Nest visit frequencies and activity patterns of Ural Owls *Strix uralensis*

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Three Ural Owl *Strix uralensis* pairs were studied in western Finland in 1971 and 1976. During incubation their daily visits to their nests averaged 9.0, at the beginning of the nestling period 12.3 and at the end 13.7. The visiting frequency did not increase during the nestling period, although the weight of the young increased continually. The Ural Owls showed a biphasic activity pattern, with the highest peak in the late evening and a lower peak in the early morning. The owls fed their young in daylight as well, mainly in the morning. At least three factors regulated the activity: light, food and the number of nestlings. Since the most important prey items (small rodents) of Ural Owls were nocturnal in May and June, the daily rhythm of the predator corresponded well with the activity pattern of the staple prey. The southern Tawny Owl *Strix aluco* is nocturnal and needs the long dark nights in its distribution area for hunting. In contrast, the northern Great Grey Owl *Strix nebulosa* is active during both day and night; in its central range, the nights during the breeding period are light. As regards its range and activity pattern, the Ural Owl has an intermediate position among the Finnish *Strix* species.

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Introduction

Three sympatrically breeding *Strix* owl species (Ural Owl *S. uralensis*, Tawny Owl *S. aluco* and Great Grey Owl *S. nebulosa*) occur in the central and eastern parts of Finland (for distribution maps, see Hyytiä et al. 1983). The southernmost species is the Tawny Owl, which is nocturnal in the breeding season (Grönlund & Mikkola 1979). It hunts almost exclusively at night until the young are well grown and need large amounts of food. The northernmost species, the Great Grey Owl is active in the morning and evening as well, only ceasing to feed its young in the afternoon (Pulliainen & Loisa 1977). As regards its distribution area, the Ural Owl has an intermediate position between these two species.

The aim of this paper is to present the nest visiting frequencies and daily activity patterns of Ural Owls breeding in western Finland, and to compare the results with the corresponding data for other *Strix* spp. Since food may be an important factor affecting the activity, data on the diet of the owl pairs studied will also be presented.

Material and methods

Three nests were studied in Southern and Central Ostrobothnia, western Finland (breeding data in Table 1):

(1) Ylivieska 1971. A natural cavity in spruce dominated mixed forest, strongly thinned.

(2) Sievi 1971. A nest-box of the open type (see Mikkola 1983) in fairly dense spruce forest. The weights of the nestlings were determined with a spring balance to the nearest 1 g at intervals of 2 to 4 days.

(3) Lappajärvi 1976. A nest-box in spruce forest between two open bog areas.

We used three different types of automatic recording apparatus. A "Norma" recorder, made in Germany, was employed in nest 1. The apparatus in nest 2 was exactly the same as that used successfully earlier, e.g. in nests of the Pygmy Owl *Glaucidium passerinum* (Mikkola 1970), Tengmalm's Owl *Aegolius funereus* (Klaus et al. 1975) and the Tawny Owl (Grönlund & Mikkola 1979). A recorder made from a tachograph was put up in nest 3. This apparatus had been used earlier to record the activity of Tengmalm's Owls (Korpimäki 1981) and Starlings *Sturnus vulgaris* (Korpimäki 1982).

Pellets and prey remains were collected in the nests and near the nests in the sitting and roosting places of the fledglings and adult owls (see e.g. Huhtala et al. 1976, Korpimäki 1981, 1985).

Results

Frequency of nest visits. Nests 1 (two nestlings, Table 1) and 2 (three nestlings at the beginning and two at the end of the nestling period) were visited by the owls about two times more per day than nest 3 (only one nestling, see Table 1). This difference was significant (t-test, $P < 0.01$). The number of daily nest visits per nestling was about the same at both the beginning (6–7) and end of the nestling period (8–9) despite the fact that the number of nestlings varied from one to three (Table 2). Since the two nests studied during incubation (1 and 3) were visited almost equally frequently during that time, the number of nestlings is evidently an important factor affecting the frequency of nest visits. In nest 1 the activity of the adult owls doubled when the young hatched, but this did not happen in nest 3.

The nest visits did not become more frequent in nest 2 as the weight of the nestlings increased (Fig. 1). The growth of the smallest chick ceased at the age of one week and it died when it was 19 days old.

The frequency of nest visits varied greatly between consecutive days at the beginning of the nestling

period, but was relatively constant when the nestlings were large (Fig. 1). The reason was accumulation of prey in the nests when the young were small. This has been shown to decrease the feeding activity of Tengmalm's Owl during the following days (Klaus et al. 1975, Korpimäki 1981). At the end of the nestling period the food consumption of the young was high and food did not collect in the nests.

Activity patterns. The breeding Ural Owls were most active between sunset and sunrise (Fig. 2). Activity peaked in the late evening and there was another lower peak in the early morning. The owls quite often fed their young in daylight as well, especially in the morning after sunrise.

The daily rhythm of the owl pair in nest 2 differed greatly from that of the two other pairs (Fig. 2). They had only one activity peak (between 23.00 and 24.00) and the other nest visits were distributed fairly evenly throughout the day and night. This was apparently caused by the short nights, since breeding was much later than in nest 1 (Table 1). In addition, at the beginning of the nestling period there were three young in nest 2, but only two in nest 1. The male probably had not time to bring enough food to the young at night because the dark time was so short (minimum three hours) and/or food was scarce, and the hungry young begging for food "drove" him to hunt almost around the clock. In spite of this, the smallest chick died.

The beginning of activity in the evening was not limited to the time after sunset (Fig. 3). During the incubation period the nest was most often visited after sunset, but during the nestling period the visits usually began before sunset and the last visits were generally made as late as three–four hours after sunrise. Activity seemed to end at sunrise only during incubation and at the beginning of the nestling period. As the young grew, the morning activity increased remarkably. The active period of the Ural Owl shortened during incubation, but at the end of the nestling period it increased to the length at the beginning of breeding.

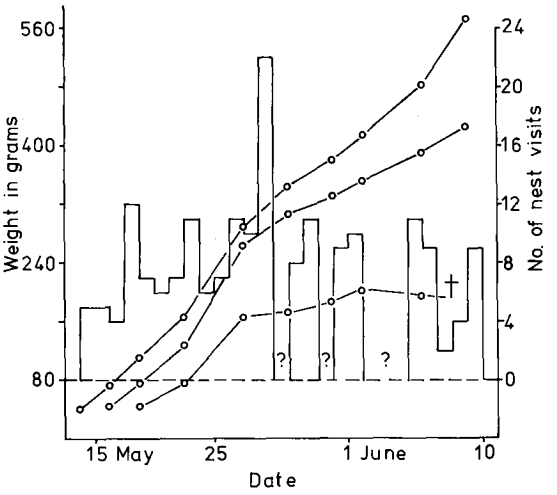

Fig. 1. Weight increase of Ural Owl nestlings compared with number of daily visits (columns) by parents in nest 2. The circles indicate the dates when the owlets were weighed. The cross shows the date when the smallest chick was found dead in the nest. ? = the recorder was not functioning.

Table 1. The main breeding data on the three Ural Owl nests.

Nest	1.	2.	3.
Date of 1st egg	26 March	?	?
Clutch size	3	3	1
First chick hatched	1 May	14 May	18 May
No. of chicks hatched	2	3	1
First chick fledged	27 May	10 June	9 June
No. of fledglings	2	2	1
Activity recorded	28 March—24 May	14 May—11 June	15 May—13 June

Diet. The diets of the owl pairs consisted of mammals (79.6 % of prey items by number), birds (18.0 %) and frogs (1.9 %, Table 3). The prey species used most often were the Field vole *Microtus agrestis* and Bank vole *Clethrionomys glareolus*. Other mammals taken fairly frequently were Water voles *Arvicola terrestris*, Arctic hares *Lepus timidus* and Common shrews *Sorex araneus*. Twenty-five bird species were identified in the diet, the most common prey birds being thrushes *Turdus* spp. and the Chaffinch *Fringilla coelebs*.

The diets in the two nests in 1971 (1 and 2) were fairly similar, since the proportions of mammals

Table 2. Number of nest visits per day (means ± S.D., number of recording days in parentheses) of Ural Owl pairs studied during incubation, and at the beginning (young 0–14 days old) and end of the nestling period.

Phase of breeding	Nest 1.	Nest 2.	Nest 3.	Total
Incubation	9.1 ± 2.3 (13)	–	8.3 ± 2.3 (3)	9.0 ± 0.3 (16)
Beginning of nestling period	21.2 ± 3.9 (6)	13.5 ± 8.3 (12)	6.1 ± 1.8 (11)	12.3 ± 5.7 (29)
End of nestling period	18.7 ± 0.6 (3)	17.9 ± 10.0 (8)	8.4 ± 3.7 (9)	13.7 ± 5.0 (20)
Total	13.7 ± 6.3 (22)	15.3 ± 9.0 (20)	7.3 ± 2.9 (23)	11.8 ± 3.5 (65)

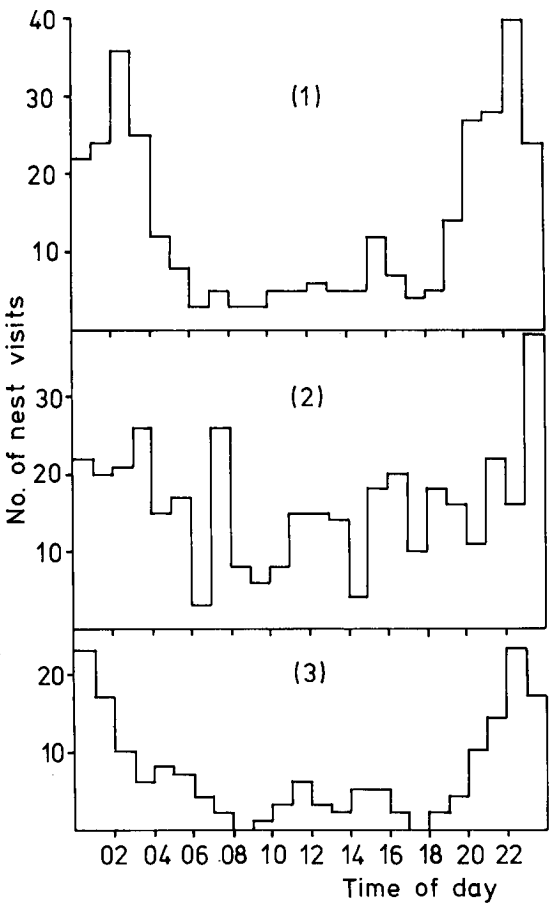

Fig. 2. Daily activity patterns of the three Ural Owl pairs (numbers of nest visits in 25 days during the nestling period): (1) Ylivieska in 1971, (2) Sievi in 1971 and (3) Lappajärvi in 1976.

Table 3. The diet (percentages of total items) of the Ural Owl pairs studied in 1971 (1 and 2) and 1976 (3).

Prey species or groups	Nest 1.	Nest 2.	Nest 3.
Soricidae	4.1	8.9	–
Microtus agrestis	54.2	30.8	15.4
Clethr. glareolus	19.2	28.2	15.4
Arvicola terrestris	5.0	1.3	–
Sciurus vulgaris	0.8	2.5	–
Lepus timidus juv.	3.3	3.8	–
Mustela erminea	–	1.3	–
Mammalia, tot.	86.8	76.8	30.8
Aves	10.6	21.9	61.6
Amphibia	2.5	1.3	7.7
Prey animals	120	78	13

were 86.8 and 76.8 % (Table 3). The year 1971 was a relatively good vole year (see Korpimäki 1981). In contrast, voles were scarce in 1976 (Korpimäki 1981); thus the proportion of mammals in the diet of nest 3 was only one third, but that of birds approximately two-thirds. The female of this nest had cleaned its nest-box very efficiently, and only a small number of prey remains and pellets were found there.

Discussion

The automatic recording apparatus did not always count real feeding visits, because birds make many "waste visits" to the nests (v. Haartman 1954). Owls use these visits to clean the nest (removal of pellets, excrements and other prey remains from the nest). On average, a Great Grey Owl female leaves the nest 3.1 times per day during incubation and 3.7 times during the nestling period (Pulliainen & Loisa 1977). In nests of Tengmalm's Owl the mechanical apparatus recorded 2.1 more visits per day than actual feeding visits (Korpimäki 1981). In the "nest visit" frequencies given by the mechanical recorders, about two–three visits per day are not actually feeding visits, but this source of error should not be important when the activity patterns are studied.

At least three factors affected the activity of the Ural Owls in the breeding season: the length of the light period, the prey species available and the number of nestlings. The light period exerted the greatest influence during incubation and at the beginning of the nestling period. In low vole years the broods were small, and the mates caught mainly birds, the mean weight of which (e.g. thrushes) was higher than that of small mammals. The nests were then visited less frequently than in good vole years, which indicated that the hunting success was low when an alternative prey was used.

The staple prey species (i.e. small rodents) of the Ural Owl are diurnal in midwinter, but their daily rhythms become nocturnal in late April — early May. Young Field and Bank voles change their rhythms more rapidly than older animals (Erkinaro 1969, 1972). The change in the daily rhythm of its chief prey species during the owl's breeding season did not affect its activity pattern; this conclusion was drawn from the data for nest 1 collected between 28 March and 24 May (Table 1). Consequently, the circadian rhythm of the Ural Owl did not depend on the activity of its main prey.

In May and June, activity peaks occurring between sunset and sunrise are shown by Bank voles (Pearson 1962, Bergstedt 1965, Mikkola 1970), Field voles (Erkinaro 1961), Water voles (Skarén & Kaikusalo 1965, Knight 1975 according to Greenwood 1978) and Common shrews (Pankakoski 1979). Consequently, the activity of the Ural Owl during the

nestling period, when the food requirement was highest, fits well with the daily rhythm of its main prey. This is in agreement with the optimal foraging theory, which predicts that the predator should concentrate its daily hunting activity in periods when the most important prey items are most available (e.g. Pyke et al. 1977).

In West Germany the activity of captive Ural Owls peaked at dusk in the evening and morning, lower peaks occurring before and after midnight (Scherzinger 1980). In autumn, winter and spring, the activity began 10–40 minutes after sunset, but when young were in the nest (in May and June) it started about 10 minutes before sunset. During the nestling period the males and young "woke up" 5–20 minutes before the "awakening" of the female. These observations are largely in agreement with the present results, apart from the four peaks in the activity pattern. This difference was probably caused by the longer dark period in Germany. The lengthening of the activity period observed in the present study at the end of the nestling phase (Fig. 3) apparently resulted in extension of the male's hunting time. When the young were about 26 days old, they were able to climb on to the edges of the boxes thus releasing the recorder switch, so that the active period appeared to lengthen still further. However, the influence of this factor on the activity records was small, since the owlets generally climb up only once from the bottom of the box. After this they climb on to the tree or jump to the ground.

In a Ural Owl population in central Sweden, peaks of hooting activity occurred between 21.00 and 23.00 and between 01.00 and 03.00 during the period from 15 April to 15 May (Lundberg 1980). Since the hooting was most intense after 01.00 (the peak before 23.00 was clearly lower), this activity pattern differed from that of the nest visiting. The explanation may be that hunting was more intense in the evening, when the young were hungriest. After 01.00 the nestlings were not begging for food so eagerly, which reduced the hunting activity (as in Tengmalm's Owl, Korpimäki 1981) and presumably left more time for intra-pair communication. This explanation of the increased hooting activity is supported by the fact that non-breeding pairs hooted more than breeding owls (Lundberg 1980).

The present Ural Owls were usually on the wing in daytime as well, which agrees with previous reports (e.g. Niemöller 1926, Stadler 1930, Kuhk 1942, Hagen 1952 and Lundin 1961).

The southern Tawny Owl usually lives in an environment in which the nights in the breeding season are long, and has adapted to these conditions by being almost completely nocturnal (see Introduction). It seems that the northern limit of its range in Finland is determined by the short light summer nights (Saurola 1983, Korpimäki 1986). In contrast, the Great Grey Owl has adapted to northern conditions by being active throughout the day and night (see Introduction). In the breeding season, the Ural Owl showed a biphasic activity pattern, with two peaks around midnight (Fig. 2). In general, it hunted in the daytime as well. As regards its daily activity pattern, the Ural Owl has an intermediate position among the Finnish *Strix* species, as might be predicted from its intermediate range.

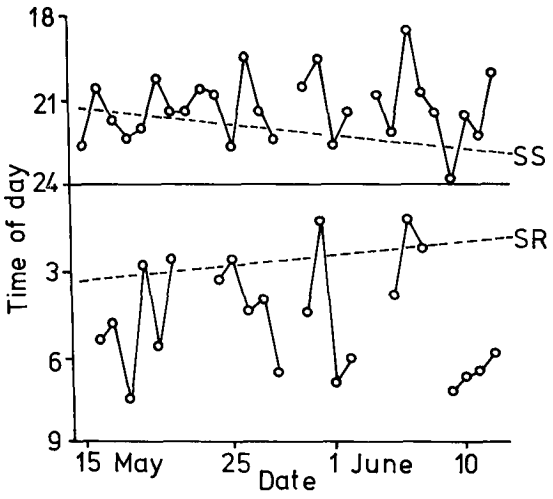

Fig. 3. Beginning and end of daily activity of Ural Owl in nest 3. (Lappajärvi in 1976). SS = sunset and SR = sunrise.

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Selostus: **Viirupöllön pesimäaikainen aktiivisuus Länsi-Suomessa**

Viirupöllön pesimäaikaista aktiivisuutta ja ravintoa tutkittiin automaattisilla rekisteröintilaitteilla Etelä- ja Keski-Pohjanmaalla kolmella pesällä vuosina 1971 (2 pesää) ja 1976.

Pöllöt kävivät pesillään haudonta-aikana keskimäärin 9.0, pesäpoikasajan alkupuolella 12.3 ja loppupuolella 13.7 kertaa/vrk. (taul. 2). Pesälläkäyntitiheys ei lisääntynyt pesäpoikasajan kuluessa, vaikka poikasten painot kasvoivat jatkuvasti (kuva 1). Käyntejä oli pesäpoikasajan alkupuolella 6–7 ja loppupuolella 8–9/poikanen/vrk., kun poikasmäärät vaihtelivat yhdestä kolmeen. Viirupöllö oli pääasiassa yöaktiivinen, suurin aktiivisuushuippu oli iltayöllä ja toinen, pienempi nousu aamuyöllä (kuva 2). Pöllöt ruokkivat poikasiaan myös varsin usein päivänvalossa, etenkin aamulla. Pesät 1 ja 2 olivat peräisin suhteellisen hyvältä myyrävuodelta (nisäkkäiden osuudet ravinnossa 87 ja 77 %), mutta pesä 3 oli huonolta myyrävuodelta (nisäkkäiden osuus vain 31 %, taul. 3).

Viirupöllön aktiivisuuteen vaikuttivat yön ja päivän vaihtelu (valo), tarjolla olevan ravinnon määrä ja pesässä oleva poikasluku. Sen pääsaaliit, pikkujyrsijät ovat yöaktiivisia touko–kesäkuussa, joten pedon vuorokausirytmi sopi hyvin yhteen pääsaaliiden kanssa. *Strix*-lajien aktiivisuusmalleja vertailtaessa todettiin, että eteläisin laji (lehtopöllö) on Suomessa lähes yksinomaan yöaktiivinen, koska yöt ovat sen päälevinneisyysalueella pesimäaikana pitkiä. Pohjoinen lapinpöllö taas on liikkeellä myös päivällä, koska pesimäajan yöt ovat sen päälevinneisyysalueella valoisia. Viirupöllö asettuu sekä levinneisyytensä että vuorokausirytminsä suhteen sukulaislajiensa väliin.

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