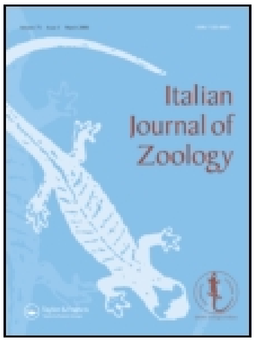

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Winter roost occupancy and behaviour at evening departure of urban long-eared owls

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ABSTRACT

Roost occupancy and behaviour at evening departure were studied in long-eared owls (*Asio otus*) at a large winter roost in the southern suburbs of the city of Milan, northern Italy. The number of roosting owls was strongly correlated with decreasing daylength, while it was weakly negatively correlated with temperature. Hence changes in photoperiod can be considered among the proximate factors promoting the winter aggregation of long-eared owls. Behaviour at departure was influenced by cloud cover: birds departed earlier, and departures were at a higher altitude and less concentrated, with covered sky than with clear sky; the reasons for these behavioural differences remain unclear. Directions of departure showed that owls do not use the urban area for hunting, as no birds were observed flying towards the city, consistently with dietary data.

KEY WORDS: *Asio otus* - Roost occupancy - Evening departure - Weather conditions - Photoperiod - Winter aggregation.

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INTRODUCTION

Most studies of the long-eared owl (*Asio otus* Linnaeus, 1758) relate to the feeding ecology and diet selection (reviewed in Marti, 1976; Nilsson, 1981; Cramp & Simmons, 1985; Village, 1981; Canova, 1989; Galeotti & Canova, 1994; Galeotti *et al.*, 1997a; Pirovano *et al.*, 1999), while relatively little work has been carried out on other aspects of the biology of this species, such as phenology of winter roost occupancy and behaviour at roost (Glass, 1971; Bosakowski, 1984; Wijnandts, 1984; Tavecchia, 1995; Galeotti *et al.*, 1997b). Winter roost occupancy was described extensively by Wijnandts (1984) on a number of roost sites in the Netherlands, but no phenological data are available for southern Europe; he suggested that the proximate factor affecting the number of roosting owls was a decrease in ambient temperature. The effect of light intensity on the owls' behaviour was investigated by Erkert (1967, 1968) on captive birds and by Glass (1971): in particular, the latter studied the behaviour at departure in relation to light conditions and wind at a roost site in Denmark, and found that the evening departure of the first owl from the roost was closely related to light intensity, independently of weather conditions.

As part of a study on the ecology of urban roosting long-eared owls in northern Italy (Pirovano *et al.*, 1997; 1999), here we analyse the dynamic of presence at roost from September to April, in order to separate the effects of photoperiod and ambient temperature in promoting the winter aggregation of owls. Further, we describe the behaviour at evening departure from the roost in relation to cloud cover, looking for possible influence of weather conditions on the owls' behaviour.

MATERIALS AND METHODS

Study area

The study was carried out in the southern suburbs of the city of Milan, northern Italy (45°28' N, 9°12' E). The roost is located along a public footpath and in private gardens, and is almost completely surrounded by large buildings, thus in a very sheltered position. Roosting trees are *Sophora japonica, Magnolia grandiflora, Betula sp.*, together with some conifers *Pinus sp.* Farmland is located 300 m E and 900 m S from the roost, while to the W farmland is slightly further away, and to the N there is the city of Milan. The birds were grouped into two sub-roosts 150 m apart, that were spatially divided by buildings and roads.

Data collection and analysis

Owls were counted weekly from September 1996 to April 1997, simultaneously at both sub-roosts as they left the roosting place at dusk (n = 25 counting sessions). The number of birds varied between the two sites also in relation to human disturbance (e.g. garden maintenance): since it was impossible to perform counts during the day (many birds were hidden in dense vegetation) or to separate owls leaving from one sub-roost or the other, the two sub-roosts were considered as a single unit. As the birds were not individually marked, some owls may contribute to more than one observation, and our dataset may contain some replicates from single birds: however, the sample size is fairly large and, given the turnover of birds at roost, it is unlikely that these possible replicates would strongly bias the results. Unless stated otherwise, the number of birds at roost was considered from 29 September onward, as only two birds were reported prior to this date.

Observations started 10-20 min before sunset. The observers (three-four) were positioned so as to see all the possible directions of departure, and were radio connected to avoid overestimations. Direction of departure for each bird (to the nearest cardinal direction) and time of departure of the first and last bird were recorded. On further 17 sessions, only the minute of departure of the first owl was recorded.

During 10 sessions, we also recorded the minute of departure and the flight height of every owl; individual minutes of departures were then grouped into 5-min intervals from departure of the first owl for analysis. Flight height was classified into two categories: 'over the treetops' (> 15 m) and 'under the treetops' (< 15 m).

The percentage (to the nearest 25%) cloud cover was estimated at sunset on every session, since cloud cover can influence light intensity, and hence the beginning of night activity. For the analyses we considered only extreme conditions, i.e. completely cloudy (100% cover) and clear sky (0% cover).

The effects of day length (time elapsing from sunrise to sunset) and temperature on the number of owls counted at the roost site were evaluated using a multiple regression (Stepwise Method; Norusis, 1992). Means of average daily temperature and means of daylength of the days prior to the census (until 10 days) were considered as the independent variables. Consequently, 10 multiple regressions (using temperature and daylength of day 1 – day prior to census – and means of average temperature and daylength of days 1-2, 1-3...1-10) were run, and the model with the highest adjusted R^2 was chosen (Norusis, 1992). Times of sunrise and sunset were obtained for our geographical location using the MPj Astro 1.5.1 software. Temperature data were obtained from Brera-Duomo Meteorological Observatory, about 3 km from the roost site, in the city centre.

Statistical analyses were carried out using SPSS ver. 6.0.1. Means and SD are given, and all tests are two-tailed.

RESULTS

The number of roosting owls ranged from two in September to a maximum of 76 on the 12th of December (Fig. 1). The number of birds at roost is strongly negatively correlated to the photoperiod of the nine days before the counting session (Table I), with mean daylength of the nine days prior to census accounting for about 89% of the variance in number of birds ($F_{1,24}$ = 201.3; R^2 = 0.89; P < 0.0001). The effect of temperature is extremely low, accounting for an additional 2% of variance (Table I). Overall, the model was highly significant ($F_{2,23}$ = 116.7; R^2 = 0.91; P < 0.0001).

Mean time of departure of the first owl from the roost was 23.1 ± 5.7 min after sunset (n = 42). This was earlier on days with cloudy sky (17.5 ± 4.8 min; n = 16) compared to days with clear sky (26.6 ± 2.6 min; n = 26) (Mann-Whitney U test, U = 10.0; P < 0.0001). No significant trend in the time of departure of the first owl was found in the study period (linear regression of minute of departure of the first owl on date, with first date = 29 September; cloudy sky: y = 22.44 - 0.051x; F_{14} = 4.13; P = 0.062; clear sky: y = 28.26 - 0.0142x; F_{24} = 2.40; P = 0.135), although there was a tendency to leave earlier towards spring. The time lag between the first and last departure was positively correlated to the number of roosting birds (considering also the two early September counts, r_s = 0.43; n = 24; P = 0.036) and was on average 20.0 ± 9.16 min (range 2-42 min; n = 24).

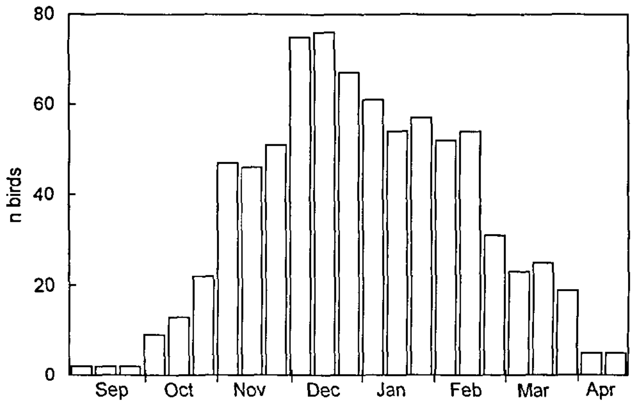

Fig. 1 - Number of long-eared owls at the roost site during the period September 1996-April 1997. Counts are grouped by decades for clarity of presentation, since data were missing for two weeks.

TABLE I - *Stepwise regression of number of owls at roost (n = 25 counting sessions) on average daylength and average temperature of the nine days prior to the census.*

	Regression Coefficient	(SE)	t	P
Daylength	-12.98	(1.75)	-7.40	0.0001
Temperature	-1.10	(0.53)	-2.07	0.0492
Constant	184.92	(14.75)		

Analysis of variance for the model: $F_{2,23}$ = 116.7, adjusted R^2 = 0.91, P < 0.0001

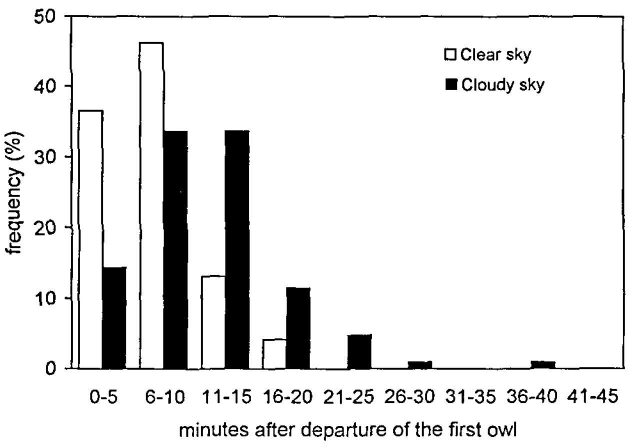

Fig. 2 - Frequency distribution of individual departures in relation to cloud cover.

Overall, 70.9% of departures were over the treetops and 29.1% under the canopies (n = 199). Owls left the roost most frequently over the treetops with cloudy sky (88.5% of departures; n = 96) than with clear sky (54.4%; n = 103); (χ^2 = 28.1; df = 1; P < 0.0001). In total, 68.3% of birds left the roost within 10 min of the first individual (n = 249 departures), and departures were more concentrated with clear sky than with cloudy sky (Fig. 2, Median Test, χ^2 = 32.0; df = 1; P < 0.0001; n = 145 individual departures with clear sky and n = 104 with cloudy sky).

Birds were oriented mostly towards S (63.9%) and E (29.2%) and were never observed going N towards the city centre.

DISCUSSION

The maximum number of long-eared owls recorded at our roost is one of the highest reported in the literature (Cramp & Simmons, 1985), and well over the Italian average number ($\bar{x}$= 10.2, range = 3-58, Vicini *et al.*, 1991). The high number of roosting birds can be at least partly attributed to the diet, although other explanations cannot be ruled out (see Bosakowski, 1984; Tavecchia, 1995). In fact, these owls rely almost exclusively on young/subadult brown rats (*Rattus norvegicus*), that are very abundant in the study area, constituting up to 70% of the predated biomass. Rat feeding may give the owls an energetic advantage, and may help in explaining the choice of a winter roost subject to a strong anthropic pressure (Pirovano *et al.*, 1999).

The variation in the number of roosting long-eared owls is similar to the pattern observed by Wijnandts (1984), with the number of birds increasing from the beginning of October, reaching a peak in mid-winter and then decreasing towards spring, when most owls probably left the roost due to the onset of breeding activities (Wijnandts, 1984; Cramp & Simmons, 1985). From February onward, some males were also heard singing at roost just prior to departure, indicating that some courtship activity may also begin at the roost site (Cramp & Simmons, 1985). However, contrary to the Netherlands (Wijnandts, 1984), where most of the roosting owls breed within a radius of 5 km from the roost site, in our study area, despite intensive searching, only two owl nests were found in the adjoining farmland (Pirovano *et al.*, 1997); so the breeding area of most birds is unknown.

The winter aggregation of long-eared owls appears to be strongly linked to photoperiod, and in particular to the mean daylength of the nine days preceding the census: this may indicate the existence of endogenous factors, influenced by photoperiod, regulating the gathering at roost sites. Despite other authors reporting an increase in number associated with cold spells and snow (Wijnandts, 1984; Cramp & Simmons, 1985), we could find no evidence of a clear link with temperature; however, during our study, we never experienced critically adverse weather conditions.

Our birds, in accordance with literature data (Wijnandts, 1984; Tavecchia, 1995; data calculated from Glass, 1971), left the roost between 20 and 30 min after sunset on average. However, cloud cover seems to influence the behaviour of owls at departure: in particular, the first owl left the roost on average 10 min. earlier with cloudy sky compared to clear sky. Although Glass (1971) stated that owls' departure was only influenced by light intensity, he did not consider the difference in time of departure in relation to cloud cover or other weather variables.

The fact that the birds left their roosting tree more slowly with cloudy sky may be due to physical factors: visible light intensity may be lower and twilight may last longer (Nielsen, 1963). However, results are open to speculations, as well as the fact that birds left the roost at a higher altitude with covered sky.

Directions of departure (S and E) clearly showed that the urban area is not exploited as a hunting territory, and this was consistent with direct observations of birds hunting at dusk in the surrounding farmland (A. Pirovano & D. Rubolini, unpubl. data). Dietary data further confirmed that hunting was carried out in farmland, as a high proportion of the diet in number were farmland small mammal species, e. g. the wood mouse (*Apodemus sylvaticus*) and Savi's pine vole (*Pytimys savii*) (Pirovano *et al.*, 1999).

In conclusion, we showed that the winter aggregation of the long-eared owl is correlated to a decrease in daylength rather than to a decrease in temperature, as previously suggested. However, some questions raised by our results on the response to weather conditions cannot be answered given the present state of knowledge on owl behavioural ecology.

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