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Breeding Strategy of the Ural Owl *Strix uralensis*

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ABSTRACT

The ecology of a Ural Owl *Strix uralensis* population (120 breeding pairs in top years) was studied in southern Finland (61°N, 24° E). Almost all pairs were breeding in nest-boxes. During the study, 1,524 active nests were found and 2,700 nestlings ringed. At 1,184 nests the female, and at 354 nests also the male, was caught (ringed or retrapped) at least once in the breeding season.

Reproduction was very much governed by fluctuating populations of microtines: during periods of low microtine populations, most pairs (up to 90 %) did not lay at all, the median laying date was up to 4 weeks later and the average clutch-size (range 1-8) 2 eggs smaller than during microtine peaks. On average, the first breeding attempt was at the age of three or four years. In the best vole years, some females reproduced successfully when only one year old. However, the lifetime reproductive output of the owls which started breeding after their first year of life was probably lower than that of older first-breeders: only 24% of one-year-old breeders were found as breeding birds later, while the corresponding percentage for three and four-year-old first-breeders was 70-77%.

INTRODUCTION

The Ural Owl *Strix uralensis* is a medium-sized bird of prey. It feeds on a wide variety of vertebrates, ranging from frogs and shrews to mammals and birds weighing up to some hundred grams. In its breeding, however, the Ural Owl is highly dependent on fluctuating populations of microtines, in Finland mainly on *Microtus agrestis, M. epiroticus, Arvicola terrestris* and *Clethrionomys glareolus* (e.g. Linkola & Myllymäki 1969, Korpimäki & Sulkava 1987).

In the 1950s the Ural Owl was considered a rare and vanishing species, suffering from the lack of suitable nest sites - old chimney-like stubs which had been largely eliminated by extensive forestry. For this reason, conservationists, mainly bird ringers, started to provide special nest-boxes for the Ural Owl (and, correspondingly, for the Tawny Owl *Strix aluco* and Tengmalm's Owl *Aegolius funereus* also). There are now in Finland more than 12,000 nest-boxes for owls, which are checked by the ringers annually (Saurola 1986).

The operation "nest-boxes for owls" started in southern Húme, in an area around the city of Húmeenlinna (61°N, 24°E). This paper summarizes some results of the studies on the population ecology of the Ural Owl in this area (see also Linkola & Myllymäki 1969; Pietiäinen *et al.* 1984, 1986; Saurola 1980,1987).

MATERIAL AND METHODS

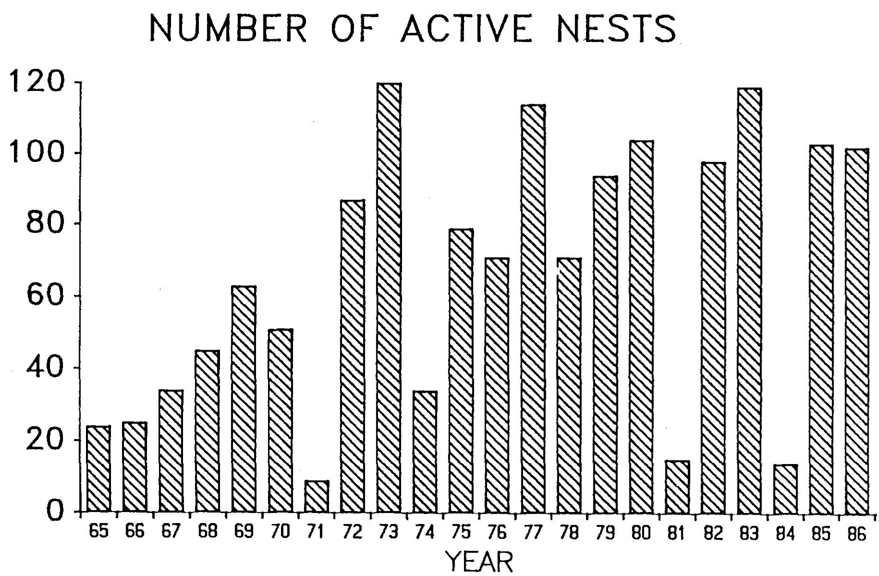
The nest-boxes were to begin with chimney-like, without a roof. At that time, only nestlings were ringed and very few females were captured. In the late 1960s a "normal" type of nest-box with a roof and an opening in one wall became the standard, and nearly all incubating and brooding females have been caught (= ringed or retrapped) since. In 1973, a trap for catching males was constructed (for details see Saurola 1987), but so far only a porportion of the males which breed in the study area have been caught annually. In total, 1,524 active nests have been found, ca. 2,700 nestlings ringed, and at 1,184 nests the female and at 354 nests also the male has been trapped at least once in the breeding season.

RESULTS AND DISCUSSION

Response to unfavourable years: nonbreeding or breeding elsewhere?

The number of annual breeding attempts in the study area has fluctuated from 9 in 1971 to 120 in 1973 (Fig. 1). The number of nest-boxes available still increased during the last years of the 1960s, and for this reason those years are not fully comparable with the others. Since the beginning of the 1970s the number of nest-boxes has changed little and the big annual differences in numbers of breeding attempts are real.

FIGURE 1: Annual numbers of active nests of the Ural Owl *Strix uralensis* found in southern Häme 1965-1986. The numbers of nest boxes available were increased in the late 1960s, and remained fairly constant thereafter.



Where are the birds when the number of breeding pairs is low? Intensive ringing and retrapping of breeding females and males has revealed that the Ural Owl is tenacious of the breeding site (Saurola 1987). All retraps (n=55) and recoveries (n=10) of males were made within 5 km from the previous nest-site. However, 4% of all retraps (n=555) and 15% of random recoveries (n=62) of females were made more than 5 km from the previous nest; the longest distances moved by females from the breeding-sites were 219, 160 and 97 km. In conclusion, even in unfavourable years practically all males and approximately 90 % of females stayed near their previous nest-sites as nonbreeding birds, but some females changed their breeding areas.

Lundberg (1979) stated correctly (on the basis of scanty data) that the strategy of the Ural Owl to stay at the breeding site during unfavourable conditions differs from that of the Long-eared Owl *Asio otus* and Tengmalm's Owl. In these species at least one of the sexes moves away during bad years (e.g. Korpimäki *et al.* 1987). Lundberg based his hypothesis on the importance of keeping the nest-hole, which is a critical resource especially for the Ural Owl, and on the difference in feeding habits between these three species: the Ural Owl is more of a generalist feeder and can survive better during microtine lows than the two other species.

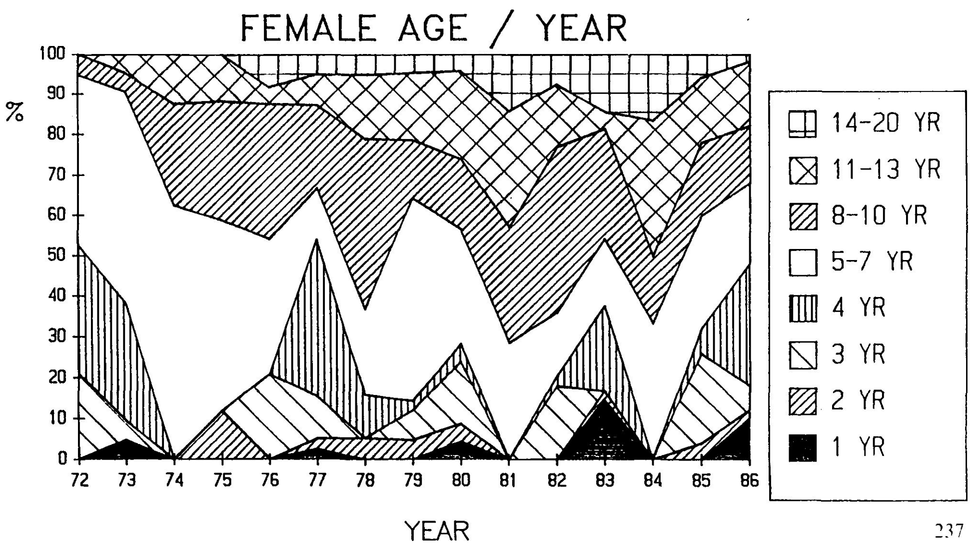
When the environmental conditions are such that the Ural Owl female is not physiologically able to produce eggs, she may still behave for much of the season as a breeding bird. In other words, she is behaviourally ready for breeding: "willing but not able". For example in a low year for microtines one Ural Owl female started to incubate 4 eggs of a Goldeneye *Bucephala clangula.* The eggs were laid in a nest-box, in which the same Ural Owl had bred successfully in previous years. After four weeks the Goldeneyes hatched and the Ural Owl defended and probably tried to feed them as long as they were alive. At another nest, a female with an egg in her oviduct was captured from an empty nest-box at the beginning of May. At the end of May the female was still "incubating" and defending the nest-box, which was empty, apart from three small pine cones.

One consequence of high nest-site tenacity is that the members of a pair breed together with a high probability as long as they are both alive. In the Ural Owl the verified divorce rate was 2.7% (n=113) compared with 12.1% (n=141) in the Tawny Owl (Saurola 1987). An indication of a "true" pair-bond in the Ural Owl is the life-history of a pair, which moved together over such long distances (3, 4, 2 and 2km) that they must have encountered other possible mates and their 10-year coexistence cannot easily be explained other than as a consequence of high nest site fidelity.

Breeding Age

During microtine minima (1974, 1981 and 1984), all breeders were at least 5 years old (Fig. 2). In those years younger birds probably needed all available energy for their own survival. But in good vole years (1973, 1977, 1980, 1983 and 1986, Fig. 2), both female and male Ural Owls proved capable of breeding successfully already at the age of one year (in their 2nd calendar year). However, only 24% of those females (n=17) which started as one-year-olds were found as breeders in subsequent years. The corresponding probabilities for breeding later on were 50% (n=14), 70% (n=40) and 77% (n=39) for two-, three- and four-year-old first-breeders respectively. The differences between one- and three-, and one- and four-year-old birds were statistically significant, and they can only partly be explained by differences in the "normal" annual mortality of these age classes.

FIGURE 2: Annual age distributions (%) of breeding Ural Owl females. Only birds ringed as nestlings included.



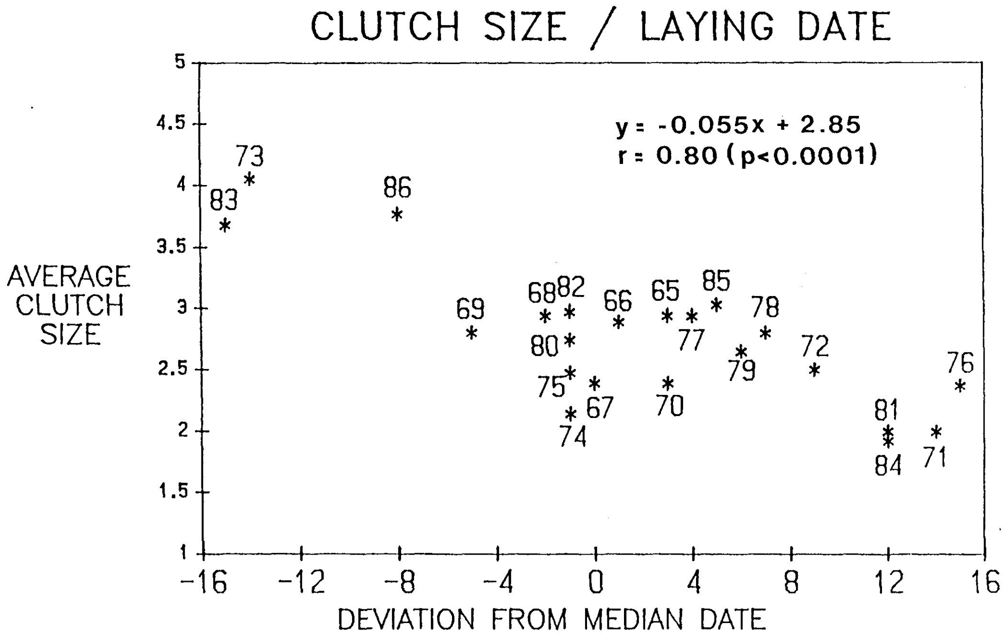
Pietiäinen *et al.* (1984) have shown that in the Ural Owl there is a negative correlation between the production of young and moult: birds which have more young are able to moult fewer flight feathers and are not so well prepared for the next winter as are birds with fewer young. Birds which do not breed at all (but are otherwise in normal condition) are able to moult extensively, sometimes all their flight feathers. For a one-year-old bird which still has its low-quality juvenile feathers, it is crucial for survival to be able to moult as completely as possible before winter. The winter after the microtine maximum, when one- and two-year-old Ural Owls can breed, is often very hard, because vole populations usually crash before the next spring. Thus, for maximizing the lifetime reproductive output it may be better for a Ural Owl to start breeding at three (or four) years rather than earlier.

Breeding Phenology

The laying date of the Ural Owl is highly dependent on the vole situation (Linkola & Myllymäki 1969). The overall median date for the onset of laying for the years 1965-1986 was 5 April; the variation of individual clutches ranges from 5 March (n=3) to 27 May, and the annual medians (Fig. 3) from 21 March to 20 April. In many cases the difference between the earliest and latest laying dates of the same female exceeded six weeks (cf. Lundberg 1981).

In the Ural Owl, egg-laying seemed to begin as soon as the female could produce the eggs, but the onset of laying was not determined simply by the number of voles present in early spring. The voles had to be not only numerous, but also easily available and not hidden under thick or hard snow cover (cf. Korpimäki 1987 for Tengmalm's Owl). Further, the quality of the preceding autumn and winter, effectiveness of the male as a hunter (see Lundberg 1980 for courtship feeding), and possibly also the reproductive effort of the female in previous breeding seasons were important factors in determining the physiological pre-laying condition of the female. Before the two earliest laying years 1973 and 1983, conditions were ideal: in 1972 vole populations were maximal, the winter 1972/1973 was exceptionally mild and there was practically no snow cover in southern Finland; ten years later the situation was more or less the same.

FIGURE 3: Average annual clutch size of the Ural Owl in relation to annual deviation (days) from the overall median date (5 April) of laying in 1965-1986.



Like young Tawny Owls (Southern 1970), young Ural Owls depend on their parents for three months after leaving the nest, a period when adults could use all extra energy for moulting and accumulation of fat for their own winter survival. Further, the mortality of the juveniles is highest during the first months after independence, and environmental conditions increasingly difficult as winter draws near. For these reasons it is advantageous for northern Ural Owls to start egg-laying as early as possible. Occasionally there are costs to early breeding, however, as in 1985, when an exceptionally late cold snap destroyed some of the earliest clutches.

Clutch Size and Egg Size

In the study area the clutch size has varied from 1 to 6 eggs, and clutches of 3 (38%), 2 (35%) and 4 (23%) were the most frequent. In favourable years the frequency of large clutches increased, e.g. in 1986 25% of all Ural Owl clutches reported by Finnish ringers had 5 or more eggs; two clutches of 8 and two of 7 eggs were also found in that year (Saurola 1986).

Clutch size correlates strongly with laying date: in years of high vole abundance egg-laying starts one month earlier, and the average clutch size is almost two eggs larger than in years with a low vole abundance (Fig. 3). By using standardized individual observations (instead of annual averages) Pietiäinen *et al.* (1986) estimated with a linear model that the clutch size of the Ural Owl decreases by 0.09 eggs per day as the spring advances.

So is the size of a Ural Owl clutch, then, really dependent on the laying date, or are both these variables governed by a third variable such as food supply? Pietiäinen *et al.* (1986), referring to the the theory of Drent and Daan (1980), have suggested that the date of laying as such is a decisive factor which determines clutch size in the Ural Owl. Their main point, especially important for late broods, is that the young get more food before independence, and the strain on the adults is less severe if there are few young instead of many. However, this will remain only a hypothesis until direct studies, i.e. feeding experiments, have been made. Thus in the Sparrowhawk *Accipiter nisus* the clutch size decreases, under natural conditions, during the season in a similar fashion to the Ural Owl, but by extra feeding Newton and Marquiss (1981) could increase the clutch size independently of laying date.

Pietiäinen *et al.* (1986) found interesting (though insignificant) differences in the egg size between different kinds of years: in bad vole years the eggs from clutches of two were the largest but, in contrast, in good vole years the eggs from clutches of four or more were the largest. They tried to explain these differences with two hypotheses. Hypothesis 1 states that the egg size is determined by genetic factors and the female's resources at the time of laying; and that in all years there are differences between territories, bad territories in good years and vice versa. Hypothesis 2 states that females are capable of adjusting their egg size according to their own condition in relation to the general quality of a year: two eggs is a profitable investment in bad years but not in good years. At the moment, neither of these hypotheses can be falsified. For me, if the 'differences' found are real and not statistical artefacts, the first one is simple and sufficient, the second more fashionable but unrealistic.

Parental Defence

Parental defence is an essential part of the breeding strategy of the Ural Owl. Dramatic evidence is provided by five cases from Finland in which the female killed herself while striking the ringer, who wore a motorcyclist's helmet (now forbidden unless covered with soft material).

Wallin (1987) has recently discussed parental defence in the Tawny Owl. Such a systematic study has not been made on the Ural Owl, so only a few general comments in the light of his work can be made.

In the Ural Owl individual (perhaps genetic) differences are most important: in general bold individuals are bold, and shy individuals are shy, throughout their lives. The defence level in a particular individual increases clearly from the egg-laying to the fledging period, i.e. with an increasing investment made by the parents. In contrast, the expected positive correlation between defence level and brood size has not so far been detected in the Ural Owl. Bold individuals strike the intruder anyway in the nestling stage, and the possible differences in starting distances and number of strikes are dependent on so many external factors (such as time of day, weather and number of people present), that any possible effects of brood size cannot be shown. There is, however, a clear difference between the sexes, as most of the females attack an observer, and few of the males do.

What is the optimal strategy for a Ural Owl breeding in southern Finland?

Because the answer will still be highly speculative, I summarize this paper with the following "life-plan" for a Ural Owl. My prediction is that those owls which live according to this "plan" will, on the average, have the highest possible lifetime's reproductive output:

1) It is probably best to be born one year before the top year for voles. The vole populations are then increasing during the summer and are already on a high level during the autumn and winter. The probability of surviving the first critical months will be high.

2) Although the vole populations are at maximum in spring (2nd calendar year), the best strategy is to try to find a free good territory and to mate, but not to breed. If not breeding, there is time and energy enough to moult as fully as possible, replacing the low-quality and worn juvenile flight feathers. The probability of surviving through the second critical period, the vole population crash, will then be high.

3) Because vole populations are low, there is practically no choice in the following spring and summer (3rd calendar year) as it is not possible to find enough energy for breeding. The vole populations start to increase again in summer, and fat accumulation will be easy in the autumn.

4) When the bird is almost 3 years old (4th calendar year), it is time to lay the first eggs (3 or 4), and if possible, in the first days of April. Even if the bird is an inexperienced breeder, the probability of surviving the next winter will be high both for the bird itself and for its offspring.

5) After this point, breeding attempts are allowed annually, even in years when food is scarce, providing that both mate and territory are good. The bird should stay on the same territory from year to year, unless conditions turn really bad.

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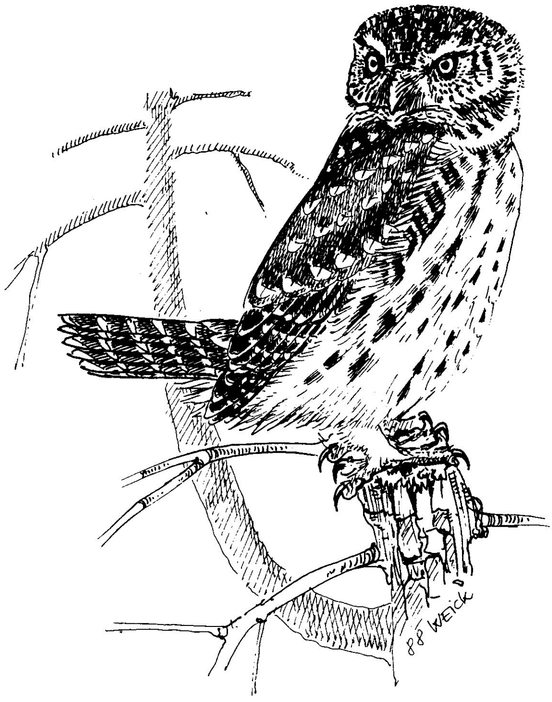
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