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Breeding biology of the Pygmy Owl Glaucidium passerinum in two biogeographical zones in southeastern Norway

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Breeding data of Pygmy Owls were collected from southeastern Norway in 1971-1982. 29 breeding sites were located. The nests were grouped according to biogeographical zones. 11 of the nests were located in the boreal zone, and the remaining 18 in the boreonemoral zone. Clutch sizes varied from 3 to 10 eggs, and the onset of breeding lasted from the end of March to the middle of May. In the boreonemoral zone breeding took place both in years of high and low vole abundance, while in the boreal zone successful breedings were only recorded in years of high vole populations.

In the boreal, but not in the boreonemoral zone, there was a negative correlation between clutch size and the onset of breeding. A possible explanation for this difference is presented.

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1. Introduction

The Pygmy Owl is a common owl species in the boreal forests of southeastern Norway, but up to 1970 only 14 nests were reported from the whole country (Haftorn 1971). Extensive investigations on the breeding biology and food choice of Pygmy Owls have been carried out since then in Germany (Scherzinger 1974, Schönn 1976) and Finland (Mikkola 1970, Kellomäki 1977).

The Pygmy Owl belongs to the Siberian fauna, its range stretching across the Eurasian continent (Voous 1960, Mikkola 1983). Although it is not as numerous as the Tengmalm's Owl (Mikkola 1983), it is evenly distributed throughout its range (Burton 1973). Löppenthin (1967) claims that the Pygmy Owl originates from the East Asian broadleaf forests of the Mandchurian province, and that the species' present distribution is the southern part of the Siberian taiga. The Pygmy Owl inhabits both coniferous forests and forests with a mixture of broadleaved trees and conifers (Voous 1960, Löppenthin 1967). The structure of the forest seem to be more important than the tree species composition, and a mixture of morphologically different forest types will favour the species (Scherzinger 1974, Glutz von Blotzheim 1980).

The coniferous forest belt of Eurasia extends from northern tundra to southern broadleaf forests, and the productivity and numbers of plant and tree species increase markedly along this gradient. In Fennoscandia the coniferous forest belt has been divided into three zones. To the south of these boreal zones lies a zone with a mixture of conifers and broadleaved trees, called the boreonemoral zone (Anon. 1977). This classification is based on earth and climate characteristics and human influences. In Fennoscandia these biogeographical or nature zones are in good accordance with the natural vegetation zones (Anon. 1977). The present study is an attempt to investigate how differences between these nature zones may influence the breeding conditions for the Pygmy Owl.

2. Methods

Data on the breeding biology of Pygmy Owls were collected from southeastern Norway (Fig. 1) in 1971-1982. Nest holes were sought for in areas where Pygmy Owls were heard singing prior to breeding. In the study areas east of lake Mjösa (cf. Solheim 1984) nestboxes of the kind described by Sonerud et al. (1972) were erected. Previously used nestholes and nestboxes were usually checked several times during the breeding season. New natural nestholes were opened when the young had reached two weeks of age, and when the female was out feeding. The cutting

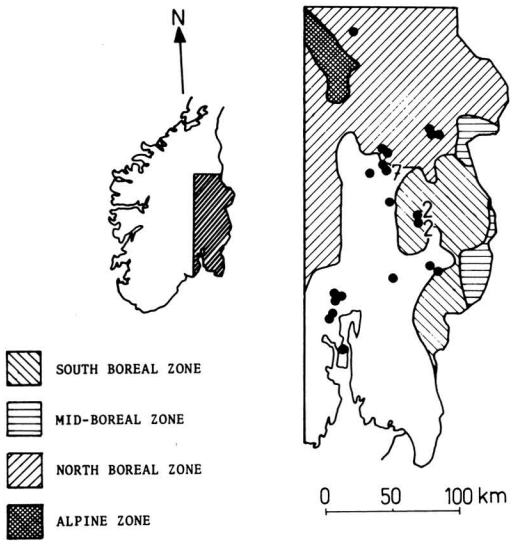

Fig. 1. Location of the 29 Pygmy Owl nests referred to in the text. White areas: Boreonemoral zone according to Anon. (1977).

Fig. 2. Natural nesthole opened for checking.

was done with a thin sawblade to produce a key-hole shaped entrance (Fig. 2). After checking the nest the "door" could then be put back in position and tightened with a string around the tree. The population of small mammals was evaluated by snap-trap lines and observations of rodent activity in the field (G.A. Sonerud pers. comm. and own obs.).

A total of 29 breeding sites of the Pygmy Owl were discovered during the study period. Eleven nest sites were located in the boreal zone, while the other 18 were found in the boreonemoral zone.

3. Results

3.1. Start of breeding

The onset of breeding in the boreal zone lasted from the end of March to the end of April, while in the boreonemoral zone clutches were also started during the first two weeks of May (Fig. 3). In early spring 1977 both voles and seed-eating birds, especially Redpolls *Acanthis flammea*, were very abundant in the boreal zone of southeastern Norway, and were heavily preyed upon by the Pygmy Owls there (unpubl. data). One clutch of 10 eggs was started about March 21st, and all hatched young (8) survived.

3.2. Clutch size

Clutch size varied from 3 to 10 eggs (Fig. 4). One clutch of three eggs was initiated as late as May 16th in the boreonemoral zone. At this nest the male was never observed, and the female left after having incubated the clutch for three weeks. The nest was located only 0.5 km away from a successful Pygmy Owl nest. According to the behaviour of the owls, onset of breeding and lack of male participation this might have been a case of polygamous breeding (cf. Solheim 1983a).

There was a slight tendency, although not significant, for larger clutches in the boreal than in the boreonemoral zone during years of high vole abundance (Table 1). Within the boreonemoral zone there was also a slight tendency, although not significant, for smaller clutches in years of low vole populations than in years of high vole populations, with years of vole population crashes showing intermediate values (Table 1). No breeding was ever recorded in the boreal zone in years of low vole populations, and only one breeding attempt was recorded in a year of vole population crashing (Table 1).

There is a significant decline in clutch size throughout the breeding season in the boreal zone, while no such relationship seems to occur in the boreonemoral zone (Fig. 5).

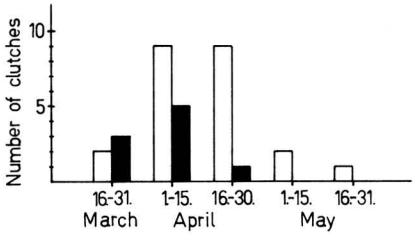

Fig. 3. Breeding start of Pygmy Owls in the boreonemoral (white columns) and boreal (black columns) zones. Total sample size 28 clutches.

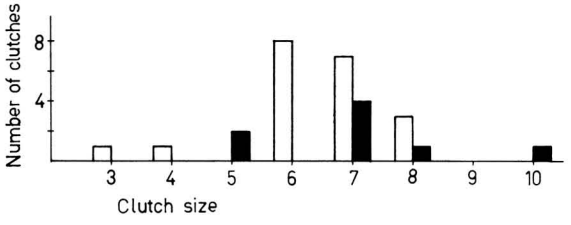

Fig. 4. Clutch sizes of Pygmy Owls in the boreonemoral (white columns) and boreal (black columns) zones. Total sample size 28 clutches.

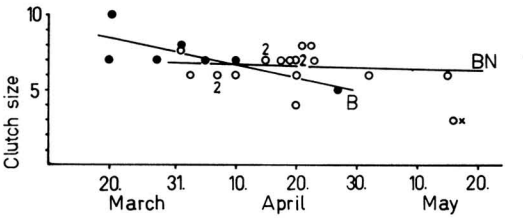

Fig. 5. Relation between clutch size and date of first egg of Pygmy Owls in the boreal zone (filled circles) and the boreonemoral zone (open circles). Cross indicates a nest where bigamy was possibly involved (excluded from the regression analysis). Total sample size 26 clutches.

Boreal zone (B): $y = 0.09x + 9.3$
$r = -0.757$ $P < 0.05$
Boreonemoral zone (BN): $y = 0.01x + 6.9$
$r = -0.090$ $P < 0.1$

3.3. Nesting success

The average number of fledglings/clutch in the boreonemoral zone was 4.00±2.7 and 6.00±2.6 in the boreal zone. The difference is not statistically significant. The average number of fledglings/clutch in peak vole years was higher, although not significantly, in the boreal zone than in the boreonemoral zone (Table 1; cf. also Appendix 1).

In the boreonemoral zone, five clutches failed to produce any young. In one nest the female left after three weeks of incubation, and in another the male disappeared (the female laid only two eggs and went on calling for the male without receiving any answer for about a month). One clutch in the boreonemoral zone was deserted, probably because of low vole abundance. The last two clutches were preyed upon. According to tracks and faeces close to the nests, predators were most probably Weasels *Mustela nivalis* or Stoats *M. erminea*. In the boreal zone one clutch was deserted in a year of crashing vole populations (Table 1).

4. Discussion

Although the number of species increases towards southern biogeographical zones (Anon. 1977), the borders in Fig. 1 are not strictly defined. The border between the boreonemoral and the boreal zones is the most well-defined,

Table 1. Clutch size and nesting success of Pygmy Owls in peak, crashing and none vole years in the boreonemoral and boreal zones. Only nests with exactly known egg numbers are included in nesting success values.

	Boreonemoral zone			Boreal zone		
Vole population:	peak	crash	none	peak	crash	none
Completed clutches	10	6	4	7	1	0
Clutch size (mean ± *SD*)	6.8±0.8	6.2±1.7	5.8±1.3	7.3±1.5	5	-
Nesting success						
Clutches, total	10	7	4	7	1	0
unsuccessful	2	2	1	0	1	-
Eggs	68	39	23	51	5	-
Fledglings	46	26	12	48	0	-
Fledglings/eggs	0.7	0.7	0.5	0.9	0	-
Fledglings/clutch (mean ± *SD*)	4.6±2.9	3.7±2.8	3.0±2.6	6.9±1.1	0	-

as the boreonemoral zone largely overlaps with agricultural districts. Based on the distribution of southern faunal elements this zone should probably be extended further northwards than shown in Fig. 1, along the main valleys of southeastern Norway (Solheim & Töråsen 1983). There are no strict borders between the three boreal zones which gradually fuse into each other. I have therefore made no distinction between Pygmy Owl nests from different boreal zones.

In the boreal zone successful breedings were only recorded in years of high vole abundance. In the boreonemoral zone breeding took place in most years, including when voles were scarce. The tendency for higher clutch sizes and nesting success found in the boreal zone indicate that during years of high vole abundance the amount of available prey is greater there than in the boreonemoral zone. The vole cycles often show the greatest amplitudes in the arctic and subarctic areas, and may almost level out in agricultural districts (Wildhagen 1952, Mysterud 1970). The boreonemoral zone may, however, offer a higher number of bird species as potential prey for the Pygmy Owl than does the boreal zone. This may explain why Pygmy Owls can breed in the boreonemoral zone in years of low vole abundance, while in the boreal zone only in vole peak years. Also Tengmalm's Owls *Aegolius funereus* seem to respond to these different breeding conditions in the same way as Pygmy Owls, with higher overall breeding frequencies but lower clutch sizes in the boreonemoral zone than in subalpine forests (Solheim 1983b).

In the boreal zone clutch size was negatively correlated with the onset of breeding, but in the boreonemoral zone no such connection was found (Fig. 5). A decline in clutch size throughout the breeding season was also found in the Ural Owl *Strix uralensis* (Lundberg 1981). However, he argued that the food supplies of the Ural Owl increased until the middle of autumn and could not explain the decreasing clutch sizes. The rather stable clutch sizes of Pygmy Owls in the boreonemoral zone may shed some light on the problem. Although I have no data on prey availability, I will speculate on a possible answer to this phenomenon.

Larger and earlier clutches of Pygmy Owls in the boreal than in the boreonemoral region may be caused by higher maximum numbers of voles in the former zone. Such a difference could, however, also be caused by voles having different vulnerability in the two areas. If the vulnerability of voles drops during spring, as reported by Mikkola (1983), a decline in clutch size of Pygmy Owls might be expected even if the total number of voles increase. This could, however, be counteracted if the owls during breeding shifted from voles to birds as prey, as found by Sonerud et al. (1972) and Kellomäki (1977). As a generalist predator (Glutz von Blotzheim 1980) the Pygmy Owl seems to react functionally and prey upon whatever prey species that is most vulnerable (Solheim 1984). Such a shift may more easily take place in the boreonemoral zone with more species of returning migrants during spring than in the boreal zone. In Central Europe the Pygmy Owl shows less fluctuating breeding success between years than the other owls because of its varied diet and hunting techniques (Glutz von Blotzheim 1980).

Although the number of voles sampled by snap-trapping gives an indication of prey density, it does not reflect their availability to a predator. The declining clutch sizes of Ural Owls could thus indeed have been caused by lower food availability although the total number of prey censused by Lundberg (1981) increased during the breeding season.

Pygmy Owls select nest holes with entrance holes less than 45–55 mm for both winter-caching (Solheim 1984) and breeding (unpubl.), and · neither Pine Martens *Martes martes* nor other owl species are usually able to enter nest holes of Pygmy Owls. Pygmy Owl nest holes are possibly also too small for the Mink *Mustela vison* to enter. The Mink is anyhow usually restricted to lakes and rivers, and only rarely observed in the nesting habitats of Pygmy Owls in southeastern Norway (own obs.). Stoats and Weasels then are probably the only predators capable of entering a Pygmy Owl nest. In the boreal region Stoats and Weasels occur in years of high vole abundance, but almost vanish when voles are scarce (own obs.). In boreonemoral areas, however, they seem to maintain more stable populations. When voles are abundant, Stoat and Weasel predation on bird eggs should be expected to be more accidental than in years of low vole populations. The possible predation of the two Pygmy Owl nests by Stoats or Weasels in the boreonemoral zone may be a mere coincidence, but do not contradict the predation pattern outlined above.

5. Conclusions

The Pygmy Owl is not so restricted to coniferous woodlands as the Tengmalm's Owl (Glutz von Blotzheim 1980), and its range also includes broadleaf forests. The southern parts of its range, with a mixture of conifers and broadleaved trees, offers a more stable level of food during a four-year period than the northern parts do. In years of high vole abundance, boreal areas seem to offer the best breeding conditions for Pygmy Owls, with prospects of greater clutch size and high breeding success. As pointed out for the Tengmalm's Owl (Solheim 1983a), differences in productivity may give rise to different movement strategies of owls in adjacent areas. Pygmy Owls in the boreonemoral zone may thus be expected to show a greater tendency for stationarity than in the boreal zone. Observations in the north boreal zone also indicate that the number of Pygmy Owls there decrease in years of low vole populations (Sonerud 1982).

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Appendix 1. Clutch size and nesting success of Pygmy Owls in peak, crashing and none vole years in the boreonemoral and boreal zones in southern Norway. Figures in brackets denote the number of hatched eggs.

Vole population	Boreonemoral zone Eggs	Boreonemoral zone Fledglings	Boreal zone Eggs	Boreal zone Fledglings
Peak	7	7	5	5
	6	5	7	7
	6	4	7	7
	6	6	8	8
	8	8	10(8)	8
	7(5)	3	7	7
	6(5)	0[1]	7	6
	7(2+)	0[1]		
	8	8		
	7	5+		
	3+	3+		
Crash	6	6	5	0[2]
	3	0[2]		
	2	0[3]		
	8(6)	6		
	7(5)	5		
	7(7)	3		
	6	6		
None	6	0[2]	0	
	6(6)	2		
	4	4		
	7	6		

[1] Post-hatching predation on nest.
[2] Clutch completed, female disappeared after having incubated for several weeks.
[3] Female and male disappeared.

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