON & SCHAAR 1970) 1.18 (HILLARP 1971)	1.04 (JENSEN 1968)

1; observe that the proportions of *Microtus* have varied between samples).

The breadth of the food spectrum. HERRERA & HIRALDO (1976) discussed the breadth of the food niches of European owls. For the Long-eared Owl in Scandinavia they presented a value of 1.47 for *H*, calculated from the data of HAGEN (1965). (*H* is a measure of food diversity and defined as Shannon's index of diversity; see HERRERA & HIRALDO 1976.) This value is much higher, i.e. indicates a broader food spectrum, than in any of the other Scandinavian studies cited here, where *H* ranges from 0.47 to 1.18 (Table 3). The reason for this seems to be that HAGEN's food list comprises material from very different areas and habitats, where different rodent species dominate. Although the *H*s calculated for the other Scandinavian investigations are slightly on the lower side, owing to the lumping of *Mus* and *Apodemus*, it is quite clear that the food niche of the Long-eared Owl has the same breadth in Scandinavia as in central Europe, where the *H* value given by HERRERA & HIRALDO (1976) was 1.00. This conclusion agrees with the fact that, although their proportions vary somewhat, *Microtus* and *Apodemus* have proved to be strongly predominant in almost all studies of the food of the

Long-eared Owl in Europe (e.g. SOIKKELI 1964 and SULKAVA 1965 for Finland, HAGEN 1965 for Norway, LUNDIN 1960, GERELL 1968, JÖNSSON & SCHAAR 1970, HILLARP 1971 and the present study for Sweden, SKOVGAARD 1920 and JENSEN 1968 for Denmark, UTENDORFER 1952, WENDLAND 1957 and ZIMMERMANN 1963 for Germany, TINBERGEN 1933 and SMEENK 1972 for the Netherlands, THIOLLAY 1968 for France, TICEHURST 1939, SOUTH 1966, WOOLLER & TRIGGS 1968 and GLUE & HAMMOND 1974 for England, FAIRLEY 1967 for Ireland, and ARMSTRONG 1958, cited in SOUTH 1966, for Michigan, U.S.A.). In particular, the importance of *Microtus* has been stressed (*M. arvalis* in Finland and the continent of Europe, *M. agrestis* in Norway, Sweden and most of Denmark, *M. oeconomus* on Texel and *M. pennsylvanicus* in North America).

It seems safe to conclude that the Long-eared Owl relies heavily on voles and mice, especially *Microtus*, and that its food niche is fairly restricted, at least compared with that of the Tawny Owl *Strix aluco* (SMEENK 1972, KÄLLANDER 1977). There is some evidence that the abundance of *Microtus* largely determines the breeding density of the Long-eared Owl (see discussion in KÄLLANDER 1977, where the risk of

circular reasoning with regard to owls and rodents is also emphasized), but the question of nomadism in this species is still unsettled (KÄLLANDER 1977).

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Selostus: Sarvipöllön ravinto Ruotsissa

Kirjoittaja on tutkinut oksennuspalloja, joista on määritetty 14 000 saaliseläintä. Kuvassa 1 on esitetty tutkimuspisteet. Taulukossa 1 esitetään päämääräaineisto. Peltomyyrän ja metsähiiren suvut vallitsevat sarvipöllön ravinnossa selvästi. Taulukossa 2 tuloksia verrataan muihin Ruotsissa julkaistuihin aineistoihin ja todetaan saatujen tulosten yhdensuuntaisuus. Sarvipöllön ravinnon monipuolisuutta on mitattu diversiteetti-indeksillä. Tulokset ovat varsin samankaltaisia eri puolilla Fennoskandian kootuissa aineistoissa (taulukko 3).

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