The Boreal Owl

Ecology, Behaviour and Conservation of a Forest-Dwelling Predator

Widespread in North American forest regions including the Rocky Mountains, the boreal owl (*Aegolius funereus*) was once the most numerous predatory bird in Eurasian boreal forests. Synthesising the results of unique long-term studies of boreal owls, this book explores hunting modes, habitats and foods, prey interactions, mating and parental care, reproduction, dispersal, survival and mortality, population regulation and conservation in boreal forests.

Providing a detailed introduction to the species, the authors study the complex interactions of boreal owls with their prey species. They examine the intersexual tug-of-war over parental care, and the behavioural and demographic adaptations to environmental conditions that markedly and predictably fluctuate both seasonally and multiannually. They also question whether boreal owls are able to time their reproductive effort to maximise lifetime reproductive success. Discussing the effect of modern forestry practices on owl populations, the book also examines how boreal owls could be managed to sustain viable populations.

Erkki Korpimäki is Professor of Animal Ecology in the Department of Biology at the University of Turku, Finland. His long-term research questions have focused on how predators are adapted to the large spatio-temporal fluctuations in their main prey densities, the apparent impacts of predators on prey populations and the effects of human-induced changes in the environment on viability of populations.

Harri Hakkarainen is Adjunct Professor of Animal Ecology in the Department of Biology at the University of Turku, Finland. His main fields of research have included landscape ecology, environmental ecology, life-history and demography, habitat and diet selection, sexual selection and dispersal of individuals.

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ERKKI KORPIMÄKI AND HARRI HAKKARAINEN

Section of Ecology, Department of Biology, University of Turku, Finland

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Preface

The senior author

It is early one sunny but chilly morning in late March 1966. The black woodpecker, *Dryocopus martius*, is drumming in the distance. It is easy to ski, because the surface snow layer is still hard enough to bear the weight of two teenage boys. The senior author of this book (EK, born in 1952 in Kauhava, South Ostrobothnia, western Finland) and Reijo Passinen, another enthusiastic young local birdwatcher, are checking some nest-boxes and natural cavities of boreal owls (*Aegolius funereus*) that they had set up or found during the previous autumn and winter. Pine-dominated coniferous forest gradually changes to denser old-growth spruce-dominated forest, where big aspen trees also grow sparsely. On the trunk of a tall aspen, eight metres above the ground, there is a natural cavity made by a black woodpecker. In the vicinity of this tree cavity, a male boreal owl has been hooting eagerly during calm evening nights from early February onwards, although the ambient temperature has often been below −15°C. EK lightly scrapes the aspen trunk, and the facial disc of a female boreal owl suddenly emerges from the entrance hole of the cavity. She has a surprised look, and only her yellow and black eyes can easily be seen looking out from the greyish-white facial disc against the background of the aspen trunk. It was their first visit to the nest of a boreal owl. When they went back, they found yet another boreal owl nest, this time in the new nest-box that they had set up the previous autumn.

This expedition remains vivid in EK's memory and engendered a lifelong fascination in predators, in particular in secretive nocturnal owls, which are really fascinating creatures. It was also the starting point of a period of explorative study, and later a professional research project, that he never imagined would still be going strong more than 40 years later.

When he was 13 years old, EK began some explorative studies on boreal owls in the natural-history clubs of the elementary and high schools at Kauhava and erected the first nest-boxes for these owls in autumn 1965, together with Reijo Passinen. The data collected during the explorative period from 1966 onwards in the Kauhava region included the number of nests, clutch size, breeding success and diet composition of boreal owls (Table 1).

During the three summers of the years in high school (1968–1970), EK worked as a research assistant on the northernmost tip of Finnish Lapland (Karigasniemi, Utsjoki) in a

Table 1. Number of available nest-boxes and nest-holes, total number of boreal owl nesting attempts (at least one egg laid; NE), number of clutches that were taken by pine martens (PM), number of clutches that failed for other reasons (mostly were deserted because of probable food scarcity; FA), percentage of boxes and holes with owl nests, number of female and male parents ringed or re-trapped at nests, and number of boxes with hooting bachelor males in the Kauhava region, western Finland during 1966–2010 (number of hooting males only in 1978–93). Data from Korpimäki (1987e), Korpimäki et al. (2008) and unpublished.

		No. of nests				Number trapped		
Year	Number of boxes	NE	PM	FA	Percent nested	Female[a]	Male	Number of bachelors[b]
1966	35	4	0	0	11.4			
1967	56	11	0	4	19.6			
1968	61	2	0	0	3.3			
1969	63	4	0	0	6.3			
1970	65	5	0	0	7.7			
1971	83	5	0	0	6.0			
1972	90	2	0	0	2.2			
1973	99	18	1	4	18.2			
1974	122	13	1	0	10.7			
1975	133	3	0	1	2.3			
1976	235	19	1	4	8.1	7	0	
1977	290	63	1	12	21.7	29	0	
1978	335	14	0	3	4.2	6	0	5
1979	355	37	2	8	10.4	22	11	6
1980	395	24	2	9	6.1	25	9	16
1981	395	10	0	0	2.5	7	6	18
1982	415	33	1	3	8.0	36	24	14
1983	450	26	1	13	5.8	25	19	30
1984	450	8	2	2	1.7	10	7	4
1985	450	50	4	8	11.1	35	36	11
1986	450	85	4	16	18.9	81	76	13
1987	450	11	0	4	2.4	12	10	8
1988	500	99	2	15	19.8	93	92	22
1989	500	147	1	43	29.4	133	129	40
1990	500	19	0	6	3.8	16	15	2
1991	500	115	1	35	23.0	95	91	12
1992	500	163	2	64	32.6	123	121	13
1993	500	13	0	5	2.6	14	12	4
1994	500	49	0	17	9.8	44	40	
1995	500	29	0	14	5.8	27	26	
1996	500	38	0	15	7.6	39	30	
1997	500	21	0	13	4.2	18	11	
1998	500	4	0	1	0.8	3	1	
1999	500	24	0	1	4.8	23	17	
2000	490	26	0	16	5.3	29	25	
2001	490	2	0	0	0.4	2	1	
2002	490	40	0	4	8.2	25	10	
2003	490	138	1	14	28.2	90	19	
2004	490	10	1	0	2.0	5	4	
2005	490	76	1	19	15.5	29	18	
2006	490	20	0	10	4.1	17	11	

Table 1. (cont.)

Year	Number of boxes	No. of nests			Percent nested	Number trapped		Number of bachelors[b]
		NE	PM	FA		Female[a]	Male	
2007	490	14	0	1	2.9	13	12	
2008	490	60	0	11	12.2	50	41	
2009	490	50	2	10	10.2	41	33	
2010	490	3	0	1	0.6	2	2	

[a] In some years, the number of ringed or re-trapped females was higher than the number of nests, because some females were also ringed in the areas surrounding the main owl study area in the Kauhava region.
[b] Number of hooting males was monitored using the point stop method.

project on the behaviour, breeding density, breeding performance and success of peatland bog and tundra birds. This project was led by the late Olavi Hildén (Department of Zoology, University of Helsinki, Finland). Docent Hildén was one of the most celebrated field ornithologists in Finland in the 1950s to 1990s who, among other things, made long-term studies on archipelago birds (Hildén 1966, Hildén et al. 1995) and published a widely cited review on habitat selection in birds (Hildén 1965). Hildén led the search for the hidden nests of the secretive arctic wader and passerine species such as the broad-billed sandpiper *Limicola falcinellus*, the spotted redshank *Tringa erythropus*, the jack snipe *Lymnocryptes minimus*, the red-necked phalarope *Phalaropus lobatus*, the Lapland bunting *Calcarius lapponicus* and the red-throated pipit *Anthus cervinus*. Docent Hildén also researched specific topics in behavioural ecology from the 1960s onwards, including the mating and breeding systems of waders (e.g. Hildén 1975, 1978). EK learned how to study the behaviour and breeding performance of individuals in bird populations at Karigasniemi.

EK embarked on his studies in biology at the Department of Zoology, University of Oulu, Finland in September 1971. There he was privileged to benefit from the wide experience, enthusiastic teaching and deep knowledge of professors Lauri Siivonen and Seppo Sulkava. The late Professor Siivonen was internationally renowned for his studies and reviews on the population cycles of forest grouse and other game animals (Siivonen 1954, 1948). Professor Sulkava is a pioneer investigator of the diet composition and predator–prey interactions of north European birds of prey, including the goshawk *Accipiter gentilis*, the peregrine *Falco peregrinus*, the golden eagle *Aquila chrysaetos*, the white-tailed sea-eagle *Haliaetus albicilla*, the eagle owl *Bubo bubo*, and the great grey owl (see, e.g., Sulkava S. 1966, 1968, Sulkava S. and Huhtala 1997, Sulkava S. et al. 1984, 1997, 1998, 2008). His tuition was of particular importance to EK, because he and his brother, Phil. Lic. Pertti Sulkava, had performed the first study on regional and between-year variations in the diet composition of boreal owls in Finland (Sulkava P. and Sulkava S. 1971). Seppo Sulkava's wide knowledge of ecology and nature in general – and of birds and mammals in particular – greatly benefited EK in planning the study designs and data collection for his Ph.D. thesis on breeding performance and predator–prey interactions in boreal owls. Under his supervision, EK also

began to collect data on between-year variations in breeding density and breeding performance in relation to fluctuations in main food abundance, diet composition and prey selection of boreal owls, as well as on the daily activity patterns of parents and growth of nestlings. These data were analysed and summarised in his Ph.D. thesis (Korpimäki 1981).

Later on, EK's research projects were extended to include population dynamics, reproductive success and behavioural ecology of many other birds of prey including, for example, the short-eared owl *Asio flammeus*, the long-eared owl *A. otu*s, the hawk owl *Surnia ulula*, the Ural owl *Strix uralensis*, the eagle owl *Bubo bubo*, the pygmy owl *Glaucidium passerinum*, the Eurasian kestrel *Falco tinnunculus*, the hen harrier *Circus cyaneus*, the common buzzard *Buteo buteo*, and the goshawk *Accipiter gentilis* (see Korpimäki 1984, 1986c, 1987c, 1992a, Korpimäki and Huhtala 1986, Huhtala et al. 1987, Korpimäki et al. 1990, Korpimäki and Norrdahl 1991a, 1991b, Reif et al. 2004, Tornberg et al. 2006, Suhonen et al. 2007). The research team headed by EK has also studied the responses of mammalian predators (the least weasel *Mustela nivalis*, the stoat *M. erminea*, the American mink *M. vison*, and the red fox *Vulpes vulpes*) to the population cycles of small mammals (e.g. Korpimäki et al. 1991, Klemola et al. 1999, Dell'Arte et al. 2007). Finally, the impacts of avian and mammalian predators on the fluctuating small mammal and game animal populations have also been studied (e.g. Norrdahl and Korpimäki 1995b, 1996, Korpimäki and Norrdahl 1998, Korpimäki et al. 2002, 2005a; and reviews in Korpimäki and Krebs 1996, Korpimäki et al. 2004, Salo et al. 2010). These two main long-term research topics have thus dealt with predator–prey interactions from both sides of the fence. First, how predators are adapted to the large spatio-temporal fluctuations in their main prey densities and, second, what are the apparent impacts of predators on prey populations? A third, more applied, research question is: how have human-induced changes in the environment, such as modern forestry practices, changes in the intensity of agriculture, and invasion of alien predators, altered the composition of predator assemblages, individual-level performance and survival of predators and their impact on prey populations (e.g. Nordström et al. 2002, 2003, Nordström and Korpimäki 2004, Salo et al. 2007, 2008).

The junior author

The junior author, HH, was born in Jyväskylä in central Finland in late March 1966, perhaps on the very same sunny but chilly morning that EK met his first boreal owl at Kauhava. HH started his studies at the Department of Biology, University of Jyväskylä, central Finland in 1987. Two years later, he joined EK's boreal owl research team, and was the first student on the project to complete a master's thesis on boreal owls. At that time, HH had a keen interest in solving the puzzle of reversed sexual size dimorphism in boreal owls and other birds of prey, and subsequently worked in the same area of study for 10 years. He first collected the data for his Ph.D. thesis on reproductive effort, body size and their fitness consequences in boreal owls (Hakkarainen 1994), which consists of six chapters (Hakkarainen and Korpimäki 1991, Hakkarainen and Korpimäki 1991,

1994a, 1994b, 1994c, 1995), and then performed postdoctoral research, mostly funded by the Academy of Finland.

HH's main fields of interest have included a wide spectrum of topics in ecology, such as landscape ecology, environmental stress, environmental ecology, life-history ecology, reproductive success, survival, habitat and diet selection, sexual selection, and dispersal of individuals. Today his main aim is to study whether changes in forest structure owing to modern forestry techniques have had effects on individuals' reproductive success, survival, physiological stress, food resources and morphological characteristics. In addition, intra- and interspecific interactions, predation and competition have been examined in differently fragmented forest landscapes. He has approached the problem of forest fragmentation by collecting long-term data on forest-dwelling species, such as the Eurasian treecreeper (*Certhia familiaris*), wood ants (*Formica* spp.) and the three bird of prey species: the boreal owl, the goshawk and the common buzzard.

During the boreal owl studies, HH has been taught by EK how to perform very efficient field studies in population ecology. He soon noticed that owl studies, as such, are energetically demanding; in the 1991 field season, with 120 owl nests to monitor, HH lost 7 kilos in weight, due to hundreds of climbs to the nest-boxes and natural cavities, and staying awake for long periods at night. But perhaps the most memorable experience occurred during the 1992 field season (a record year – with 163 nests altogether), when our new Ph.D. student, Vesa Koivunen, introduced 'the ladder technique' to the project. Previously the nest-box trees had been climbed without any instruments. 'The ladder technique' increased our daily record for checking nest-boxes considerably, from 80 to 120. This new technique, unfortunately, also turned out to increase HH's body mass, and these days, in fact, ladders are obligatory when checking nest-boxes.

During the last 25 years, our research on boreal owls and other birds of prey has also included an experimental approach along with the observational approach. In the experiments, we have attempted to test the predictions of hypotheses that have been derived on the basis of observational results. We hope that these studies will continue in the future, as the value of long-term data in animal population ecology is always increasing.

In conclusion, it has been our pleasure and privilege to perform long-term studies of the boreal owl – perhaps the most fascinating bird in the coniferous forests of the world.

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