SOME RESULTS OF LONG-TERM RAPTOR MONITORING IN THE KOSTOMUKSHA NATURE RESERVE

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Twelve species of diurnal raptors and seven species of owls, including species from the Red Data Books of Russia and Karelia, were registered during the 20-year period of observations in the Kostomuksha nature reserve. During this period most encounters happened with two species of buzzards – the Common and Rough-legged ones. Annual registration numbers have decreased since the beginning of regular observations due both to subjective factors (registration of raptors by observers) and actual population decline.

Key words: diurnal raptors, owls, Kostomuksha nature reserve, contact cards.

НЕКОТОРЫЕ РЕЗУЛЬТАТЫ МНОГОЛЕТНИХ НАБЛЮДЕНИЙ ЗА ХИЩНЫМИ ПТИЦАМИ В ЗАПОВЕДНИКЕ «КОСТОМУКШСКИЙ». Адрианова О.В., Кашеваров Б.Н. Государственный природный заповедник «Костомукшский», Карелия, Россия.

За 20-летний период наблюдений в заповеднике «Костомукшский» зарегистрировано 12 видов дневных хищных птиц и 7 видов сов, в том числе занесенных в Красную книгу России и Карелии. Наибольшее количество визуальных встреч произошло за это время с двумя видами канюков, обыкновенным и мохноногим. С начала регулярных наблюдений произошло снижения количества ежегодно регистрируемых хищных птиц, что объясняется как субъективными факторами (регистрация наблюдателями хищных птиц), так и реальным снижением их численности.

Ключевые слова: дневные хищные птицы, совы, заповедник «Костомукшский», карточки встреч.

INTRODUCTION

In the 1940s, the area where the Kostomuksha nature reserve is now situated was studied by Finnish ornithologists and later, in the 1970s, in connection with the construction of the town of Kostomuksha, by Karelian scientists (Danilov et al. 1977). In 1985-1986, after designation of the Kostomuksha nature reserve, the authors started observations upon birds, including raptors, and inventory of the reserve fauna. There were practically no ornithologists in the reserve staff during its history, and observations were conducted by inspectors of the security department and by specialists in various fields from the scientific department. The results of these observations were published in several reviews about the reserve fauna (Adrianova et al. 1990, Kashevarov & Pozdnyakov 1977, Kashevarov 1979). Short studies in the reserve were done by Finnish ornithologists from the Game and Fisheries Institute, Oulu University, by Russian ornithologists from the Moscow State University (Matyushkin & Danilenko 1999), but the largest contribution was made by S.V. Sazonov (Karelian Research Centre), who conducted his research for several years. Thanks to these studies 171 bird species were registered from the Kostomuksha area, including 137 species within the reserve (Sazonov 1997, Sazonov & Zimin 1997).

MATERIALS AND METHODS

Observations upon raptors (diurnal raptors and owls) are conducted in the territory of the reserve all year round. The instruction is that being in the field all employees of the reserve should register all encounters with raptors in special contact cards. All in all, slightly more than 300 encounters with raptors have been registered over the period of observations. Most of the encounters were with two species of Buzzards, as well as with the Osprey, Goshawk and Great Grey Owl (fig. 1). Because information about identification of buzzard species is not always reliable due to the sometimes inadequate qualification of observers, registrations of the two species were summed up.

RESULTS AND DISCUSSION

As of now, 12 species of the diurnal raptors (*Accipiteriformes*) and 7 species of owls (*Strigiformes*) have been registered from the reserve. They are: the Osprey (*Pandion haliaetus),* White-tailed Sea Eagle (*Haliaeetus albicilla),* Golden Eagle (*Aquila chrysaetos),* Common Buzzard (*Buteo buteo),* Rough-legged Buzzard (*Buteo lagopus),* Goshawk (*Accipiter gentilis),* Sparrowhawk (*Accipiter nisus),* Hen Harrier (*Circus cyaneus),* Black Kite

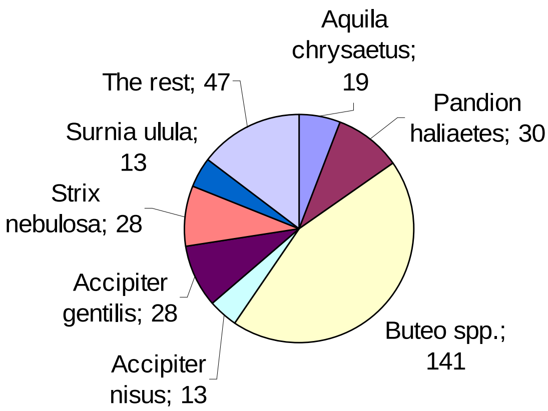

Figure. 1. Number of encounters with raptors in 1986–2004 (n = 319).

(*Milvus migrans*), Peregrine Falcon (*Falco peregrinus*), Merlin (*Falco columbarius*), Hobby (*Falco subbuteo*), Kestrel (*Falco tinnunculus*), Great Grey Owl (*Strix nebulosa*), Ural Owl (*Strix uralensis*), Pygmy Owl (*Glaucidium passerinum*), Tengmalm's Owl (*Aegolius funereus*), Short-eared Owl (*Asio flammeus*), Hawk Owl (*Surnia ulula*) and Snowy Owl (*Nyctea scandica*).

Four species (Hen Harrier, Kestrel, Ural Owl and Snowy Owl) were registered only once each. Some others – the Merlin, Hobby, Pygmy and Tengmalm's Owls – were registered less than 5 times over 20 years.

One can see from the species list that 4 raptor species from the Red Data Book of Russia have been registered from the reserve: the Golden Eagle, White-tailed Sea Eagle, Osprey and Peregrine Falcon. Unfortunately, it is nowadays impossible to affirm for sure that they nest in the reserve, although some time ago it was definitely so, at least for three of them.

Analysis of raptor registrations during the above mentioned period gave the following results (fig. 2). The number of encounters with diurnal raptors and owls was high in 1986–1990. The number peaked in 1988 (51 contact cards). Buzzard registrations in this year constituted less than 25%. In 1987 and 1989, Buzzards accounted for 69% and 43% of all registrations, respectively. In 1986–1990, the number of annually registered species was also the highest (10–14). Later, this index decreased to 2–6 species annually, the same happening to the total number of contact cards.

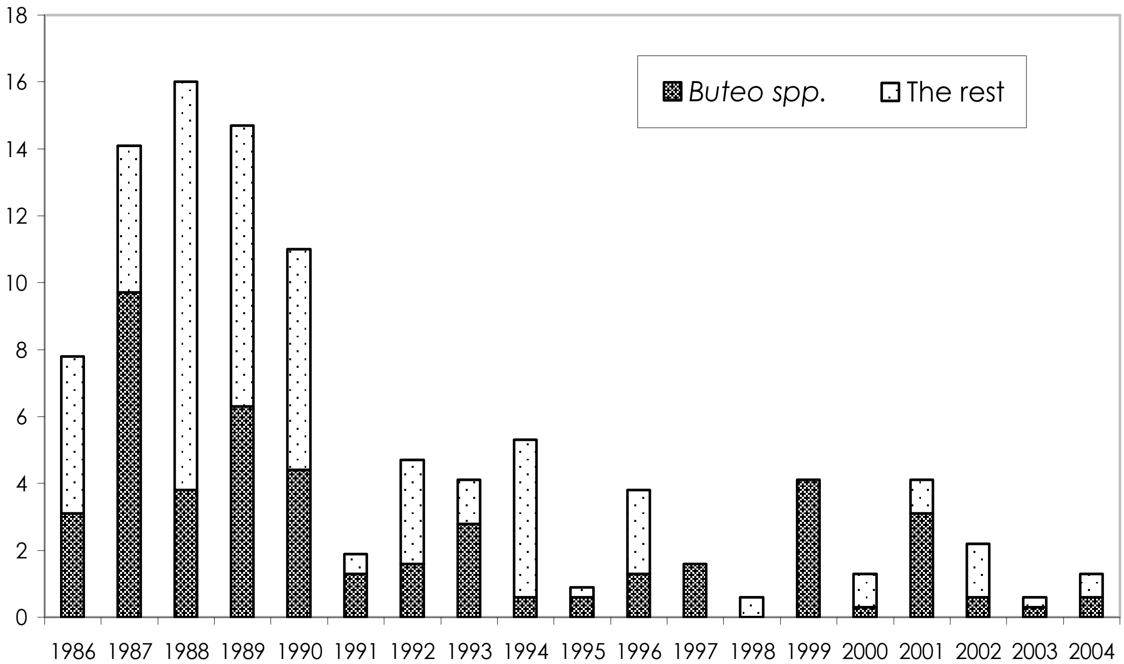

Figure 2. Number of contact cards (%) for Buzzards and other raptors in 1986–2004 (n = 319).

The year to be noted specifically is 1988. This year a record number of contact cards were filled for the Great Grey Owl and the Hawk Owl – 12 and 9, respectively. This may be due to the fact that 3 breeding pairs of the Great Grey Owl were registered from Lake Kalivo area, two of them nesting at a distance of less than 200 m apart, and the third one not further than 2 km away. The Hawk Owl was also registered there in summertime, most probably also in relation to breeding. Osprey nests were found on one of the islands in Lake Kalivo and on its eastern shore, close to the border of the reserve, and 3 to 6 contact cards were filled for this species annually in 1986–1990. This constitutes 7–14% of annually filled contact cards. As mentioned above, the number of annually filled contact cards has been decreasing since 1990. Most encounters were with Buzzards, but even for these species encounters have lately been few.

A possible explanation for the decrease in the number of raptor registrations may be that the reserve staff spent less time in the field conducting observations. But this is not the only reason. At the same time, winter track counts showed a trend for a decline in grouse population in the reserve, especially for the Capercaillie (*Tetrao urogallus*) (Kashevarov & Heikkilä 2003). Moreover, the number of encounters with species like Buzzards decreased notably compared to the late 1980s although the regularity of visits to northern parts of the reserve and observations remained the same. At that time, the authors observed 1–2 pairs of the birds circling in the sky on nearly every trip to the reserve. It is possible also that guards did not always fill contact cards for the species (since they were common), and the number of the cards could have been greater. In the past several years, no pairs of circling birds have been observed.

CONCLUSION

The number of raptors in the area where the Kostomuksha nature reserve is situated now has probably decreased over the period of observations. This happened although some human impacts, like disturbance, direct persecution, etc., on the reserve territory itself decreased. Human impact on the territory now keeps decreasing further due to the reform of the national border guarding system. On the other hand, commercial exploitation of the forests around the town of Kostomuksha and the reserve has intensified with harvested areas coming very close to the reserve border. Thus, assessing the status of bird populations, not to speak of forecasting it, appears impossible without detailed investigations by ornithologists and close heed to the situation with raptors from all reserve staff.

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SPECIES DIVERSITY, POPULATION AND ECOLOGY OF RAPTORS ON THE NORTHEASTERN SHORE OF THE RYBINSK RESERVOIR

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Studies were done (1999–2005) in a 125 km² research area. The study area is situated on the NE shore of the Rybinsk reservoir, near the city of Cherepovets (Vologda region). During the 7 years of observations, 14 species of *Falconiformes* were recorded in the area, and breeding was confirmed for 12 of them. The combined mean annual abundance of breeding species was 32 pairs (27 to 37 pairs in different years) with an average population density of 29 pairs/100 km². The bulk of the population is constituted by the Black Kite (study period mean 23.7%), Hobby (21%), Black Kite (16%), Sparrowhawk (15.6%), Buzzard (11.6%) and White-tailed Sea Eagle (9.8%). The rest of the species contributed 1–10% to the total raptor population in the research area (Marsh Harrier (7.6%), Osprey (3.6%), Honey Buzzard (3.1%), Hen Harrier (2.2%)). The Kestrel (0.9%), Goshawk (0.4%) and Peregrine Falcon (0.4%) contributed less than 1% each. Occasional registrations of the Golden Eagle and transient Rough-legged Buzzard were also reported. Data on the abundance dynamics and ecology of *Falconiformes* in the investigated part of the Rybinsk reservoir shore area are presented.

Key words: Falconiformes, species diversity, population, ecology, Rybinsk Reservoir.

ВИДОВОЕ РАЗНООБРАЗИЕ, НАСЕЛЕНИЕ И ЭКОЛОГИЯ ХИЩНЫХ ПТИЦ СЕВЕРО-ВОСТОЧНОГО ПОБЕРЕЖЬЯ РЫБИНСКОГО ВОДОХРАНИЛИЩА. Бабушкин М.В. Московский государственный педагогический университет, Россия.

Исследования проводились (1999–2005 гг.) на стационаре площадью 125 км² исследуемая территория находится на северо-восточном побережье Рыбинского водохранилища, в окрестностях г. Череповца (Вологодская область). За 7 лет наблюдений на стационаре зарегистрировали пребывание 14 видов соколообразных, для 12 из них доказано гнездование. Среднегодовая суммарная численность гнездящихся видов составила 32 пары (от 27 до 37 пар в разные годы) со средней плотностью населения 29 пар/100 км². Основу населения составляют черный коршун (в среднем за все годы 23,7%), чеглок (21%), черный коршун (16%), ястреб-перепелятник (15,6%), канюк (11,6%) и орлан-белохвост (9,8%). Доля остальных видов в общем населении хищников стационара составляет 1–10% (болотный лунь (7,6%), скопа (3,6%), осоед (3,1%), полевой лунь (2,2%)), менее чем 1% приходится на пустельгу (0,9%), ястреба-тетеревятника (0,4%) и сапсана (0,4%). Отмечены единичные встречи беркута, а также на пролете зимняка. В работе приводятся данные по динамике численности и экологии соколообразных на исследуемом участке побережья Рыбинского водохранилища.

Ключевые слова: соколообразные птицы, видовое разнообразие, население, экология, Рыбинское водохранилище.

INTRODUCTION

Events of the past two decades, namely the sharp economic decline in the industry and agriculture of Russia and its north-western regions in particular, could not but tell on the population of raptors (Pchelintsev 2001). On the other hand, latest studies have shown that it is in the north of the forest zone that viable populations of rare raptors have survived. Data on the abundance and distribution of common raptor species are insufficient, however. Our main task therefore was to analyse the species composition, distribution and abundance dynamics of *Falconiformes* in north-western parts of the Upper Volga area.

MATERIAL AND METHODS

The paper is based on the results of studies carried out in 1999–2005 in the permanent sample plot situated in the Cherepovets district of the Vologda region. In the first year (1999) observations were made in an area of 70 km², between 2000 and 2003 the area increased to 125 km², in 2004 the sample area was 115 km², and in 2005 it decreased to 110 km².

The study area is situated on the left hand (SE) shore of the Sheksna branch of the Rybinsk reservoir, in the immediate vicinity of Cherepovets (fig. 1). The station is NE of the Darwin reserve, ca. 15 km away from its boundary (Babushkin 2003).

A considerable part of the polygon is under pine forests (45%). Raised bogs overgrown with dwarf pine trees cover 35% of the study area. Spruce forests account for 8%, birch forests for 6%. Aspen and black alder stands cover 5% and 1% of the polygon, respectively.

There are 10 settlements in the study area: 6 villages (ca. 500 inhabitants in total), 3 summer cottage villages (2000 people) and a tourist centre operating all year round. The human population density, including recreational load, is 20 people per 1 km^2. Over the 7 years of studies in the station, the road network has doubled, 2 new summer cottage communities with a total of 1300 inhabitants in the summer period appeared, the area of timber felling increased to 8–10 ha per year.

The main methods in the field were detection of nest areas and search for nests following standard procedures suggested by Galushin (1971). Also widely used was the transect counts method with registration of all raptors encountered along a transect, as well as observations from elevated watch sites and trees (Osmolovskaya & Formozov 1952, Galushin 1971, Drobyalis 1991). When searching for rare species and those rarely occurring in the region, checks of potential nesting areas were complemented with interviews with local people, who were very helpful in finding nests of the Osprey and White-tailed Sea Eagle.

The size of breeding territories, nest areas and hunting ranges were determined by constant registration and mapping of all raptor contacts with the type of activity (hunting, prey carrying, etc.) recorded.

During the study period (1999–2005), we registered 14 species of *Falconiformes*, of which 12 regularly nested in the area (Babushkin 2006). The initial material for assessing the distribution and abundance of raptors was 1872 registrations from various types of counts, maps of 51 nest areas of 12 species, as well as descriptions of 48 occupied nests of 8 species of *Falconiformes*.

Material on the diet of the Osprey, White-tailed Sea Eagle and Black Kite was gathered from the Darwin reserve in 2003–2005. Sampling of initial material was done mainly by gathering food remains (bones, feathers, scales, cast pellets) directly from the nest, from its immediate vicinity and from perches. The remains were then analysed to determine the species and weight of the prey, as well as the size class of the fish taken by the birds (Babushkin 2005).

The age of the prey was calculated from annual rings on scales and flat bones (cleithra). Then, knowing the fish age, its weight and length were determined. This was done using summary tables by Svetovidova (1975) reflecting linear growth rates of fishes from the Rybinsk reservoir.

Mean weight of prey birds in the Osprey, White-tailed Sea Eagle and Black Kite diet was calculated using data on the mean weight of birds (Ilyichev & Mikheev 1986). Mean weight of mammals detected in the diet of the species in question was determined after Sokolov (1989).

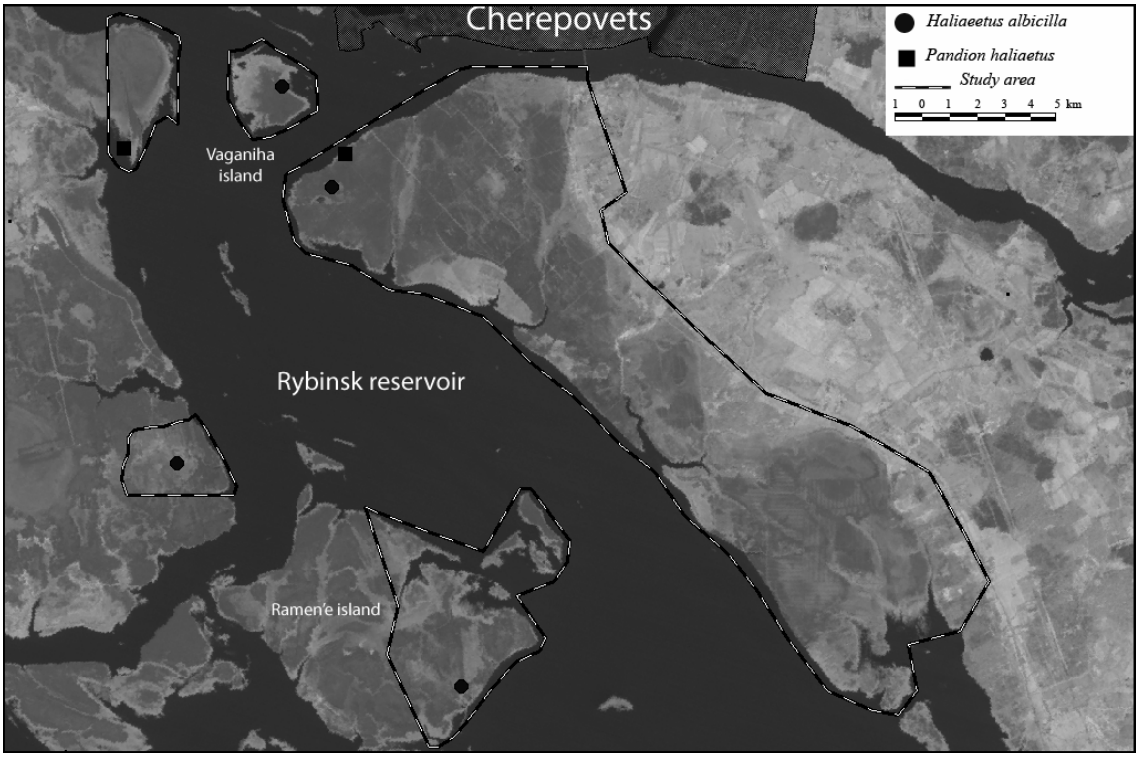

Figure 1. Distribution of Osprey and White-tailed Sea Eagle nests in the Cherepovets study area.

An important addition to the above-described methods of studying raptors was direct observations in hunting grounds and at nests. Total duration of observations over the breeding and hunting behaviour of the species was 130 hours, of which 36 h was hunt watching and 94 h observations at nests. Raptor hunting behaviour was watched from tall trees on the reservoir shore and from a tower 60 m high.

Within the present study (2003–2005) we gathered 47 samples of food remains from 13 White-tailed Sea Eagle nests, 11 Osprey nests and 5 Black Kite nests. From 2683 prey fragments (scales, bones, feathers) and cast pellets we identified 254 food items of 25 species. A total of 220 fish specimens (11 species), 29 bird specimens (11 sp.) and 5 mammal specimens (3 sp.) were identified.

RESULTS AND DISCUSSION

Osprey *Pandion haliaetus*. The species best studied among rare raptors in the Vologda region today are the Osprey and the White-tailed Sea Eagle. The reasons are good visibility of their nests from the air and during winter surveys, as well as the fact that the species are widely known and quite easily recognizable even by a little experienced birder.

Osprey and White-tailed Sea Eagle populations in the Vologda region are now mostly concentrated in four areas:

1) *Darwin reserve* and adjacent parts of the Mologa–Sheksna drainage divide. This is the core area for the populations of both species. There now live 50–55 breeding pairs of the Osprey and 25–30 pairs of the White-tailed Sea Eagle.

2) *Siz'ma widening of the Sheksna impoundment reservoir.* In 1988, there nested 3 Osprey pairs and 3 White-tailed Sea Eagle pairs (Belko 1990). In 1993, we detected 5 Osprey nests and 3 White-tailed Sea Eagle nests. Surveys and interviews with local people in 1999 yielded data about breeding of 11–12 Osprey pairs and 11 White-tailed Sea Eagle pairs at the widening. Now there nest ca. 15 White-tailed Sea Eagle pairs and 20–22 Osprey pairs.

3) *Lake Beloye shore.* In 1988, the shore was surveyed around the lake with 1 White-tailed Sea Eagle nest and 5 Osprey nests detected (Belko 1990). In 1993, the western shore of the lake was inspected with 6 breeding pairs of the White-tailed Sea Eagle and 1 Osprey pair registered.

4) *Lake Vozhe.* In 1988, 3 White-tailed Sea Eagle nests and 1 Osprey nest were found. The 2000 expedition detected 9 breeding Osprey and 11 White-tailed Sea Eagle pairs around the lake (Babushkin et al. 2000).

The Osprey population in the western part of the region is diffuse. There are quite a few lakes with 1–2 Osprey pairs nesting around (lakes Shol'skoye, Pereshnoye, Katromskoye, Siverskoye, Borodaevskoye, etc.) (Kuznetsov 2000).

The White-tailed Sea Eagle in the Vologda region tends to settle around large bodies of water, wherefore their surveys show higher densities of the species (Kuznetsov & Babushkin 2003).

Annually, 1–3 pairs of the Osprey breed in the Cherepovets area (fig. 1). One occupied and one abandoned nest were found during the study period. The nests were 5 and 3.5 km away from industrial districts of the city. Also, an old Osprey nest was found 2.5 km away from the city in August 1999.

In spring, Ospreys arrive in the Upper Volga area in the second ten days of April, with the onset of flood on rivers (Kerdanov 1991). The earliest arrival in the Cherepovets station was on 29 March 2000, the latest on 21 April 2003, the 7-year average being 12 April. Pairs were registered at nests in the second half of April – 7 April 1999 and 16 April 2000. At this time, snow starts melting actively in open sites, but its depth in the forest is still 20–30 cm. The Rybinsk reservoir is then covered in solid ice, although first openings already appear in the ice cover.

Most Ospreys breeding around the reservoir start incubating eggs early in May. We registered a full clutch on 7 May 2000, the size of eggs in the nest closest to Cherepovets (2000) was 63.4 x 47.2; 63.7 x 47.7; 65.1 x 48.0. The young hatch in the first half of June (10 June 2000). In the Darwin reserve, the nestling stage lasts 40 to 56 days (our data) depending on feeding. Fledglings leave nests in the station in the second ten days of July (18 July 2000). In the reserve, we recorded the first fledglings out of the nest on 12 July 2003, 13 July 2004; the latest date known for the Osprey young to have left the nest in the reserve is 3 August 2005. After leaving the nest, fledglings stay around throughout August. The male keeps providing the brood with food, delivering it to the nest 4–6 times a day. Two peaks have been recorded in the feeding activity of male Ospreys (from 56 hours of observations at nests in the Darwin reserve) – from 11 a.m. to 2 p.m. and from 6 p.m. to 9 p.m. Starting about mid-August, juveniles appear over the reservoir water area, where adults continue feeding them at first. Departure takes place in late October – early November: the latest Osprey contacts in the area are dated to 27 October 2000 and 8 December 2004; in some years, Ospreys may stay in the Darwin reserve until mid-November.

The Osprey is strictly ichthyophagous, preying on fish only. Some authors, however, report that the Osprey may on some occasions eat gulls (Dmokhovskiy 1933) (on River Pechora), waterfowl and muskrats (Gusev & Chueva 1951) (River Il'), as well as other animals (Dementiev & Gladkov 1951).

The diet of Ospreys breeding around the Rybinsk reservoir comprises 8 fish species (tab. 1). One should note that our material contained nothing but fish. As regards the number of specimens, the main species in the Osprey diet are: bream (27%), blue bream (25%), roach (24%) and ide (13%). The lowest proportion is contributed by pike and ruff (1%), a medium position belongs to perch (6%) and white bream (3%). The dominants by weight were also bream (51% (21 kg)), blue bream (17.4% (7.18 kg)),

Table 1. Diet composition of the Osprey (data from pellets and prey remains).

Species		N	% N	Biomass consumed (g)	% biomass
Pike	*Esox lucius*	1	1	2300	5.6
Roach	*Rutilus rutilus*	19	24	4228	10.2
Ide	*Leuciscus idus*	10	13	4840	11.7
White bream	*Blicca bjoerkna*	2	3	800	1.9
Bream	*Abramis brama*	21	27	21,000	50.8
Blue bream	*Abramis ballerus*	20	25	7180	17.4
Perch	*Perca perca*	5	6	855	2.1
Ruff	*Acerina cernua*	1	1	110	0.3
Total		79	100%	41,313 kg	100%

(17.4% (7.18 km)), ide (11.7% (4.84 kg)) and roach (10.2% (4.23 kg)) (tab. 1). Linearly, prey-fish ranged from 12 cm (ide) to 61 cm (pike), an average being 29 cm. The weight of fish taken by the Osprey ranged from 78 g (ide) to 2800 g (pike), with an average of 630 g (N=79).

The size of fish in the diet of Ospreys from the Okskiy reserve size reported by Galushin (1958) was quite similar. Thus, Osprey diet there included specimens 10 to 40 cm long and weighing 35 to 1000 g (N=26). An average size of fish taken by the Osprey was 20 cm, average weight 340 g. For Germany, an average weight of Osprey prey fish reported by Moll (1956–1957) was 300–400 g, and by Mertens (1956) – 200–300 g. An adult bird living at the Rybinsk reservoir eats 500–700 g of fish a day. A male brings 1200–1500 g of fish to a nest with two nestlings four weeks old. Thus, an Osprey family consumes ca. 120 kg of fish over a breeding period – from late April – early May to mid-July. Researchers studying Osprey diet in southern Finland estimated that each bird family took about 120 kg of fish over ca. 130 days of stay in Finland (Häkkinen 1977).

Honey Buzzard *Pernis apivorus*. The Honey Buzzard has never been considered abundant in the Vologda region, and in the middle of the 20th century the species was rare in the region (Voropanova & Kochin 1954). It now occurs throughout, contacts being most frequent at the edge of tree stands and forest openings, along forest roads and forested shores (Butjev & Shitikov 2000, our observations).

In the Darwin reserve (112630 ha) the species would only breed in hot and dry years with abundant wasps, whose nests the species can find in forests and mires. The Honey Buzzard abundance in favourable years does not exceed 2–3 pairs (Kuznetsov & Nemtsev 2005, our observations).

The Honey Buzzard arrives later than other raptors. The 1999–2005 average date of arrival was 25 April, the earliest first contact was on 14 April 2000, the latest on 17 May 2002. Breeding begins in late May – early June. Summer young were seen on 21 July 2000, 17 July 2002, 19 July 2005. The spring migration is inconspicuous: only 5% of all contacts were recorded in April and May. After the young hatch, Honey Buzzard contacts become more frequent and 25% of all contacts occur in July. The species becomes most noticeable in autumn: 55% of all registrations are made in September. During the autumn migration, the birds often form groups of 7–8, not so often up to 10 individuals. The earliest date of the last contact was 13 August, the latest 25 September. In October, no contacts occurred.

The Honey Buzzard is insectivorous, its diet in the research area comprising chiefly bumblebees and digger wasps. On two occasions a Chaffinch (*Fringilla coelebs*) hunt was observed.

Over the study period (1999–2005), 1 breeding pair of the species was registered from the study area, but no nests were found (Babushkin 2003). The Honey Buzzard breeding density in the area is 1 pair per 100 km^2. Galushin (1978) reported of 2 to 5 pairs staying constantly in the area situated in the central part of the region (100 km^2) in the mid-1970s, the species breeding density thus reaching 4 pairs/100 km^2.

Black Kite *Milvus migrans*. The Black Kite is unevenly distributed across the Vologda region. In the middle of the past century the species was common in the Sukhona river floodplain, not so common on Lake Kubenskoye and River Vologda (Voropanova & Kochin 1954). In the first years after the Rybinsk reservoir impoundment (1946–1950) the species nested abundantly at the edges of large mixed conifer-dominated forest areas bordering vast flooded spaces (Spangenberg & Oliger 1949). Later on, however, the Kite grew adapted to the new conditions and started concentrating around fishermen's villages and fish cutting stations. Black Kites hunted also tundra voles (*Microtus oeconomus*) in temporarily flooded areas overgrowing with low herbaceous vegetation. Their numbers then increased somewhat and stayed at a relatively high level during the 1960s–1970s, when the Black Kite was the second most abundant (after the Osprey) raptor species in the Darwin reserve. The species population in the reserve at the time was up to 16 breeding pairs (Kuznetsov & Nemtsev 2005). As the area of meadows shrank and the temporarily flooded area became overgrown with taller vegetation (canary grass, club-rush, willow carrs and especially reeds), availability of rodents to the species decreased. As the result, the Black Kite abundance around Rybinsk reservoir dropped significantly in the 1980s. Our estimate is that the Darwin reserve now has 6–7 breeding pairs of the species.

The Black Kite arrives mostly in the second half of April, when much of the reservoir water area has freed of ice. The earliest date of arrival is 28 March 2000, the latest 24 April 2002. Birds leave the reservoir in the first ten days of September, although in 2003 a registration was made in October (9 October 2003). The earliest time a clutch was found was 29 April 2000, the latest – 14/V 2003. An average clutch size (n=5) is 2 eggs, with a variation of 2 to 4. The first egg (n=4) hatched between 28 May and 12 June, the second (n=4) between 1 June and 16 June, the third (n=2) between 4 June and 16 June. An average brood is 1.8 nestlings (n=5), the parameter ranging from 1 to 4. The earliest registration of poorly flying fledglings about the nest was on 10 July 2000. The young stay close to the nest until 10 August.

Every year of observations 5 to 9 Black Kite pairs nested in the area (tab. 2). Over the seven years of activities in the area we detected 11 nest areas of the species. Five pairs demonstrated impressive fidelity to the same nest areas for seven years in a row. Two nests were occupied for 5 and 3 years, respectively. Nests and nest areas were situated at a significant distance, over 2 km apart, but occupied nests of other raptors, first of all the Hobby, were found just 150 to 400 m away.

The Black Kite is an obligate floodplain dweller – 6 of the 11 nest areas discovered were situated in the valleys of rivers forming the bays of the Rybinsk reservoir, 2 on islands, 3 in the reservoir shore area. All nests were in the immediate vicinity of open areas (reservoir water surface, temporarily flooded zone, meadows), 20–170 m away. Roads are nearby three of known nests. Four nests were built on pine trees, two on spruce trees. The nest trees were 18–27 m tall, an average being 22 m. Nests were placed in the central part of the crown at a height of 10–19 m, on branches close to the trunk (n=5), in the trunk forking (n=1).

During the study period (2003–2005) we gathered 47 samples of food remains from 13 White-tailed Sea Eagle nests, 11 Osprey nests and 5 Black Kite nests.

We detected 8 fish species (81.25%) in the Black Kite diet. Like for the Osprey, the dominants were roach (20%), blue bream (17.5%), and bream (15%). The second position was occupied by perch (10%) and pike (8.75%). A minor contribution was made by ide (6.25%), white bream (2.5%) and crucian carp (1.25%). The situation would be somewhat different if one calculates the weight of the fish captured by the Black Kite. The first one in the diet would then be bream (28.8% (16.4 kg)), the second position, instead of blue bream, would belong to pike (26.4% (15kg)), blue bream (8.7% (5.0 kg)) and roach (6.7% (3.8 kg)). The rest of fish species contribute ca. 10% (tab. 3).

Birds account for 17.5% (8 species) of the total number of prey in the Black Kite diet. The most frequent prey-bird species is the Chaffinch (6.25%). The Black Grouse and Anatidae account for 2.5% of the food range each, Capercaillie, *Larus spp*., Black Woodpecker and Hooded Crow for 1.25% each. Analysis of the diet by the weight of prey shows that the Chaffinch occupies only 0.2% (0.1 kg) of the food range, the first position in this case being held by the Capercaillie (7% (4 kg)), the second by the Black Grouse (4.2% (2.4 kg)), the third by *Anatidae spp*. (2.5% (1.4 kg)). The rest 4 species contribute to ca. 2% of the total weight of prey (tab. 3).

Mammals are represented by one species, the muskrat, which accounts for 1.25% of the food range, or 2.2% of the total prey biomass.

The Black Kite feeds on fish from 15 cm (roach) to 83 cm (pike) long and weighing from 10 g (perch) to 4300 g (pike) (N=65). An average fish taken by the Black Kite was 31 cm long and weighed 794 g.

Table 2. Abundance and breeding density of the Black Kite and Marsh Harrier in the Cherepovets research station.

Years	Explored area, km^2	Number of breeding territories		Density, pairs/100km^2		%	
		M.migrans	*C.aeruginosus*	*M.migrans*	*C.aeruginosus*	*M.migrans*	*C.aeruginosus*
1999	70	5	3	7.1	4.3	18,5	11.1
2000	125	7	4	5.6	3.2	18.9	10.8
2001	125	9	3	7.2	2.4	24.3	8.1
2002	125	8	2	6.4	1.6	25.0	6.3
2003	125	8	2	6.4	1.6	27.6	6.9
2004	115	8	1	7.0	0.9	27.6	3.5
2005	110	8	2	7.2	1.8	24.2	6.1
7-year mean	113.6	7.57	2.43	6.7	2.3	23.7	7.5

Table 3. Diet composition of the Black Kite (data from pellets and prey remains).

Species		n	% n	Biomass consumed (kg)	% biomass
Total Mammals		1	1.25	1.25	2.2
Muskrat	*Ondatra zibethicus*	1	1.25	1.25	2.2
Total Birds		14	17.50	9.02	15.9
Ducks	*Anas sp.*	2	2.50	1.40	2.5
Black Grouse	*Lyrurus tetrix*	2	2.50	2.40	4.2
Capercaillie	*Tetrao urogallus*	1	1.25	4.00	7.0
Gulls	*Larus sp.*	1	1.25	0.25	0.4
Black Woodpecker	*Dryocopus martius*	1	1.25	0.17	0.3
Hooded Crow	*Corvus cornix*	1	1.25	0.50	0.9
Magpie	*Pica pica*	1	1.25	0.20	0.4
Chaffinch	*Fringilla coelebs*	5	6.25	0.10	0.2
Total Fish		65	81.25	46.62	81.9
Pike	*Esox lucius*	7	8.75	15.00	26.4
Roach	*Rutilus rutilus*	16	20.00	3.79	6.7
Ide	*Leuciscus idus*	5	6.25	2.80	4.9
White bream	*Blicca bjoerkna*	2	2.50	0.72	1.3
Bream	*Abramis brama*	12	15.00	16.40	28.8
Blue bream	*Abramis ballerus*	14	17.50	4.96	8.7
Crucian carp	*Carassius carassius*	1	1.25	1.10	1.9
Perch	*Perca perca*	8	10.00	1.86	3.3
Total		80	100	56.89	100

A substantial part of the Black Kite food range is carrion, chiefly dead fish. Quite a few times we observed the raptor take half-dead fish from the reservoir water surface. We do not distinguish "carrion" into a separate category in the Black Kite diet since one cannot accurately determine the number of dead quarry, but the species shows clear preference for carrion.

Similar data on the Black Kite diet are reported by Shepel' for the Perm region. Thus, nearly a half of the Black Kite food range in the region is carrion – dead fish and birds. Birds in this group are dumped chickens and ducklings (Shepel' 1992).

Hen Harrier *Circus cyaneus*. Uncommon species with a sporadic distribution across the region. Noting the wide distribution of the Hen Harrier in the Vologda region, Butjev & Shitikov (2000) stress that alongside with areas where it stays (and perhaps breeds) continuously for many years there are significant areas of similar habitats where the birds have never been observed. Occasions are known from the mid-20th century when the raptor was bagged in the Vologda and Tot'ma districts of the region (Voropanova & Kochin 1954).

Breeding pairs of the species were registered from the Darwin reserve in the first years of its operation (late 1940s – early 1950s). Overgrowing of open land with scrub and forest caused the species to stop breeding there. Later on, the Hen Harrier visited the reservoir as passage migrant only (Kuznetsov & Nemtsev 2005).

First birds of the species appear around Cherepovets in late April – early May. The average date of arrival for the study years is 12 April. The earliest registration was on 27 April 2000. Autumn passage takes place in September–October, occasional birds are observed also in late October.

Breeding of the species in the study area is irregular. We failed to find any nests of the species during the study period. Breeding pairs of the Hen Harrier were, however, observed in 2000, 2001 and 2005. In 2000 and 2001, breeding of two pairs was proved, and 1 pair nested in 2005. All breeding habitats of the Hen Harrier were situated in abandoned farmland along the Cherepovets–Yaroslavl highway.

Marsh Harrier *Circus aeruginosus*. Common breeder in the Vologda region. Often occurs around lakes of the Sukhona lowland, around Lake Kubenskoye and in other paludified areas (Voropanova & Kochin 1954).

The species was absent from the Darwin reserve in its first years. Occasional pairs started breeding in the reserve as late as the early 1950s. For thirty years afterwards (until the mid-1980s) territorial, most probably breeding pairs were observed in the reserve rarely and not annually. A rise in the abundance of the species clearly coincided with massive spread of reeds in the temporarily flooded zone. The Marsh Harrier numbers peaked in the late 1980s – first half of the 1990s. It was then the third most numerous among raptors in the reserve (after the Osprey and White-tailed Sea Eagle), the population being 12–14 breeding pairs. The reed beds then kept expanding year after year, occupying more and more space and largely displacing sedge communities in the temporarily flooded zone. The continuing expansion of reed beds in the reservoir, which resulted in the dominance of reeds in most of the temporarily flooded zone, not just did not promote the abundance of the Marsh Harrier – it apparently led to its notable decline in the past few years. Marsh Harrier abundance has been declining since the mid-1990s. Thus, in 2003–2004 only one pair was detected at inland bays in the Darwin reserve, where up to 5 pairs used to breed in the late 1980s–early 1990s. At present, no more than 5 pairs breed in the reserve (Kuznetsov & Nemtsev 2005; our data).

The Marsh Harrier arrives in the breeding grounds near Cherepovets in mid-April, the 7-year average date being 13 April. The earliest arrival was registered on 28 March 2000, as well as on 1 May 2002. In autumn, the last birds depart in late September already; in 2004 a single bird was seen on 6 October.

In our study area the species is one of the most widespread. There annually breed 2–4 pairs, but no nests were found during seven years (Babushkin 2003). Judging by the number of contacts and breeding pairs in the station in 1999–2001, the Marsh Harrier abundance used to be high. Its sharp decline began in 2002 and still continues (tab. 2). The most probable reason is that extensive reed beds made it more difficult for Harriers to hunt any type of prey from the root vole (*Microtus oeconomus*) to waterfowl chicks. Reeds have spread so massively in the Rybinsk reservoir that waterfowl brood counts have become impossible – the broods hardly ever appear in open areas. The reed belt in many parts of the temporarily flooded zone reaches several kilometres in width.

Goshawk *Accipiter gentilis*. In the mid-20th century the Goshawk was a common species in the region, occurring there all year round (Voropanova & Kochin 1954). Galushin (1978) reported the Goshawk population density in the Vologda region to be 2 pairs/100 km^2. There now breed 3–5 pairs of the species (0.6 pairs/100 km^2) in the Darwin reserve (Kuznetsov & Nemtsev 2005).

In the Cherepovets station, the Goshawk is sedentary, often observed in the city of Cherepovets in winter (1999, 2000, 2002, 2004). We also observed it annually in the Vologda city parks.

Most registrations are made in autumn and winter – in this period up to 12 Goshawks were sometimes observed in the study area (e.g., January 2001). In all years of studies in the Cherepovets city area, only one pair of the species was reliably proven to breed there (2000). Thus, the species breeding density in the area is 0.8 pairs/100 km^2. The abundance is most probably underestimated due to the secretive life style of the species.

Sparrowhawk (*Accipiter nisus*). The main habitat in the Vologda region is marginal forests. Observed a few times around the city of Vologda and in the Vologda district (Voropanova & Kochin 1954). In the Darwin reserve, the species nests in mixed pine-spruce forests. In the 1980s and 1990s the species numbers in the reserve started growing. In the reserve, the birds settle in young mixed pine-spruce stands, at forest edges, and sometimes in low-productivity pine forests. The abundance of the hawk there is rather low – there now breed no more than 5–7 pairs in the reserve (2 pairs/100 km^2) (Kuznetsov & Nemtsev 2005; our data).

A totally different situation is observed in the study area. The Sparrowhawk is one of the most abundant species there and its numbers are quite stable – there annually breed 3 to 5 pairs, the breeding density being 4 to 5.5 pairs/100 km^2 (tab. 5). We have detected and described 8 nests of the raptor.

The Sparrowhawk is a migratory species, occasionally wintering near Cherepovets (1999, 2000, 2004). A minor part of residential birds wander during autumn and winter. Massive spring migration takes place in late April. First birds appear in the area in the first half of April, the 7-year average date being 13 April; the earliest registrations were on 4 April 2000 and 6 April 2002. The autumn migration begins in September and continues until mid-October. The latest Sparrowhawk registration during the autumn migration was on 23 October 2001.

We know of 9 nest areas in the area, of which 4 were occupied in seven successive years, 2 in two years and 1 in one year. The smallest distance between two occupied nests was 4.2 km on average. Nests of other raptor species were, however, much closer – 400 to 700 m. All nests found (n=8) were situated in low forest, on trees not higher than 16–18 m. Seven of the nests were on pine trees and one on a spruce tree. The nests (n=8) were 43 cm in diameter and 21 cm high on average. Most nests were rather loose, hardly ever lasting through the winter and not reused by the birds, although it did happen in 2000 that a Sparrowhawk used its last-year's nest again. Continuously used roads were found near three nests only; two nests were 70 m away and one 20 m away from a road.

Clutch initiation takes place in the first week of May: 3-8 May 2000, 1-2 May 2001, 3-6 May 2003. Hatching occurs in early to mid-June: 7-10 June 2000, 5-9 June 2001, 10-11 June 2003, 12-13 June 2004. Departure of fledged juveniles was observed for 6 nests. It usually happened in late June – early July: 24 July 2000, 17 July 2000, 3 July 2002, 7 July 2002, 25 June 2003, 5 July 2004.

Most clutches comprised 5 eggs (3 to 6), an average brood being 3.8 (2 to 5) young. The size of the eggs ranged from 37.8–42.9 x 31.3–38.0 mm, the average being 40.9 x 35.3 mm. The average brood size decreased by 20% over the breeding season (tab. 4.).

Table 4. Changes in Sparrowhawk brood size in the study area.

Number	Date		
	16-30 June	1-15 July	16-30 July
Nestlings	5	4,3	4
Nests	3	7	2

Rough-legged Buzzard *Buteo lagopus*. In the mid-20th century the Rough-legged Buzzard was rare in the Vologda region, even during migration (Voropanova & Kochin 1954). In 1927, a Rough-legged Buzzard was observed in the Cherepovets district during autumn migration (Bogachev 1927). Since the late 20th century, the species has been a common passage migrant with no registrations in some years.

The earliest spring contacts were on 17 March 2004 and 20 March 2000, the latest one on 24 April 2003. In the period from 1999 to 2005, explicit spring passage was observed 3 times: 19 birds flew over on 12–14 April 2002; 15 and 12 birds flew over on 24–25 April 2003 and 12–13 April 2004, respectively. In the rest of study years, birds were observed on spring migration, flying in small groups of 2–3 birds. All in all, 53 birds were registered on spring passage in 7 years of observations. There were no Rough-legged Buzzard contacts in the area in 2000 and 2005.

Active autumn migration of the Rough-legged Buzzard is observed in September–October. The last registration was on 17 September 1999 at earliest, and on 12 November 2003 at latest. The only year with no autumn registrations of the Rough-legged Buzzard was 2002. Autumn passage was explicit in the following years: 12–13 April 2000 32 contacts; 16-17 October 2003 24 contacts and 9 October 2005 6 contacts. Over 4 years of observations we recorded a total of 73 Rough-legged Buzzards on autumn migration.

Common Buzzard *Buteo buteo*. The Common Buzzard is one of the most common raptors in the Vologda region. Galushin (1978) reported the breeding density of the species in the region to be up to 12 pairs/100 km^2. The Buzzard abundance in the reserve has always been low, the reason certainly being the insufficient area of open habitats. The species numbers were the highest in the 1960s–1970s, when up to 7–10 pairs nested in the reserve. As the area of open habitats decreased the Buzzard became rare in the reserve, and overgrowing of littoral areas with reeds made its settlement in the Rybinsk reservoir temporarily flooded zone impossible. At present, Buzzards live only around settlements, where hay is mown and they can prey on Microtus voles. Even in years with high Microtus vole abundance there are no more than 3–4 pairs of Buzzards breeding in the reserve (Kuznetsov & Nemtsev 2005, our data). In low vole years Buzzards do not nest in the reserve at all.

Annually, 3 to 5 pairs of the raptor nest in the research station, the breeding density averaged for seven years being 3.2 pairs/km^2. The Buzzard arrives in April – early May; the earliest date recorded was 5 April 2000, the latest 1 May 2003. The 7-year mean arrival date is 12 April. The latest encounters in autumn were recorded on 3 October 2000 and 10 October 2003.

In all years of studies in the Cherepovets research station we found 4 occupied nests and identified 7 nest areas of the species (tab. 5). The nest areas were 1.3 to 5 km apart, average spacing being 2.1 km. Closest to the Buzzard nests were nests of the Hobby , 880 m, and the Sparrowhawk ,1.5 km away.

Three nest sites of the Buzzard were situated in mixed pine-birch forests and one in a birch forest. All nests were 20–70 m away from open habitats (fields, forest glades). The height of nest trees was 12–22 m (18 m on average). Nests were sited at a height of 8–17 m (11 m on average).

Table 5. Abundance and breeding density of the Common Buzzard and Sparrowhawk in the Cherepovets study area.

Years	Explored area, km^2	Number of breeding Territories		Density, pairs/100km^2		%	
		B. buteo	*A. nisus*	*B. buteo*	*A. nisus*	*B. buteo*	*A. nisus*
1999	70	3	3	4.3	4.3	11.1	11.1
2000	125	5	5	4.0	4.0	13.5	13.5
2001	125	4	6	3.2	4.8	10.8	16.2
2002	125	3	5	9.4	4.0	2.4	15.6
2003	125	3	5	2.4	4.0	10.3	17.2
2004	115	4	5	3.5	4.4	13.8	17.2
2005	110	4	6	3.6	5.5	12.1	18.2
7-year mean	113.6	3.6	5	3.2	4.41	10.6	15.9

We observed two Buzzard pairs throughout the breeding period (2000, 2003) – from the beginning of nest construction to the departure of fledged juveniles. The Buzzards starts nesting in the station quite late – the first egg (n=2) was laid on 10 May 2000 and 13 May 2003. Hatching was recorded on 9 June 2000 and 15 June 2003. There were 3 (2000) and 2 (2003) chicks in the nests, and survival until fledging was 2 (2000) and 2 (2003) chicks, respectively. Fledglings departed (n=4) between 25 June and 17 July. Fledged juveniles stay with their parents within the nest area for quite a long time.

Golden Eagle *Aquila chrysaetos*. The species has always been rare in the Vologda region, although suitable breeding habitats are abundant (Voropanova & Kochin 1954). For the Darwin reserve, three nest areas of the Golden Eagle were known before 2000, and the areas were not used simultaneously. No more than 2 Golden Eagle pairs bred in the reserve at a time. No breeding pairs of the species have been detected in the reserve in the past few years (Kuznetsov & Nemtsev 2005, our data).

Over the 7 years of studies in the research station no occasions of Golden Eagle breeding have been recorded, but in some years the raptor was observed there in the post-breeding period. Thus, in 1999 there were two registrations (19 August 1999 and 28 August 1999) of the species. In both cases, these were single birds hunting in raised bogs. In 2000 (30 August 2000) we observed a young bird in the immediate vicinity of the city of Cherepovets (2 km away).

White-tailed Sea Eagle *Haliaeetus albicilla*. As mentioned above, the best studied populations in the region now are those of the Osprey and White-tailed Sea Eagle. During expeditions the author carried out together with the Darwin reserve staff, the main high-density breeding areas of the White-tailed Sea Eagle were identified. The species tends to settle around large lakes and reservoirs in the northwest of the region: Rybinsk reservoir (ca. 40 pairs), Sheksna reservoir (11–15 pairs), Lake Vozhe (11–13 pairs) and Lake Beloye (6–7 pairs) (Kuznetsov & Babushkin 2003, Kuznetsov 2000).

The Cherepovets research station is 15 km away from the Darwin reserve, which is the Sea Eagle high-density source area for the Vologda region. At present, 30–35 pairs of the raptor (3.5 pairs/100 km^2) nest within the Darwin reserve and its buffer zone (Kuznetsov & Babushkin 2003). Owing to the vicinity of the reserve, the Sea Eagle abundance in the station is quite high. Over the seven years of observations we found 4 occupied nests, and 2 to 4 breeding pairs of the species were registered annually (tab. 1). Thus, the breeding density of the raptor in the station is 3.2 pairs/100 km^2, i.e. comparable to that in the Darwin reserve (tab. 6).

In spring, White-tailed Sea Eagles arrive in late February – early March, when the reservoir is still under ice cover. The earliest registration in the research station was on 21 February 2003. In the winter of 2000–2001, a single bird overwintered near Cherepovets, feeding on fish left behind by fishermen, as well as on bivalves from branches and logs entangled in nets. In March, Sea Eagles quite often concentrate (10 birds or more) by melt ponds and rivers freed of ice, where they pick fallen fish.

Breeding begins in the first or second ten days of March; hatching takes place in late April – early May. A clutch (n=2) comprises 2 to 3 eggs.

The White-tailed Sea Eagle hunts actively, taking mostly fish, shorebirds and mammals. In the spring season, a significant part of the raptor's diet is animals that had died during the winter and fallen fish (carrion).

A characteristic feature of the White-tailed Sea Eagle diet is its wide range (Ben'kovskiy 1963, Vladimirskaya 1948, Kishchinskiy 1980, Labzyuk 1975, Ladygin 1991, Shibnev 1981, Shul'pin 1957). There are no clear food preferences. The species can utilize various food resources depending on their availability. It is an active predator mostly taking individuals deviating from the norm.

Table 6. Abundance and breeding density of the White-tailed Sea Eagle and Hobby in the Cherepovets study area.

Years	Explored area, km^2	Number of breeding territories		Density, pairs/100km^2		%	
		H. albicilla	*F. subbuteo*	*H. albicilla*	*F. subbuteo*	*H. albicilla*	*F. subbuteo*
1999	70	4	6	5.7	8.6	14.8	22.2
2000	125	4	6	3.2	4.8	10.8	16.2
2001	125	4	7	3.2	5.6	10.8	18.9
2002	125	4	8	3.2	6.4	12.5	25.0
2003	125	2	7	1.6	5.6	6.9	24.1
2004	115	2	6	1.7	5.2	6.9	20.7
2005	110	2	7	1.8	6.3	6.1	21.2
7-year mean	113.6	3.1	6.7	2.9	6.1	9.8	21.2

In our case, fish contributed a substantial part to the Sea Eagle diet, ca. 80% (10 species) of all food items by number, and 67% by weight (tab. 7). The most frequent fish species in the diet were bream (22%), roach (18%), crucian carp and pike (8% each). Occasional specimens of perch and blue bream (6% each), sabrefish and pike-perch (1% each) were found. The situation appears different, however, if one calculates the weight of all fish captured by the White-tailed Sea Eagle. Bream remains the main pray, ca. 28 kg, i.e. over 26% of the weight of all prey. The second position belongs to pike rather than roach, ca. 15.2 kg (14.1%), the third one is crucian carp, 11.83 kg (11%). The rest of fish species account for ca. 16% of the Sea Eagle prey.

Table 7. Diet composition of the White-tailed Sea Eagle (data from pellets and prey remains).

	Species	n	%n	Biomass consumed (kg)	% biomass
Total Mammals		2	2	2.5	2.3
Muskrat	*Ondatra zibethicus*	2	2	2.5	2.3
Total Birds		15	16	25.83	24.0
Heron chick	*Ardea cinerea*	1	1	0.70	0.7
Ducks	*Anas sp.*	4	5	2.80	2.6
Black Grouse	*Lyrurus tetrix*	1	1	1.20	1.1
Capercaillie	*Tetrao urogallus*	5	5	20.00	18.6
Gulls	*Larus sp.*	1	1	0.25	0.2
Jay	*Garrulus glandarius*	1	1	0.18	0.2
Jackdaw	*Corvus monedula*	1	1	0.20	0.2
Hooded Crow	*Corvus cornix*	1	1	0.50	0.5
Total Fish		76	80	72.28	67.2
Pike	*Esox lucius*	8	8	15.20	14.1
Roach	*Rutilus rutilus*	16	18	6.50	6.0
Ide	*Leuciscus idus*	5	5	2.81	2.6
White bream	*Blicca bjoerkna*	5	5	1.62	1.5
Bream	*Abramis brama*	20	22	28.10	26.1
Blue bream	*Abramis ballerus*	6	6	2.09	1.9
Sabrefish	*Pelecus cultratus*	1	1	0.26	0.2
Crucian carp	*Carassius carassius*	8	8	11.83	11.0
Pike-perch	*Stizostedion lucioperca*	1	1	2.20	2.0
Perch	*Perca perca*	6	6	1.69	1.6
Total Carrion		2	2	7.00	6.5
Racoon dog	*Nyctereutes procyonoides*	1	1	4.00	3.7
Wild boar	*Sus scrofa*	1	1	3.00	2.8
Total		95	100	107.61	100%

Like for the Black Kite, birds are a significant component of the White-tailed Sea Eagle quarry, 16% (24% of biomass). Grouse and waterfowl prevail, 5% each. The food range includes a heron chick, a gull (species not identifiable), Eurasian Jay, Eurasian Jackdaw, Hooded Crow (1% each). The main prey by weight is the Capercaillie, 20 kg (18.6%), followed by *Anatidae spp*., 2.8 kg (2.6%) and the Black Grouse, 1.2 kg (1.1%). Heron chicks, gull sp., the Jay, Jackdaw, Hooded Crow contributed ca. 2% (by weight).

The only mammal prey species (2% of all quarry) was the muskrat (2 specimens). The wild boar and raccoon dog (2%) were taken by the White-tailed Sea Eagle as carrion. In about 80% of cases carrion was eaten in the period from February to May. This fact is due to the unfavourable feeding conditions: the reservoir is then still under ice and the main prey, fish, is inaccessible. Our observations show also that the proportion of carrion is rather high in the diet of young birds in the first months after leaving the nest, since they are not skilled enough to capture live prey. Similar data on the White-tailed Sea Eagle diet are reported by some authors from Russia and other countries. Thus, the main component of the White-tailed Sea Eagle diet in the Middle Dnieper area (Gavrilyuk et al. 2001), like on Rybinsk reservoir, is fish, ca. 80% of all food items, birds account for ca. 15% and mammals for ca. 5%.

The size of the fish we found in the nests and calculated from the scale diameter by linear growth tables for the reservoir (Svetovidova 1975) ranged from 17 cm (roach) to 85 cm (pike), the average being 34.5 cm (N=76). Fish weight ranged from 90 g (perch) to 4500 g (pike), the average being 718 g (N=76) (tab. 4). The White-tailed Sea Eagle diet in Poland (Zawadzka 1999) differs somewhat from our data in the ratio of individual groups of organisms. There, fish contributed 30.1%, birds 65.9%, mammals 2.7%, carrion 1.3% of total quarry.

We observed 17 occasions of White-tailed Sea Eagles stealing prey from Ospreys. A Sea Eagle rather aggressively attacked an Osprey, which in 86% of cases was a male carrying food to the nest.

Peregrine Falcon *Falco peregrinus*. In the 1940s–1950s, the Darwin reserve harboured up to 3 breeding pairs of the Peregrine Falcon, whose nests were 50 km apart. Peregrine nests were situated in the temporary flooding zone, on floating peatlands and a flooded church. The last breeding event was recorded in 1961. Not a single individual of the species was registered in the reserve from 1964 to 1990 (Kuznetsov & Nemtsev 2005). Since the early 1990s, however, the Peregrine started appearing in the reserve again, and in 2003 it was regularly observed in its south-eastern part. In addition to the above, we registered the Peregrine during the expeditions of the Darwin reserve staff to north-western parts of the region. Thus, in July 2000, a pair of the falcons was observed over the western shore of Lake Vozhe (Babushkin et al. 2000). Butjev & Shitikov (2000) also report of a number of Peregrine contacts in the region. E.g., a singular bird was seen over the northern shore of the Siz'ma widening of the Sheksna reservoir on 5 June 1998; another singular bird (adult female) was encountered near the village of Pundoga, Harovsk district of the Vologda region on 10 June 1996 (Butjev et al. 1997).

In 2000, a pair of Peregrines stayed in the research station throughout the breeding period, and a few times the raptor was observed hunting ducks and terns. All registrations were made on Vaganikha Island (2 km away from the Cherepovets city industrial zone), or in its immediate vicinity.

Hobby *Falco subbuteo*. This falcon has always been a widespread species in the Vologda region. Early in the 20th century it was considered a common breeder in the Cherepovets province (Bogachev 1927). Its breeding habitats in the Darwin reserve today are both forest edges and mires. The abundance is quite stable, although a slight rise has been observed in the past decade. At present, no more than 5–7 pairs of the raptor breed in the reserve (Kuznetsov & Nemtsev 2005). In 2003, we registered 4 breeding pairs of the Hobby in the reserve (2.3 pairs/100 km^2), in 2004 3 pairs (2.6 pairs/100 km^2), in 2005 5 pairs (4.5 pairs/100 km^2). The density of the Hobby population in the forested Darwin reserve (3-year average 3.2 pairs/100 km^2) is much lower than the values obtained by Galushin (1978) for the agricultural landscape in the Lake Katromskoye area, Vologda region (6 pairs/100 km^2).

In spring, the Hobby arrives in the research station in late April – early May, the average date being 29 April. The earliest arrival was recorded on 16 April 2000, the latest – on 6 May 2004.

Over the 7 years of studies in the research station we detected 22 occupied nests; in one of them a clutch of 2 eggs was initiated but abandoned for an unknown reason. Six to eight Hobby pairs bred in the study area every year (tab. 6). The breeding density ranged from 4.8 pairs/100 km^2 (2000) to 8.6 pairs/100 km^2 (1999), the 7-year mean being 6.1 pairs/100 km^2. We know of 8 Hobby nest areas in the area. Three pairs used them for 7 years, two pairs for 6 years, two for 4 years and one for 2 seasons. The distance between the nest areas is significant, 800 m to 6.5 km, average distance being 3–3.5 km.

All nests found in the research station were situated around the Rybinsk reservoir, close to the water edge (10–200 m). Most nests were sited in sparse mixed spruce-pine and pine-aspen forests 12–31 m high, the average height being 20 m. In the Darwin reserve, the species breeds not only on the reservoir shore but also in raised bogs, where nests are located on pine-overgrown ridges.

Nests within the station were placed at a height of 10–25 m (20 m on average) close to the tree top. In 91% of cases (20 nests) birds chose pine as the nest tree; one nest was found on a spruce tree and one on an aspen tree. All nests occupied by the Hobby had been constructed by the Hooded Crow. The nest diameter ranged within 30-55 cm, the average being 45 cm, the height within 15–30 cm, the average being 22 cm.

The Hobby tolerates the presence of people in its nest area fairly well. Roads and recreation sites were situated 30–200 m away from the nests occupied by the falcon. Neither does it avoid human settlements: thus, three pairs nested annually 100, 150 and 300 m away from human dwellings, and in 2000 we detected breeding of the raptor in the Cherepovets city park.

Egg laying usually takes place in May, a clutch normally comprising 2–4 eggs with an average (n=55) of 3.2 eggs (tab. 8). Egg size (n=32) is 41.1–45.4 x 31.7–33.9 mm, the average being 43.2 x 32.8 mm. Hatching takes place between 20 June and 10 July. Egg failure is ca. 6.3%. The number of young in a brood ranges from 2 to 4, the mean value being 3.0 (tab. 6). Mean breeding success over seven years (n=18) is 92.7%. Well flying fledglings were observed in mid-August. In August, adult birds continue feeding their young, and by September the latter are normally self-dependent.

Table 8. Reproductive indices of the Hobby in the Cherepovets research station.

Year	Mean clutch size	Egg mortality, %	Mean no of hatched young	Nestling mortality,%	Mean no of fledglings	Breeding success
2000 (n=6)	3.5	10.5	2.8	0.0	2.8	89.5
2001 (n=2)	2.5	0.0	2.5	0.0	2.5	100.0
2002 (n=4)	2.8	18.2	2.3	0.0	2.3	81.2
2003 (n=1)	4.0	0.0	4.0	0.0	4.0	100.0
2004 (n=3)	3.3	0.0	3.3	10.0	3.0	90.0
2005 (n=2)	3.0	0.0	3.0	0.0	3.0	100.0
Mean (n=18)	3.2	6.3	3.0	1.0	2.9	92.7

We determined the size of the Hobby breeding territory by colour ringing in 2000 and 2001. An average breeding territory was ca. 1 km^2 (0.8–1.9 km^2), and 1600–2400 m long. An interesting fact is that the birds used 1/3 (0.6–1.1 km^2) of the territory for hunting. Only the female hunted close to the nest, whereas the male preferred hunting in a radius of 200–1000 m away from the nest.

The quarry of the Hobby in our studies included small passerines and insects, *Coleoptera* and *Odonata* prevailing among the latter. We quite often observed young birds hunting Sand Martins, each seventh attack, as a rule, being successful.

Most birds depart in September, singular registrations were made in October, on 16 October 2000 and 9 October 2003.

Kestrel *Falco tinnunculus.* The Kestrel is a relatively common species in the region. Most of the species nest areas are strictly confined to the outskirts of settlements, meadows and hayfields. In areas adjoining the research station (Darwin reserve), the Kestrel is also an uncommon rarely breeding species. Up to 3–4 pairs of the Kestrel breed in the reserve not every year (Kuznetsov & Nemtsev 2005). The main reason for such low abundance of the species in the study area is the lack of open habitats (meadows, hayfields) suitable for hunting. Thus, in three years of surveys in the Darwin reserve (2003–2005) we observed only one breeding pair of the Kestrel (2005).

Over seven years of studies in the Cherepovets area we reliably proved breeding of a Kestrel pair, which occupied the same nest area for two seasons (2004 & 2005). Thus, the Kestrel breeding density in the area is 0.9 pairs/100 km^2, this value being much lower than the one reported by Galushin (1978) for the Vologda region, 1.0–3.0 pairs/100 km^2. In 2004, we found the only Kestrel nest – it was an old Hooded Crow nest on an 18 m high pine tree. The nest tree was 50 m away from a hay meadow.

The Kestrel arrives in the station between 5 April and 19 April, the two-year mean being 12 April. Clutch initiation takes place in late April – early May: 3 May 2004; hatching was registered on 8 June 2004; fledglings outside the nest were seen on 11 July 2004 and 17 July 2005. In late August – September most birds depart; the latest contact was on 9 October 2004.

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DIETS OF THE PYGMY OWL *GLAUCIDIUM PASSERINUM* AND TENGMALM'S OWL *AEGOLIUS FUNEREUS* IN THE GULF OF KANDALAKSHA AREA, WHITE SEA

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The material was gathered from the islands and mainland coast at the head of the Gulf of Kandalaksha, White Sea. Information on the Pygmy Owl is mainly focused on the winter diet determined by pulling apart the cast pellets and food caches which the owls placed in passerine nest boxes during autumn and winter. Data on Tengmalm's Owl includes only the composition of cast pellets collected from nests. The diet of both species included rodents, insectivores and birds. Stores made by the Pygmy Owl were found to contain 5 vole species (*Clethrionomys glareolus*, *Cl. rufocanus*, *Cl. rutilus*, *Microtus oeconomus*, *M. agrestis*), 2 lemming species (*Lemmus lemmus*, *Myopus schisticolor*), 1 shrew species (*Sorex araneus*) and ca. 10 passerine species. Cast pellets of Tengmalm's Owl contained only 3 vole species (*Cl. glareolus*, *M. oeconomus*, *M. agrestis*), 1 shrew species (*S. araneus*), several passerine species and remains of insects.

Key words: Eurasian Pygmy Owl, Tengmalm's Owl, diet, Gulf of Kandalaksha, White Sea, *Glaucidium passerinum*, *Aegolius funereus*

ПИТАНИЕ ВОРОБЬИНОГО *GLAUCIDIUM PASSERINUM* И МОХНОНОГОГО *AEGOLIUS FUNEREUS* СЫЧЕЙ В РАЙОНЕ КАНДАЛАКШСКОГО ЗАЛИВА, БЕЛОЕ МОРЕ. Н.С.Бойко, Е.В. Шутова. Кандалакшский государственный природный заповедник.

Материал собран в районе островов и материкового побережья в вершине Кандалакшского залива Белого моря. Для воробтиного сыча рассмотрено в основном зимнее питание по результатам разбора погадок и запасов пищи, которые сычи в осенне-зимний период устраивают в искусственных гнездовьях для воробьиных птиц. Для мохноногого сыча приводится только состав погадок, собранных из гнезд. В питании обоих видов встречены грызуны, насекомоядные и птицы. В запасах воробьиного сыча обнаружены 5 видов полевок (*Clethrionomys glareolus, Cl. rufocanus, Cl. rutilus, Microtus oeconomus, M. agrestis*), 2 вида леммингов (*Lemmus lemmus, Myopus schisticolor*), 1 вид землероек (*Sorex araneus*) и около 10 видов воробьиных птиц. В погадках мохноногого сыча отмечены только 3 вида полевок (*Cl. glareolus, M. oeconomus, M. agrestis*), 1 вид землероек (*Sorex araneus*), несколько видов воробьиных птиц и остатки насекомых.

Ключевые слова: воробьиный сыч, мохноногий сыч, питание, Кандалакшский залив, Белое море, *Glaucidium passerinum, Aegolius funereus*.

The Pygmy Owl and Tengmalm's Owl inhabit forests of Eurasia from the Atlantic to the Pacific. In the Kola Peninsula, the limit for the distribution range of both species is the northern timberline. Sightings are rare due to low abundance and secretiveness of the birds.

Our material was collected from the islands and mainland coast of the Gulf of Kandalaksha, White Sea. Additionally, Kandalaksha Reserve archival data since 1955 were used. Surveys were done on islands of the Severnyi and Luvengskiy archipelagoes, on the Karelian and Kandalaksha mainland coasts opposite the archipelagoes, on Velikiy Island, in Porja Guba Bay and adjacent mainland areas (fig. 1). The diets were determined by pulling apart the food caches, cast pellets and food remains collected from the Severnyi and

Figure 1. Map of the study area in the Gulf of Kandalaksha. Black circles show localities with nest-boxes.

Luvengskiy archipelagoes and from the mainland in the Luvenga village area. Material on the Eurasian Pygmy Owl includes 153 food caches and "eating areas" and 54 cast pellets from nest boxes; material on Tengmalm's Owl 42 cast pellets and food remains from 2 nests.

Pygmy Owl *Glaucidium passerinum*

Rare species. Considered to be breeding in the Kola Peninsula (Bianki et al. 1993), but no reliable evidence is available so far. Singular birds were usually seen or heard on the islands and coast of the Gulf of Kandalaksha and in the Lapland reserve (Semyonov-Tyan-Shansky & Gilyazov 1991). In Finland, north of the Arctic Circle, breeding has been confirmed by observations (Väisänen et al. 1998).

There have been 25 Pygmy owl encounters in the Gulf of Kandalaksha from 1955 to 2005. The first one occurred in 1958 with no further encounters until 1973. The situation in the Lapland reserve was the same – not a single Pygmy Owl encounter was recorded there in the 1960s. Apparently, the Murmansk region population of the species declined or, possibly, even went extinct at the time. Since the early 1970s, Pygmy owls have been encountered more or less regularly, recorded 24 times over 14 years. The finds of "caches" and "eating areas" of the Pygmy Owls made in winter in nest boxes indicate their nearly annual presence in the study area (for 25 out of 33 years). All actual bird encounters took place from August to April, not a single bird sighted during the breeding season. In some summers, however, nest boxes were found to contain devastated passerine nests with females or nestlings consumed and prey body fragments (wings, feet, headless carcasses) or crippled nestlings remaining. Since the Pygmy Owl typically tears prey into pieces before eating, one can assume that it was this species that had ravaged the nests.

In winter, Pygmy Owls often use cavities and nest boxes for caching food. We usually found traces of their presence in nest boxes during first spring checks. Mounting of nest boxes began in 1971 on islands and in 1991 in the mainland. Their number gradually increased from 20 to 470. Nest boxes have been placed on 7 islands and 2 sites on the mainland coast (see fig. 1, tab. 1).

Table 1. Occupation of next boxes by the Pygmy Owl on the Gulf of Kandalaksha in 1973–2005.

Winter season	Number of next boxes				Number of stored animals			Localities*
	inspected	with stored animals	with animal remains	with pellets	total	mean	maximum	
1973/74	108	3	0**	1	12	4.0	?	R
1974/75	130	0	0	0				
1976/77	170	0	0	0				
1977/78	224	0	0	0				
1978/79	289	0	8	0				R, Lo
1979/80	332	1	0	0	2	2.0	2	R
1980/81	356	0	0	0				
1981/82	376	0	1	0				R
1982/83	401	15	16	1	164	10.9	51	BV, Lo, R
1983/84	420	0	2	0				R
1984/85	422	3	2	0	4	1.3	2	BV
1985/86	379	0	0	0				
1986/87	384	0	0	0				
1987/88	412	10	2	0	12	1.2	2	R
1988/89	411	1	0	0	1	1.0	1	BV
1989/90	402	0	0	0				
1990/91	415	1	0	1	1	1.0	1	R
1991/92	443	2	0	0	4	2.0	2	DL, Lu
1992/93	450	0	2	0				BV, K
1993/94	438	1	1	0	1	1.0	1	Lu
1994/95	417	0	0	0				
1995/96	369	14	0	0	107	7.6	21	Lu
1996/97	466	0	1	0				Lu
1997/98	434	0	0	0				
1998/99	429	0	0	0				
1999/00	420	17	3	0**	123	7.2	30	Lo, Lu, R
2000/01	438	5	0***	2	5	1.0	1	BV, Lu, R
2001/02	446	11	3	1	34	3.4	5	A, BV, Lo, Lu, R
2002/03	442	15	2	2	104	6.9	25	BV, Lo, Lu, R
2003/04	430	7	2	3	19	4.8	13	BV, Lu
2004/05	454	5	0	0	53	13.2	29	Lu

Note: * - Localities: A – Anisimov Island, BV - Berezhnoi Vlasov Island, D – Devichya Luda Islet, K – Karelian coast, Lo – Lodeinyi Island, Lu – Luvenga village area, R – Ryashkov Island.
** - animal remains or cast pellets found in nest boxes with stored animals,
*** - animal remains found in nest boxes with cast pellets.

Most islands and coastal localities with nest boxes are no more that 1 km^2 in area, only the largest one, Ryashkov Island, has an area of ca. 4 km^2. Since the winter range of one bird or a pair of Pygmy Owls is 1.5 to 4 km^2 (Pukinskiy 1977; Golodushko & Samosenko 1961), all food stores found in one island or mainland locality were probably cached by one bird. Usually, the distance between nearest "caches" was 50 to 350 m, reaching 1.5 km in the Ryashkov Island only. Judging by the use of nest boxes, Pygmy Owls come to the study area virtually every year (tab. 1). In some years there was definitely more than one bird because caches were found 2 to 14 km apart. It appears that the greatest number of birds (probably 3–5) were present in the study area in the winter of 1982/83 and from 1999 to 2003.

A total of 784 food items were found in the caches, eating sites and cast pellets over all study years. An overwhelming majority of these were mammals (90.8%), chiefly rodents (85.8%). Insectivores contributed as little as 5.0%, birds were slightly more frequent – 9.2%. The species composition of the Pygmy Owl prey is shown in tab. 2. As regards small mammals, the diet comprised *Muridae* and *Sorex* species common the area. Also present was the quite rare common vole *Microtus arvalis*, first discovered in the Murmansk region in 1981 (Kataev et al. 1999) and occurring in the Kandalaksha and Luvenga areas since 1999. Voles found in caches were mostly young individuals (94.7%, and 2.0% were younger than 1 month) compared to 5.3% of overwintered ones, which corresponds to a typical age ratio of voles in autumn. The species composition of birds in the prey was far more diverse, but most of them occurred not so frequently. Common species prevailed, but some relatively rare ones in the area, like the Coal Tit *Parus ater* and the Long-tailed Tit *Aegithalos caudatus* were also recorded. Thus, Pygmy Owls do not focus on specific species, but hunt any feasible prey. They can even take birds weighing almost as much as themselves, e.g. crossbills *Loxia sp*. A case is known when a woodpecker was hunted (Pukinskiy 1977). Non-selectivity is confirmed also by the fact that different rodent species prevailed in different years and locations among the prey depending on their availability. On Lodeinyi Island, e.g., about a half

Table 2. Diet of the Pygmy Owl in the head of the Gulf of Kandalaksha.

Species	Stored animals	Animal fragments	In pellets	Total	
				no	%
Clethrionomys rufocanus	35	0	2	37	4.7
Clethrionomys glareolus	140	5	20	165	21.0
Lemmus lemmus	2	1	2	5	0.6
Myopus schisticolor	36	1	0	37	4.7
Microtus oeconomus	24	4	7	35	4.5
Microtus agrestis	190	1	5	196	25.0
Microtus arvalis	11	0	0	11	1.4
Cricetidae, sp.	121	45	21	187	23.9
All rodents	559	57	57	673	85.8
Sorex araneus	12	0	0	12	1.5
Sorex caecutiens	2	0	0	2	0.3
Sorex sp.	19	5	1	25	3.2
All insectivores	33	5	1	39	5.0
All mammals	592	62	58	712	90.8
Anthus sp.	0	1	0	1	0.1
Motacilla alba	2	2	1	5	0.6
Aegithalos caudatus	1	0	0	1	0.1
Parus montanus	12	0	0	12	1.5
Parus cinctus	4	0	0	4	0.5
Parus ater	1	0	0	1	0.1
Parus major	9	3	1	13	1.7
Parus sp.	2	0	0	2	0.3
Passer domesticus	2	0	0	2	0.3
Fringilla coelebs	0	1	0	1	0.1
Fringilla montifringilla	0	1	1	2	0.3
Acanthis flammea	3	2	0	5	0.6
Acanthis hornemanni	2	0	0	2	0.3
Loxia pytyopsittacus	0	1	0	1	0.1
Loxia curvirostra	0	1	0	1	0.1
Loxia sp.	0	1	0	1	0.1
Pyrrhula pyrrhula	0	3	0	3	0.4
Emberiza citrinella	0	1	0	1	0.1
Plectrophenax nivalis	1	3	0	4	0.5
Passeriformes, sp.	1	4	5	10	1.3
All birds	40	24	8	72	9.2
Total	632	86	66	784	

(52.0%) of animals in caches were bank voles *Clethrionomys glareolus*, and 24% field voles *Microtus agrestis.* In the spring of 1983, however, 89.5% of the 187 animals stored by the Pygmy Owl were field voles. The number of species and prevalence of one species or another in the caches correlated quite well with their occurrence in the habitats. Thus, bank voles on the Ryashkov Island made up 96% in total rodent counts, and 80% in the Pygmy Owl diet. The species diversity of rodents in the mainland near Luvenga is higher than on the islands, and the Pygmy Owl diet was found to include 7 species (vs. 4 on the islands). The dominant species here, too, was the bank vole, but its proportion in caches was much lower than on the islands, just 34.2%, on average; about equal proportions were contributed by the grey-sided vole *Clethrionomys rufocanus*, the field vole, the root vole *Microtus oeconomus* and the wood lemming *Myopus schisticolor* (10–15% each). The species ratio, however, varies notably among years (tab. 3). When winter stores were low, the proportion of birds in the caches increased to 30–33% (2000/2001 and 2001/2002). Given these significant variations between years one should be very careful when comparing the diets of Pygmy Owls from different parts of the range, especially when the study period is relatively short.

Where possible, the Pygmy Owl establishes distinctly separate areas for caching food, eating and rest (Likhachev 1957). Nest boxes containing stored animals, food remains and cast pellets simultaneously were quite rare. In our study area, nest boxes containing only stored animals accounted for 62.1% of all those used by Pygmy Owls (166), boxes with only food remains 28.3%, and boxes with only cast pellets 3.6%. Only 6.0% of the nest boxes included both stored animals and cast pellets, stored animals and food remains, or cast pellets and food remains. One may note that Pygmy Owls most often use nest boxes for storing food. The stores are partially or fully consumed by the birds during the winter. In some years we found only cast pellets and remains of animals and birds in nest boxes. Each nest box contained 1 to 51 objects. Those with 1–2 specimens prevailed (tab. 4). On islands, such stores were 1.7 times more frequent (61.2%) than in the Luvenga area (36.4%). The only time large stores made by the Eurasian Pygmy Owl were found on an island was on Lodeinyi Island in the winter of 1982/1983, when 162 animals were collected from 12 nest boxes. In the Luvenga area, on the contrary, more than a half of caches comprised at least 5 specimens each. The difference may be related to the pattern of stay and duration of food caching. Apparently, they are most of the time resident in the mainland staying within the same area, whereas the islands are most probably quite shortly visited by nomadic birds.

Pukinskiy (1977) writes that foods are actively cached in autumn, before the snow cover establishes. In 2002–2005, we examined nest boxes both in spring and in autumn. In 2002 and 2004, full caches were found on October 24–27. The snow cover in these years established on 24 October and 10 November, respectively. Food cached later in these winters contributed 19.0% and 3.6%. In 1982 and 1995, when Pygmy Owls also stored food very actively, snow covered the ground even earlier – on 14 and 22 October. In years with a later winter and snowless November (1996, 2000) stores were small. It turns out that the activeness of food caching by the Pygmy Owl in the Murmansk region is independent of the timing of the snow cover formation and snow depth in the early winter, as pointed out by Likhachev (1957, 1971) for the Prioksko-Terrasnyi reserve. On average, the snow cover in the region establishes on 25 October, and most food stores seem to be cached by mid-October. A confirmation is the finds in the stores of the Long-tailed

Table 3. Composition (%) of the diet of the Pygmy Owl in the Luvenga area, 1999–2005.

Species	Winter season					
	1999/2000	2000/01	2001/02	2002/03	2003/04	2004/05
Clethrionomys rufocanus	6.7	0.0	0.0	15.8	4.2	20.8
Clethrionomys glareolus	27.4	11.1	23.1	48.5	16.7	9.4
Myopus schisticolor	0.0	0.0	0.0	0.0	2.1	56.6
Microtus oeconomus	18.1	11.1	15.4	5.0	10.4	0.0
Microtus agrestis	27.6	0.0	0.0	8.9	6.2	5.7
Microtus arvalis	7.6	0.0	0.0	3.0	0.0	0.0
Cricetidae, sp.	5.7	44.4	15.4	1.0	47.9	1.9
Soricidae, sp.	6.7	0.0	15.4	13.9	2.1	3.8
Birds	2.9	33.3	30.8	4.0	10.4	1.9
Total individuals	105	18	13	101	48	53

Table 4. Number of animals in the stores made by the Pygmy Owl on the islands and in the mainland coast (%).

Location	Number of animals in one store						Number of stores
	1–2	3–4	5–10	11–20	21–30	> 30	
Islands	61.2	16.7		20.0		1.6	60
Mainland: Luvenga area	36.4	6.8	20.5	22.7	13.6	0.0	44

Tit *Aegithalos longicaudus*, which appears in the area in the first half of October. Pygmy Owls, however, do some minor food caching in winter and spring, too. On Ryashkov Island, we found recent food remains from March to May 20. The Pied Wagtails *Motacilla alba*, Bramblings *Fringilla montifringilla*, Chaffinches *Fringilla coelebs*, Snow Buntings *Plectrophenax nivalis* seen among the stores and remains had also been most probably taken in spring. The caches and eating areas with 1–3 items are also more likely to have been made in the winter and spring season. The proportion of birds there is much higher (27.0%) than in larger autumn stores (meagre 1.5%). This is quite natural given that in autumn, especially when the abundance of rodents is high, they are the most easily available prey, whereas in wintertime rodent hunting is difficult and Pygmy Owls hunt birds more often. In some regions, birds prevail over mammals in the winter diet of owls; in Central Europe birds accounted for 61.6% of all prey (Vorontsov et al. 1956). A similar idea was expressed by Likhachev (1957). In the North, however, the role of birds is not so significant because of the low number of resident, winter resident and nomadic species and their relatively low abundance. Judging by the relatively high number of Great Tits *Parus major* and finds of House Sparrows *Passer domesticus* in Pygmy Owl food in the Luvenga area, as well as by two encounters of Pygmy Owls in the village in wintertime, they often visit settlements to hunt. Cases are known when the Pygmy Owl hunted tits at feeders (Malchevskiy & Pukinskiy 1983).

Tengmalm's Owl *Aegolius funereus*

Uncommon or rare breeder. In the winter season, Tengmalm's Owls apparently leave for more southern parts of the range, since not a single encounter has been recorded from December to February. Only 50 encounters were recorded from the area over 50 years of surveys (in 23 of the 50 years). A substantial part of the encounters (22) is from the Velikiy Island, where lekking birds were often heard from March to May. Records from the Severnyi Archipelago at the head of the Gulf of Kandalaksha include 16 encounters. Pygmy Owl records from the Karelian and Kandalaksha mainland coasts, Porja Guba Bay and Cape Turij are fewer (1–3 encounters in each area), but the reason is most probably the shorter period of observations in the areas. To make a nest, the Tengmalm's Owl needs spacious cavities with a wide entryway. In natural settings, abandoned nests of the Black Woodpecker *Dryocopus martius* are best suited for that (Pukinskiy 1977). In northern forests, however, Black Woodpeckers are few and the Pygmy Owl suffers a deficit of suitable nesting sites. As the result, they often settle in nest boxes made for the Goldeneye *Bucephala clangula* (8 of the 10 known nests were in Goldeneye nest boxes). The earliest time juveniles are known to have left the nest was on 6 June 1958, i.e. egg laying in the nest began early in April. In the rest of the nests, clutches appeared in late April – first half of May. The size of the clutches was 3 to 7 eggs.

The diet of Tengmalm's Owl in summertime can be judged by the composition of 42 cast pellets and food remains collected from 2 nests on Ryashkov Island (Severnyi Archipelago) in 1981, 1984 and 1991. Each pellet contained the remains of 1–3 objects, 1.5 specimens on average. Pellets with 1 mammal accounted for 61.9%, with two mammals 7.1%, with three 2.4%, with a mammal and a bird 23.8%, with two mammals and a bird 4.8%. All in all, fragments of 109 food items were collected from nests and cast pellets. One can see from tab. 5 and 6 that the main prey for Tengmalm's Owl in the Murmansk region is small mammals, chiefly rodents (70–85%). The role of shrews in the species diet is insignificant. The species composition of hunted mammals may vary notably across years and depending on the place where the material was gathered from. Thus, field voles (22.0%) and bank voles (19.2%) prevailed on the relatively small Ryashkov Island with its highly mosaic taiga vegetation and a belt of coastal meadows among the lengthy coastline, whereas in the more homogeneous forests of the Lapland reserve 57% were contributed by the grey-sided vole and 12.5% by the Norway lemming *Lemmus lemmus* (Semyonov-Tyan-Shansky & Gilyazov 1991). Furthermore, the proportions of individual species varied notably across years depending on their abundance. In the Lapland reserve, Norway lemmings accounted for 35.3% in 1982, but only for 6.3% in 1983; grey-sided voles contributed 33.3% in 1982, and 82.5% in 1983. Contributions of other animal groups in Tengmalm's Owl diet also vary significantly in different locations. On islands, where the density of passerine birds is much higher than in mainland forests (Shutova 1989), their role in the diet is also higher. Passerines became prey several times more often there (19.3% of all food items) than in the Lapland reserve (2.8%). Table 5 demonstrates that Tengmalm's owl took only small passerines, although the species is known to hunt larger ones as well – pellets from the Lapland reserve were found to contain woodpecker remains (Semyonov-Tyan-Shansky & Gilyazov 1991), and a thrush hunt was observed in the Severnyi Archipelago. Like other owl species, Tengmalm's Owl may practice cannibalism (Kadochnikov 1962; Pukinskiy 1977). A pellet we took from a nest contained a ring and remains of the youngest owlet in the brood. In the mainland, when small rodents are in deficit, Tengmalm's Owl may eat frogs (tab. 6), which are missing from islands in the sea. Insects, although occasionally found in cast pellets, are too few to play any role in the species diet.

One may note from tables 5 and 6 that nest contents and cast pellets differ markedly in the ratio of animal groups. Cast pellets contain more of shrews and insects, whereas nests more of bird remains. Apparently, fragments of larger objects are more likely to remain in the nest, whilst small mammals and insects are nearly always swallowed whole and remain in the nest only as cast pellets, part of which are trampled down by nestlings so that some objects become unidentifiable. As regards birds, Tengmalm's Owl plumes them before eating so that nests grow littered with feathers. Then sorting such remains out, one is likely to exaggerate the role of birds compared to mammals. Our accounts indicate the lowest possible number of birds from nest material.

The summer diet of Tengmalm's Owl on Ryashkov Island included equal numbers of adult and juvenile voles (50% each), the age of which was determined (n=58), and 3.4% of juveniles were younger than 1 month. This age ratio is typical also for the habitat in the period. We saw no preference for a certain age class in Tengmalm's Owl's hunts.

Table 5. Diet of Tengmalm's Owl on the Severnyi Archipelago.

Species	In pellets	In nests	Total
Mammals			
Rodents			
Clethrionomys glareolus	9	12	21
Clethrionomys rufocanus	3	0	3
Microtus agrestis	10	14	24
Microtus oeconomus	1	2	3
Cricetidae, sp.	23	0	23
Insectivores			
Sorex araneus	3	0	3
Sorex caecutiens	1	1	2
Sorex sp.	1	0	1
Birds			
Motacilla alba	1	2	3
Ficedula hypoleuca	0	1	1
Phoenicurus phoenicurus	0	1	1
Parus cinctus	1	0	1
Fringilla montifringilla	1	1	2
Acanthis flammea	0	2	2
Pyrrhula pyrrhula	1	2	3
Passeriformes, sp.	6	1	7
Aegolius funereus, pull	0	1	1
Insects			
Hymenoptera: Camponotus herculeanus	7	0	7
Coleoptera: Cerambycidae	1	0	1
Total individuals	69	40	109

Table 6. Diet of Tengmalm's Owl on the Gulf of Kandalaksha Bay and in the Lapland reserve.

Taxon	Gulf of Kandalaksha						Lapland reserve	
	from pellets		from nests		total		total	
	n	%	n	%	n	%	n	%
Rodents	46	66.7	28	70.0	74	67.9	182	84.3
Insectivores	5	7.2	1	2.5	6	5.5	2	0.9
Mammals	51	73.9	29	72.5	80	73.4	184	85.2
Birds	10	14.5	11	27.5	21	19.3	6	2.8
Amphibians	0	0.0	0	0.0	0	0.0	21	9.7
Insects	8	11.6	0	0.0	8	7.3	5	2.3
Total	69		40		109		216	

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STATUS AND MONITORING OF THE PEREGRINE AND GYRFALCON IN THE KOLA PENINSULA, RUSSIA

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The paper summarises the results from the 1977–2003 field surveys carried out in the Murmansk Region and covering a significant part of the Kola Peninsula. Surveys in different parts of the region revealed the area of highest significance due to concentration of raptor populations. It is the lowland landscape in the upstream and midstream parts of the Ponoy River watershed, called the Ponoy Depression. This is where annual monitoring of breeding raptors was made. It turns out that the Ponoy watershed has retained the last stable Peregrine *Falco pereginus* population in European Russia. Simultaneously, the Ponoy Depression proved to be a landscape suitable for Gyrfalcon *Falco rusticolus* breeding. Long-term monitoring of the raptor population (study area ca. 1000 km^2) yielded data on the status of populations of the falcons and their breeding success in the Ponoy Depression. Throughout the study period, 18 locations ever occupied by breeding Peregrine pairs have been discovered in the Ponoy Depression. At the same time, total species abundance in the Murmansk region was estimated at 25–30 breeding pairs. The greatest number of territories occupied by the Peregrine in the Ponoy Depression was recorded in 1991 and 1994, and equaled 11. The population reached the highest productivity in 1996–1999. The Peregrine food range in the breeding season comprised over 30 prey species. The most frequently taken one was the Ruff *Philomachus pugnax*, 52%. Total Gyrfalcon abundance in the Murmansk Region was estimated at approximately 5–10 territorial pairs. A drastic decline in the Gyrfalcon abundance and instability of its breeding in the region have been observed, which seem to be related primarily to the very low level of the populations of the Willow Grouse *Lagopus lagopus* and other tetraonids *Tetraonidae* that has lasted for about 20 years. The most frequently taken prey for both the Peregrine and the Gyrfalcon nesting in the Ponoy Depression was the Ruff (43.2% in the food range).

Key words: Kola Peninsula, Peregrine, Gyrfalcon, population, distribution, monitoring, productivity, food range.

СОСТОЯНИЕ И МОНИТОРИНГ ПОПУЛЯЦИЙ САПСАНА И КРЕЧЕТА НА КОЛЬСКОМ ПОЛУОСТРОВЕ, РОССИЯ.
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В настоящей статье обобщены результаты полевых исследований, проведенных в 1977-2003 гг. в Мурманской области и охвативших значительную часть Кольского полуострова. Обследование различных частей региона позволило выявить территорию, наиболее значимую как место локализации популяций хищных птиц. Ей оказался низинный ландшафт бассейна верхнего и среднего течения р. Поной, именуемый Понойская депрессия, где и проводился ежегодный мониторинг состояния гнездовых группировок. Как выяснилось, в бассейне Поноя сохранилась последняя для Европейской части России устойчивая популяция сапсана, одновременно с этим Понойская депрессия оказалась гнездопригодным ландшафтом для кречета. В результате многолетнего мониторингка населения хищных птиц (площадь обследуемой территории около 1000 м^2) были получены данные о состоянии популяций соколов и успехе их гнезлования в Понойской депрессии. За весь период наблюдений в Понойской депрессии было обнаружено 18 местообитаний, когда-либо занимаемых сапсанами для гнездования. В то же время общая численность вида в Мурманской области оценивалась в 25-30 гнездовых пар. Максимальное количесто гнездовых территорий, занятых сапсаном в Понойской депрессии, было учтено в 1991 и 1994 гг. и составило 11. Наиболее высокая продуктивность популяции была достигнута в 1996-99 гг. Спектр питания сапсана в гнездовой период включал более 30 видов-жертв. Наиболее часто добываемым был турухтан *Philomachus pugnax*, 52%. Общая численность кречета в Мурманской области приблизительно оценена в 5-10 территориальных пар. Отмечено глубокое падение численности кречета и нестабильность его гнездования в регионе, очевидно в первую очередь связанные с крайне низким уровнем популяций белой куропатки *Lagopus lagopus* и других тетеревиных *Tetraonidae*, державшимся в период около 20 лет. Как и для сапсана, для кречета, гнездившегося в Понойской депрессии, наиболее частой жертвой был турухтан (43,2% в спектре питания).

Ключевые слова: Кольский полуостров, сапсан, кречет, популяция, распределение, мониторинг, продуктивность, спектр питания.

INTRODUCTION

At the same period of the 1950s and 1960s as many other species of raptors, the falcons' populations were critically declined in Europe and the Soviet Union by pesticides, contaminant chemicals, poisons and direct persecution by human (the last legally continued in the USSR until 1964).

North-European populations of the Peregrine Falcon *Falco peregrinus* were among those which the destroying impact of all above stated factors on migration routes and wintering ranges despite they had been occupying the most untouched and undisturbed nesting grounds. But even in remote northern areas Peregrines were continuing to be exposed to contaminants remaining closely related with migratory prey species. In the 1970s the outlawing of DDT commenced, and chemical residue in raptor eggs diminished significantly. Residue concentrations from eight eggs of Peregrine Falcon from the Kola Peninsula were reported by Henny et al. (1994). Peregrines from the study area were shown to have relatively high levels of contaminants, and further satellite telemetry study of migration pathways and wintering localities were conducted in order to map areas where these Peregrines might be exposed to contaminants (Henny et al. 2000). More detailed analyses of movements and winter ranging of migratory Peregrines breeding in far northern European Russia are presented by Ganusevich et al. (2004).

Gyrfalcons *Falco rusticolus*, inhabiting for most of the year their arctic home range and feeding on native prey species, have not shown similar declines as Peregrines exposed to pesticides and other contaminants year round. No eggshell thinning or related reproductive failures have been observed in Gyrfalcons, but local breeding populations fluctuate in numbers between years with their prey species – a common phenomenon in the Arctic (Burnham & Mattox 1984).

Isakov (1982) considered the Kola Peninsula to be among the regions with quite well studied avifauna due to a lot of bird surveys carried out basically in the Lapland and Kandalaksha Reserves. But none of them covered the eastern interior of the peninsula. Until wider ornithological surveys of the Kola Peninsula were commenced in 1976 organized by the Geographical Society of the USSR, very little data on the falcons could be found to estimate the status of their populations.

Wider surveys had suggested that the Kola Peninsula – the eastern part of the Murmansk Region – was a unique terrain for the field study of migratory raptors, for related long-term biological study, and possibly for special conservation measures. Early field surveys (from 1977) to various locations identified the wetlands of the middle reaches of the river Ponoy and its wetlands, hereafter referred to as the Ponoy Depression, as a main habitat for raptors, and consequently further surveys followed.

The eastern interior of the Kola Peninsula was thought to hold the last significant population of the Peregrine Falcon in European Russia and to provide suitable habitats for Gyrfalcons discovered as nesting in the same area.

STUDY AREA

The location of the fieldwork summarised in this report is the northwestern corner of the Russian Federation: Murmansk Region, known historically as Russian Lapland. Together with Sweden, Norway and Finland, this area belongs to a land mass named Fennoscandia. Murmansk Region is situated almost entirely north of the Arctic Circle, occupying a total area of nearly 145,000 km^2, of which the mainland and islands occupy 56,000 km^2, and the Kola Peninsula 89,000 km^2. The region extends 390 km from north to south (N70° to N66°) and about 550 km east to west (E28° to E41°). The north and east of the region is bordered by the Barents Sea, part of the south by the White Sea. The western land borders are contiguous with (north to south) Norway, Finland, and Republic of Karelia. The eastern, peninsular part of the region (the Kola Peninsula) is almost separated from the mainland by a series of northsouth fissures including the Kola Gulf in the north and Lake Imandra towards the south.

The character of the entire region's terrain is generally described as tundra in the north, changing through forest tundra to taiga (boreal forest) in the south. A dividing line in this respect can be drawn approximately diagonally from the northwest to the southeast of the Region.

Our surveys have been generally concentrated on peninsular part of the Murmansk Region which was supposed to include well-preserved and diverse wilderness areas inaccessible by road and uninhabited by humans, perhaps unique in Northern Europe.

An area discovered as the most important for both species is situated in the wetlands basin of the middle course of the Ponoy River, currently known as the Ponoy Depression. It is characterized by abundance of prey species (primarily shorebirds associated with bogs and lakes), suitable nesting sites (cliffs and rocks), and low human activity, was chosen as the main survey area. The area has provided unique 'wilderness' conditions and a model terrain for long-term study. A typical habitat of nesting Peregrines and Gyrfalcons in the Ponoy Depression is shown in fig. 1.

MATERIAL AND METHODS

Although this report mostly concerns the Kola Peninsula, and is respectively titled, we add all available data which were obtained in other areas of the Murmansk Region or available from other researchers in order to make estimation on population status of the species more representative for the region.

Our survey work in the Murmansk Region began in 1977 in the area later coined as the Ponoy Depression Survey Area. This location was surveyed every breeding season from the very beginning, other areas in which our research was carried out are mapped in fig. 2.

Figure 1. Nesting habitat of Peregrines and Gyrfalcons in the Ponoy Depression.

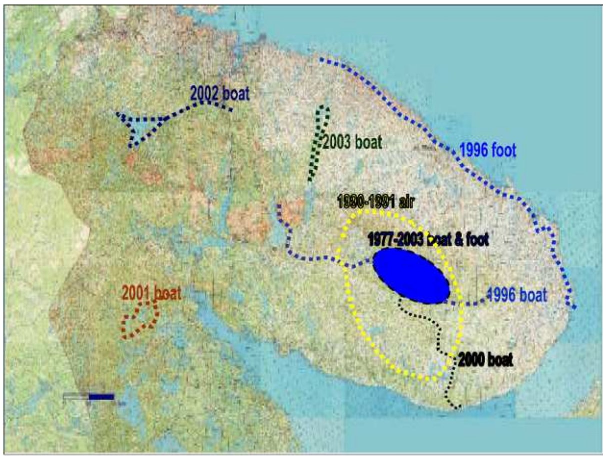

Figure 2. Areas, routes and years of raptor surveys conducted by the author in the Murmansk Region.

We used boat transportation where feasible and available, but basic material was collected by long-distance investigations by foot which was the only possible way in the absence of roads or waterways. We tried to check as many nest sites already located as possible to determine occupancy and productivity, and to do additional searches for new ones. During the whole period of the study we have had only two possibilities to make careful air inspection of potential nesting habitats of Peregrines and Gyrfalcons in the eastern interior of the Peninsula.

By local monitoring of a selected 1000 km^2 area within the Ponoy Depression we managed to reach conclusions about the status and breeding success of the falcon populations there.

PEREGRINE POPULATION

Distribution

In 1976, the first two nesting pairs were discovered by K. Mikhailov and A. Fil'chagov (pers. comm.) in the area later coined as the Ponoy Depression Survey Area. Previously there had been no data on locations of nesting Peregrines in the Murmansk Region; the only finding was described in the Kandalaksha Gulf (Bianki 1960).

Early in our survey, the eastern interior of the Peninsula was suspected to hold the last significant population of the Peregrine Falcon in European Russia. Further wider and long-term investigations could confirm this. Only isolated nesting sites existed elsewhere.

Initial estimation of Peregrine population status in the Kola Peninsula based on investigations conducted by expeditions of the Geographical Society in 1977–1980 is found in Ganusevich (1988).

For the population of the Peregrine Falcon locally distributed in the Ponoy Depression, we currently know 18 locations in the survey period occupied by breeding pairs. Other nest sites known occupied in the last few years are mapped in fig. 3.

An estimation of the total number of Peregrines nesting in the Murmansk Region is between 25 and 30 pairs. The estimation is given roughly since the Peregrine population has been the only one locally monitored and still in need of a much wider survey.

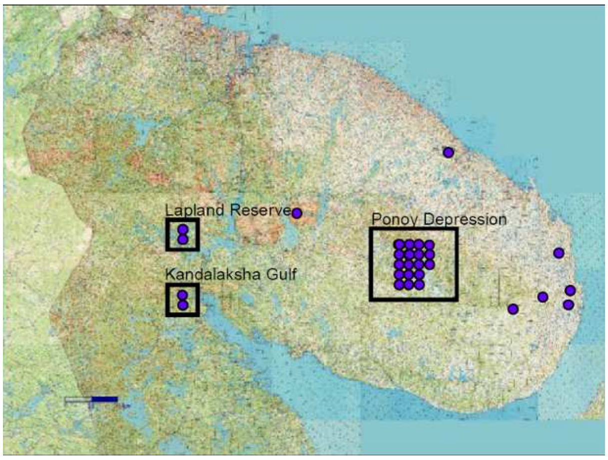

Figure 3. Distribution of Peregrine Falcon nest sites currently known in the Kola Peninsula.
Note: Locations were provided for the Lapland Reserve by A. Gilyazov (pers. comm.), for the Kandalaksha Gulf by I. Kharitonova (pers. comm.), for Lovozero and downstream of the River Ponoy by I. Vdovin (pers. comm.).

Peregrine productivity

The number of known Peregrine Falcon nesting territories in the Ponoy Depression increased during the early years of investigation (Ganusevich 1988) due to a better knowledge of the region and habitat requirements. A history of these discoveries is shown in fig. 4. Since 1996, all suitable nesting locations of

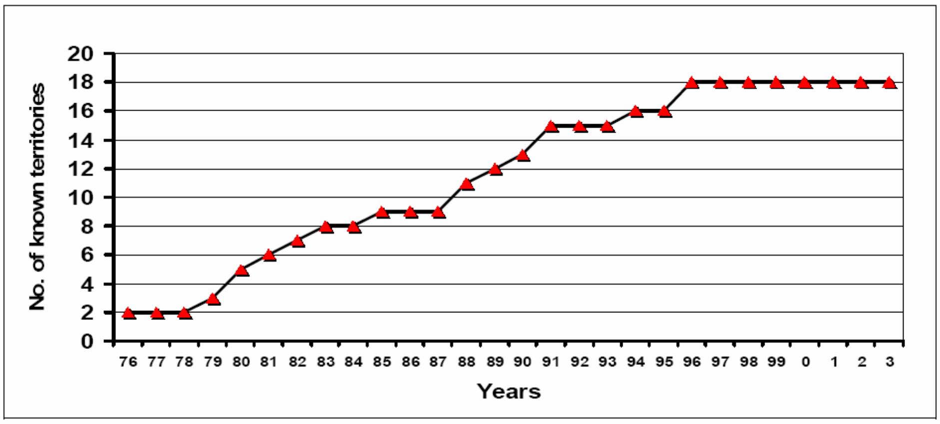

Figure 4. The number of the Peregrine nest territories discovered in the Ponoy Depression Survey Area, since 1976.

Peregrines in the Ponoy Depression Survey Area are supposed to be completely known. By this time the 1000 km^2 study area was believed to be surveyed adequately.

Since 1986 (except 1997), not less than half of all suitable nesting territories have been annually checked in order to monitor occupancy (fig. 5) and productivity (fig. 6). The maximum number of occupied territories was eleven in 1991 and 1994. The highest productivity of the population was achieved in 1996-1999. Both clutch and brood size almost doubled. In 2001, we could observe a nest with a successful brood of five nestlings (fig. 7),

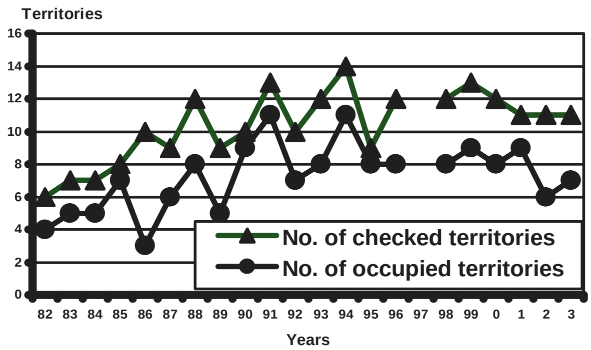

Figure 5. Monitoring of the Peregrine population status in the Ponoy Depression, 1976–2003.

Figure 6. Monitoring of the Peregrine population productivity in the Ponoy Depression, 1986–2003.

while two years later in the same nest a five-egg clutch was found as failed (fig. 8). The eggs were opened, and in all of them dead embryos were found at different stages of development. It looked as an evidence of contamination but still has to be tested. Another threat to success of nesting Peregrines is easy access to many nests by predatory mammals.

Prey species

Food remains from the eyries and their vicinity were used to evaluate prey species eaten by Peregrine Falcons. The diet consists of more than 30 prey species (fig. 9). The most frequently found is Ruff *Philomachus pygnax,* 52%, which is a migratory species and a very possible source of Peregrine's contamination.

GYRFALCON POPULATION

Distribution

Before the Kola Peninsula ornithological survey project by the Geographical Society was started in 1976, most of the region had not been inspected at all, and the only areas mentioned as Gyrfalcon nesting habitats were the coast of the Barents Sea, including the Seven Islands Archipelago, and the Lapland Reserve (Ganusevich 1988). As a result of investigations carried out in 1977–1986 new nesting locations of the Gyrfalcon were discovered near the mouth of the River Ponoy and in the Ponoy Depression. All available data on the species nest sites distribution are summarized in fig. 10. The timing of nesting attempts which have been observed in these locations (table 1) regretfully demonstrates that the status of the Gyrfalcon population in the region can be currently considered mostly from the historical perspective.

Nevertheless, the present status of the species population in the Murmansk Region can be approximately estimated to be 5–10 territorial pairs, the estimate based on some very fresh information obtained from observers as personal comments.

Figure 7. Five-nestling successful brood of the Peregrine Falcon.

Figure 8. Five-egg failed clutch of the Peregrine Falcon.

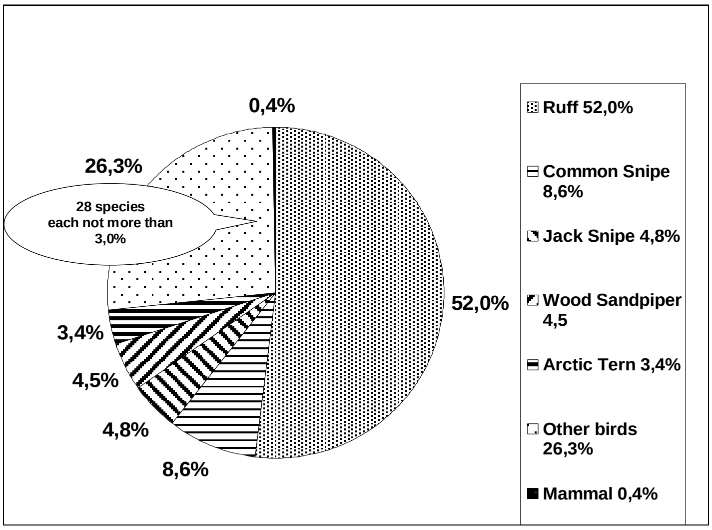

Figure 9. Diet of the Peregrines nesting in the Ponoy Depression. The number of prey items is 269.

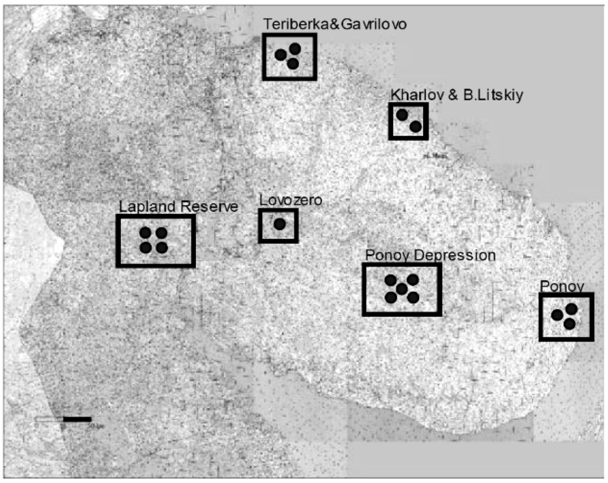

Figure 10. Distribution of the Gyrfalcon nest sites known in the Kola Peninsula (including the Lapland Reserve).

Table 1. Known observations of Gyrfalcon nesting attempts.

Areas	Number of nest sites	Years	Authors
Teriberka & Gavrilovo	3	1955–1956	Kishchinskiy
Kharlov & B. Litskiy	2	1941, 1976–1978	Shklyarevich, Krasnov
Lapland Reserve	4	1938, 1975, 1986	Semyonov-Tyan-Shansky, Gilyazov
Lovozero	1	1993	Hunting, Committee
Ponoy Depression	5	1977–1986	Ganushevich
Ponoy	3	1977–1979	Fil'chagov et al.

Gyrfalcon productivity

Table 1 shows that Gyrfalcons have nested in the region very irregularly. Very deep decline of the Gyrfalcon population and instability evidently links with the former decline and very low level of the Willow Ptarmigan *Lagopus lagopus* population (and other *Tetraonidae*) that has lasted for a period of about 20 years. The most recent observations concerning Willow Ptarmigan winter density obtained from local people of the eastern interior of the peninsula, together with findings of Gyrfalcon active nests, will hopefully make positive impact on restoration of the falcon population in the region.

Prey species

An estimation of the diet of the Gyrfalcon nesting in the Ponoy Depression shows (fig. 11) that, like for the Peregrine, the most common prey species is the Ruff *Philomachus pygnax*, 43.2%. This migratory species is the most abundant in the area from late spring through summer, but in early spring, which is the most crucial time for nesting Gyrfalcons, the Ruff is not available to serve as a substitute for the Ptarmigan.

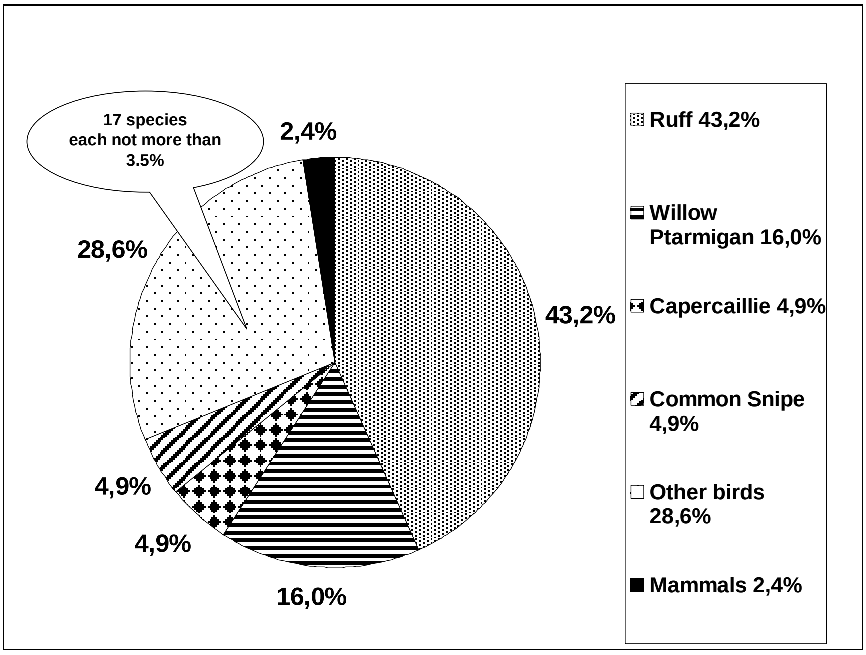

Figure 11. Diet of Gyrfalcons nesting in the Ponoy Depression. The number of prey items is 206.

Acknowledgements. Ornithological inspection and inventory of the Kola Peninsula terrain in which the author took part in 1977–1980 was initiated by V. Bianki (Geographical Society). Very important data for estimation of the Peregrine and Gyrfalcon population status and distribution became available thanks to K. Mikhailov, A. Fil'chagov, V. Semashko and A. Cherenkov, who conducted field work in other areas of the peninsula.

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POPULATION OF DIURNAL RAPTORS (*FALCONIFORMES*) IN THE LAPLAND NATURE RESERVE AND ADJACENT AREAS: DYNAMICS IN 1930–2005

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The 2748 km² of the Lapland Reserve represent northern taiga and alpine tundra. There occur 13 diurnal raptor species, 10 of which nest in the area. From the 1930s to the 1960s–1980s, the numbers of the Osprey *Pandion haliaetus*, the White-tailed Sea Eagle *Haliaeetus albicilla,* the Merlin *Falco columbarius,* and the Kestrel *Falco tinnunculus* were decreasing. Since then, the status of the species populations has stabilized and their abundance has been increasing. The reasons for that are reduced use of pesticides, and improved attitude towards raptors. The abundance of the wintering species, the Golden Eagle *Aquila chrysaetos,* the Goshawk *Accipiter gentilis*, and the Gyrfalcon *Falco rusticolus*, as well as that of the Peregrine Falcon *Falco peregrine* has been either stable or increasing since the 1980s. The most common species are the Rough-legged Buzzard *Buteo lagopus*, the Goshawk and the Merlin. The area of strict nature reserves is insufficient for maintaining stable populations of raptors which are naturally rare. The main risk factors in the Murmansk region are logging of old-growth forests, declining food resources, water pollution, disturbance during the breeding season, poaching, accidental trapping in baited traps, commercial exploitation, accumulation of chlorine organic compounds and other contaminants, and accidental netting. The present-day status of raptor populations in the Kola Peninsula needs to be studied better.

Key words: Kola Peninsula, raptors, conservation, change.

НАСЕЛЕНИЕ ДНЕВНЫХ ХИЩНЫХ ПТИЦ *(FALCONIFORMES)* ЛАПЛАНДСКОГО ЗАПОВЕДНИКА И ЕГО ОКРЕСТНОСТЕЙ: ИЗМЕНЕНИЯ ЗА 1930–2005 ГОДЫ. Гилязов А.С. *Лапландский государственный природный биосферный заповедник.*

В Лапландском заповеднике на территории 2748 км² представлены северная тайга и горные тундры. Встречаются 13 видов дневных хищных птиц, из них 10 гнездятся. С 1930-х гг. до 1960–1980-х гг. численность скопы *Pandion haliaetus*, орлана-белохвоста *Haliaeetus albicilla,* дербника *Falco columbarius,* пустельги *Falco tinnunculus* уменьшалась. Позже состояние популяций этих видов стабильное или их численность растет. Причина – ограничение применения пестицидов, улучшение отношения к хищным птицам. Численность зимующих видов: беркута *Aquila chrysaetos,* тетеревятника *Accipiter gentilis*, кречета *Falco rusticolus*, а так же сапсана *Falco peregrine* стабильна или растет с 1980-х гг. Наиболее обычными являются зимняк *Buteol lagopus*, тетеревятник *Accipiter gentilis*, дербник. Для сохранения стабильных популяций хищных птиц как естественно редких видов площадей заповедников не достаточно. Основными угрожающими факторами на территории Мурманской области являются: вырубка старых лесов, сокращение кормовых ресурсов, загрязнение водоемов, беспокойство в период гнездования, браконьерская охота, случайный отлов капканами у привад, использование в коммерческих целях, накопление хлорорганики и других загрязнителей, случайный отлов сетями. Необходимо изучение современного состояния популяций хищных птиц на Кольском полуострове.

Ключевые слова: Кольский полуостров, хищные птицы, охрана, изменения.

INTRODUCTION

Nature monitoring in the Lapland reserve started in 1930. Diurnal raptors have been studied within the "Nature Chronicles" programme only, without any *ad hoc* studies. The results were summarized in several publications (Vladimirskaya 1948, Gilyazov 1991, Semyonov-Tyan-Shansky & Gilyazov 1991). This paper presents data gathered later from a wider area, since in 1983 the Lapland reserve had been enlarged northwestwards from 1600 km² to 2784 km², and it provides also a spatial-temporal analysis of changes in the population of diurnal raptors in Lapland in 1930–2005. The present-day reserve territory comprises the following habitats: old-growth forests (spruce, pine, birch) 57%, alpine reindeer lichen and dwarf shrub tundra 19%, montane elfin birch woodland 7%, mires (chiefly bogs) 8%, rocky areas 6%, and waters 3%. In the region in general, forests cover 23% of the territory, elfin birch woodland 14%, mires 37% (in eastern areas, paludification rises to 60%), alpine tundra 4%, and meadows 2% (Tokarev 1964, Bianki et al. 1993).

MATERIAL AND METHODS

Observations were made around the year: by regular snow mobile tours along the reserve perimeter in combination with ski trips to control sites and routes in the snow-covered period; from a boat and by walking transects in the snow-free period. The combined length of fixed routes is 130 km on water, 186 km in forest and 20 km in tundra habitats, and 160 km (40 km on lakes and 120 km in forests) by snow mobiles. Raptor nest sites known from previous years were monitored, including those in areas adjoining the reserve: westward to the Verkhnetulomskoye (Upper Tuloma) impoundment reservoir, northward to Lakes Kutskol' and Pulozero, eastward to eastern and northern foothills of the Khibines, southward along Imandra and Pirenga lake valleys. From 7 to 21 June 1990, the avifauna was surveyed in the upstream of River Jokanga (NE Kola Peninsula) in ca. 400 km^2 of flatland tundra with elfin birch-willow woodland and scrub along waterside.

In addition, data from the files of observations made by the reserve staff and information from interviews with visitors of different kinds (representatives of game and forest management units, hunters, fishermen, tourists) were used in the paper.

The activities and methods applied for the species were generally similar. There are, however, some distinctions necessitated by differences in ecology or behaviour. Some of the species are winter residents or start nesting earlier. They differ also in the choice of habitats, nest sites, diet, nest-associated behaviour, etc.

1. Determination of the abundance and its dynamics

Transect counts have been carried out during which individuals, nests, and traces of activity in respective habitats were recorded in the Lapland reserve and adjacent areas. First of all, information from previous years about encounters of individuals or breeding pairs, and nests found were used. Winter residents (Golden Eagle, Gyrfalcon, Goshawk) were monitored all year round, mainly from February to October, and migrants from the second half of April to October. The routes, registrations of birds and nests were mapped.

2. Determination of breeding outcomes

Nests were inspected after hatching and after fledglings had left the nest. Information was gathered on the causes of clutch and nestling death, and on the diet (cast pellets and food remains were gathered, and their composition determined).

3. Study of food resources

Food availability has been monitored through annual fixed-route counts of potential prey.

3.1 Winter transect count of wintering bird and mammal species

Potential winter prey has been monitored in forest habitats in late February – early March along 8 transects with a combined length of 103 km (Priklonsky 1965, 1973, Lindén et al. 1996, Lomanov 2000).

3.2 Counts of grouse (*Tetraonidae*) broods

Grouse were censused in forest habitats in mid-August along 9 transects with a combined length of 126 km (Stakhrovskiy & Morin 1932).

3.3 Counts of waterfowl (*Gaviiformes, Anseriformes*) broods

Waterfowl were censused in the second half of August along lake and river shoreline along 150 km long transects (Isakov 1952, 1963, Priklonskiy 1971).

3.4 Counts of small forest and tundra associated bird species (*Charadriiformes*, *Piciformes, Passeriformes*, etc.)

Smaller birds were censused in forest and tundra habitats in June along 6 transects with a combined length of 52 km (Järvinen & Väisänen 1976, 1977, Shchegolev 1977).

3.5 Small mammal counts

Small mammals were censused in June and September by kill-trapping along a 1 km transect running up a mountain slope (Kucheruk 1952, Semyonov-Tyan-Shansky 1970, Myllymäki et al. 1971, Kataev et al. 1994). (Since 1974, performed by the Leading Researcher G. Kataev.)

4. Determination of the factors limiting the abundance

Information on deaths and causes of death of adult birds, clutches and the young was gathered and analysed.

RESULTS AND DISCUSSION

All records from the Lapland reserve until year 2005 include 13 species of diurnal raptors, of which 10 are breeders. Two more species are known from the south and south-east of the Murmansk region – the Common Buzzard *Buteo buteo* and the Hobby *Falco subbuteo*, both occasionally breeding in the area (Bianki et al. 1993, 2003). Table 1 provides information on the patterns and duration of stay, nesting, abundance and tendencies of its change in the reserve in 1930–2005 for 13 raptor species. The most common ones are the Rough-legged Buzzard *Buteo lagopus*, the Goshawk *Accipiter gentilis*, and the Merlin *Falco columbarius.* Five species are listed in the Red Data Book of Russia as those of special concern (Bianki & Gilyazov 2003, Gilyazov & Kohanov 2003, Gilyazov et al. 2003). These species are described here in more detail.

Osprey *Pandion haliaetus*

In the past 15 years, like before, 2 pairs of Ospreys annually occur and breed at River Nyavka mouth and Lake Kupis'. Both localities feature a multitude of relatively shallow-water fish-rich lakes surrounded by swampy pine forests with isolated patches of treed ridges and elevations. A third pair used to nest in a similar site by the eastern boundary of the reserve until 1976. In 1967, the Leningrad-Murmansk highway was built along the reserve border, 1 km away from the nest. This apparently urged the birds to abandon the site.

Table 1. Diurnal raptor *(Falconiformes)* status, dates of stay, abundance and its tendencies in the Lapland reserve.

Species	Status	Dates of stay for migrations	Abundance	Abundance Tendencies
1. Osprey *Pandion haliaetus*	Breeder	20 May (*n*=38) – 7 September (*n*=43)	2–3 pairs	Decline until the 1980s, stable afterwards
2. Honey Buzzard *Pernis apivorus*	Vagrant	April – October	Very rare	
3. Black Kite *Milvus migrans*	Vagrant	21 May – 29 September	Very rare	
4. Hen Harrier *Circus cyaneus*	Vagrant	9 June – 24 August	Very rare	
5.Goshawk *Accipiter gentilis*	Breeder	Partially wintering	Common	Stable
6. Sparrowhawk *Accipiter nisus*	Breeder	April – October	Very rare	
7. Rough-legged Buzzard *Buteo lagopus*	Breeder	26 April (*n*=52)	Common	Lately decreasing
8. Golden Eagle *Aquila chrysaetos*	Breeder	Partially wintering	2–3 pairs + juveniles	Stable. Increasing since the 1980s
9. White-tailed Sea Eagle *Haliaeetus albicilla*	Breeder	18 April (*n*=55) – 3 October (*n*=45)	1–2 pairs + juveniles	Decline until the 1970s, stable thereafter
10. Gyrfalcon *Falco rusticolus*	Breeder	Partially wintering	2–4 pairs	Stable or increasing since the 1980s
11. Peregrine Falcon *Falco peregrinus*	Breeder	May – October	Very rare	Stable or increasing since the 1980s
12. Merlin *Falco columbarius*	Breeder	17 May (*n* = 40) – 31 August (*n* = 31)	Common	Decline until the 1960s, stable thereafter
13. Kestrel *Falco tinnunculus*	Breeder	May - September	Rare	Decline since the late 1960s

Single individuals are seen more or less frequently on all water-bodies, including those in the areas recently included in the reserve, but no traces of other nesting pairs have been seen in these areas. North-western parts of the reserve have a higher percent cover of mountains and forests, and a lower number of lakes and still river stretches. In total, 2 breeding pairs and 2–4 single individuals live in the reserve.

Judging by information from interviews and own observations, 1–2 Ospreys are regularly encountered outside the reserve, in the northern part of Lake Imandra. According to fisheries inspectors, the Osprey does not occur on the Verkhnetulomskoye reservoir. On surveys in the upstream of River Jokanga, near Tichka river mouth (NE Kola Peninsula) on 7–21 June 1990 we encountered no Ospreys. Shallow-water lakes rich in fish are plentiful in the area, but pine forests are lacking. One may assume that the distribution of the Osprey is related to pine forests.

All the 7 nests known from the Lapland reserve are situated on the very top of pine trees, the tops being "flat", and the branches bent sideways and downwards. Pine trees bearing Osprey nests are lower than the tallest pine trees, and grow in low parts of swampy sparse woodland. Thus, the nests are sheltered from wind and not easily visible from a far despite their size.

The Osprey is a strict specialist. In Lapland, it depends heavily on the abundance of medium-size fish weighing 0.5–1 kg at maximum, but may occasionally prey also on birds on water. The prey ranges of the Osprey and the White-tailed Sea Eagle partially overlap, so that competition may arise. On 5 August 1997, e.g., a fight between an Osprey and a White-tailed Sea Eagle was observed during brown trout upstream and grayling downstream migration in the Upper Chuna River.

Known Osprey deaths are few: on 15 September 1961 an Osprey died in fishing nets on Lake Nyukhchi, on 22 May 1935 an adult male was killed for a collection on Lake Chuna (Semyonov-Tyan-Shansky & Gilyazov 1991).

White-tailed Sea Eagle *Haliaeetus albicilla*

The White-tailed Sea Eagle is more widespread in Lapland than the Osprey. There are 3 nest areas within the reserve. Four more are known from the reserve vicinities: by Lakes Ol'che, Osinovoye, Vumba and in Vuva river valley. The Verkhnetulomskoye reservoir harbours three more nest areas (one appears to be abandoned). The areas adjoin each other, covering a total of ca. 8000 km^2, i.e. each area being ca. 1000 km^2 in size.

Another nest area we are aware of (in addition to those known from our colleagues' publications) is situated in the upper reaches of River Jokanga, where a nest with a fledgling was found in the downstream of River Rova on 20 June 1990. In the 1970s, staff of the "Kolmozero" weather station knew of at least three more nests in the locality. In 2005, the fish inspector A. Zhanbaliev detected 3 nests on Tersky Coast rivers.

The species abundance in the Kola Peninsula has been stable or growing in the past 20 years (Gilyazov & Kohanov 2003).

When a nest area is surveyed thoroughly enough, up to 4 nests are usually found. The smallest distance between known nests from different territories is 22 km. Given that in some years all three nest areas (within the reserve) may be occupied, Sea Eagle pairs can be said to stick to their home ranges.

Of known nests, 19 were situated on the upper storey pine trees close to or on the top, 2 on ledges of sheer cliffs (rivers Vaikis' and Nyavka), 4 on birch trees (in forest tundra where pine trees were missing), and, as a rule, close to the shoreline. Of the 22 nest occupation records, 1 offspring hatched and fledged in each of 9 nests, one of the fledglings dying on the day it left the nest, one nest produced 2 juveniles, three nests were abandoned with clutches, two nests were ravaged by a bear, the fate of the remaining 7 nests is not known.

Over the past 40 years, remains of 9 Sea Eagles have been found. Within the reserve one bird was shot, the remains of four (bones and feathers) were found in different parts of the reserve. Outside the reserve one bird was found entangled in nets in northern Karelia in May 1996; an adult female was trapped in a baited trap in Lavna tundra in late April 1997; a starved bird was found dead by Verkhnetulomskiy village on 29 September 1997; an adult was found dead due to an unknown reason on ice of Vochelambina Bay, Lake Imandra on 1 June 1994.

The White-tailed Sea Eagle specializes on larger fish than the Osprey – usually heavier than 1 kg. The largest pike known to have been taken by the Sea Eagle was 12–15 kg (10 August 1986), the largest brown trout ca. 5 kg (6 July 1990). The diet includes also water animals, carrion, and even forest animals, medium-sized birds (Semyonov-Tyan-Shansky & Gilyazov 1991). The latter fact is probably related to the openness of forests in Lapland. The White-tailed Sea Eagle is more of a generalist, and its diet overlaps that of both the Osprey and the Golden Eagle.

Golden Eagle *Aquila chrysaetos*

In contrast to the Osprey and the White-tailed Sea Eagle, the Golden Eagle is a permanent resident in Lapland, at least part of its population, and occurs throughout. Wintering and, perhaps, breeding opportunities are directly related to the availability of ungulates, reindeer and moose, and their predators, wolves, wolverines and bears, which supply food for wintering Golden Eagles by carcasses of their prey. As reported by Finnish ornithologists (Tuomo Ollila, Teuvo Hietajärvi), unbanded young Golden Eagles are sometimes encountered in Northern Finland and Finnish Lapland, and Finnish researchers believe them to come to their area from Russia, attracted by abundant domestic reindeer.

We failed to find any patterns in the distribution of Golden Eagle nests (9 found), except that they were located in pine forests: 8 nests were built on the highest pine trees, 3 of which were in "witches brooms", and one on a ledge of a sheer cliff under Seida-pahta. Unlike White-tailed Sea Eagles and Ospreys, Golden Eagles are cautious and secretive around their nests, and the nests are more difficult to spot. Therefore, on many occasions nesting in the reserve remains unrecorded. So far, no nesting Golden Eagles have been recorded from outside the reserve and areas adjoining it. There is a relatively stable population of wild reindeer, and common northern taiga species, including grouse, in the eastern part of the Kola Peninsula, within the forest zone. These areas are little disturbed, with human settlements present along the seacoast only.

Judging by the distance between the nests and registrations of pairs and juveniles there are 2–3 pairs and 2–4 young Golden Eagles in the reserve. This has been the situation for many years.

Of the 12 known nest occupation cases, 6 nests produced 1 fledgling each, in one of the nests a second juvenile was killed by a bear; 2 other nests were ravaged by a bear; 4 nests were abandoned because of human disturbance, the fate of three is unknown. Seven cases of breeding success are known also from brood registrations in other years. In the ten years of the 1990s there were 10 cases of breeding, and in each of 1987, 1989, 1990 and 1991 two breeding attempts were recorded. These were the years when reindeer abundance in the reserve was increasing. In 2000–2005, as reindeer moved westwards, no signs of breeding were recorded in the reserve. Reindeer herds and moose are regularly accompanied by 1–2 wolf families, which facilitate Golden Eagle overwintering and breeding. Stable abundance is demonstrated also by the bear (30–50 animals) and wolverine (10–20).

Some of the factors influencing the Golden Eagle population outside the reserve are: 1) disturbance, especially at the onset of the breeding season before eggs hatch, because of the species prudence; 2) trap hunting: we know of 6 cases when Golden Eagles were trapped – the last ones took place in January 1992 and the winter of 1993/1994. Besides, a starved young female was found dead on Lake Chunozero on 23 September 1979, and a young male was taken down for a collection on 23 September 1931.

Gyrfalcon *Falco rusticolus*

One may encounter the species anywhere in the Kola Peninsula: in the forest, in the mountains, in the tundra, over a lake, and in the non-breeding period – even in a city with 80,000 inhabitants and a well-developed industry. A flying pair (male and female) was seen in the city on 27 July 1990 (unpublished communication, O. Semyonov-Tyan-Shansky). In 1994–2000 (20 October 1996 – 28 February 1997; 12 September 1997 – l8 January 1998; 7–12 November 1998, 19 August – 16 October 2000), a light-morph Gyrfalcon overwintered there. Like the Goshawk, the Gyrfalcon is attracted here by synanthropic bird species: Feral Dove *Columba livia*, Hooded Crow *Corvus corone*, House Sparrow *Passer domesticus*, etc. Although widely spread, the Gyrfalcon is rare in the Kola Peninsula. In the first 44 years of observations in the Lapland reserve between 1930 and 1988 (the reserve was closed for the war years 1941–1945 and in 1951–1958 following a governmental resolution), 81 Gyrfalcons were seen, and 4 cases of breeding were noted (Semyonov-Tyan-Shansky & Gilyzov 1991). In 16 years between 1988 and 2005, Gyrfalcons were encountered more often, and 16 occupied nests were recorded. Here, the following factors that have presumably influenced the number of Gyrfalcon registrations and nest finds should be taken into account:

1. Until the 1960s, extermination of some raptor species (Goshawk *Accipiter gentilis,* Marsh Harrier *Circus aeruginosus*) was encouraged in Russia as they were claimed to be harmful both for the nature and for people. People's skills in distinguishing between species being poor, they killed all "raptors". This phenomenon had a massive scope. We are not aware of any cases when Gyrfalcons were killed or nests were destroyed. Outside the reserve, however, the Golden Eagle, White-tailed Sea Eagle and other raptors were sometimes trapped (accidentally in animal traps) or shot for collections, but more often only for fun. There has been no official persecution of raptors for over 40 years now, and this fact could not but tell on their population. Some winter residents among raptors may wander during the non-breeding period in search of food, away from the reserve, too.

2. Gyrfalcon's main food, the grouse *(Tetraonidae),* declined in number during the last 52 years: the Capercaillie to a third, the Willow Grouse by 60%, the Hazel Grouse to a quarter (Semyonov-Tyan-Shansky 1989). The declining trend is continuing. The most probable reason for that is habitat deterioration or destruction (forest logging and fires, road and industrial construction, etc.). Human population in the Murmansk region increased from 27,000 in 1927 to 1,000,000 in 2000 (Gilyazov 2000). Grouse are prey for large raptors: the Golden Eagle, White-tailed Sea Eagle, Goshawk, and the Peregrine Falcon.

3. More data on the reserve territory are becoming available with times going on. Since Gyrfalcon nests are situated in difficult-to-access mountainous areas, it is not easy to spot the nests, and the search requires specialized activities.

All the three factors could act simultaneously. Nonetheless, the fact that the status of the Gyrfalcon population did not worsen is encouraging.

Up to 2006, 9 nest sites are known from the reserve: 8 on cliffs, 1 on a pine tree. In 1986, 1997, 1999, 2002 and 2003 Gyrfalcons nested in two sites simultaneously. The distance between the closest nests is 3, 10, 13, 23, 40 and 27 km. In areas adjoining the reserve we observed single Gyrfalcons north of the Khibines in 1994 and 1995, and south of Lake Pirenga in 2003. An interesting fact is the winter residence of a single light-morph Gyrfalcon in the city in 1994–2000.

Two Gyrfalcon pairs nested north of the reserve in 1986, and 1 pair prior to that (A. Kosyakov, unpublished). Between 1993 and 2001, the Gyrfalcon nested in the same area 6 times (in 1994, 1996 and 1997 nests were not inspected) (Yu. Bychkov, unpublished). All of the nests were situated on cliffs.

The Gyrfalcon and Goshawk diets are shown in tab. 2. The data are based on observations of hunting birds, remaining fragments of the prey and cast pellets from nests.

The composition of pellets is described separately, as they include small food items that cannot be detected using other methods of food range determination. The Gyrfalcon's diet in the reserve is similar to that of birds from other inland, non-coastal parts of the Gyrfalcon's distribution range, e.g. Norway (Oien et al. 1998). In winter, the Gyrfalcon's diet is chiefly composed of grouse: Ptarmigan *Lagopus mutus*, Willow Grouse , Capercaillie *Tetrao urogallus*, and Black Grouse *T. tetrix*. In summer, the species additionally preys on ducks, wading birds, gulls, voles and lemmings. The diet of the Goshawk is similar to that of the Gyrfalcon, but being a forest-dwelling bird, the Goshawk in winter preys more on the Capercaillie, Black Grouse, Hazel Grouse, other forest birds. The summer diet of the Goshawk also includes more of small forest bird species and far more insects (ants, beetles, etc.) than the Gyrfalcon diet, whereas the proportion of ducks, waders and gulls is lower. The reason is the Gyrfalcon's manner to hunt in open treeless areas. The similarity between the Gyrfalcon and the Goshawk diets probably arises from the openness of Lapland forests, with rather low stocking density.

In the city, the Gyrfalcon preyed on Feral Doves *(Columba livia)* only, whereas "urban" Goshawks hunted on Doves as well as Hooded Crows and Sparrows. It is possible, however, that the information is biased because there are more observations of the Goshawk.

Peregrine Falcon *Falco peregrinus*

This is the rarest among the species under consideration (Semyonov-Tyan-Shansky & Gilyazov 1991). Nonetheless, bird pairs and a breeding attempt were observed for the first time in the period between 1987 and 1997. In June–July 1988, a pair of Peregrines stayed by a cliff where Gyrfalcons used to nest. When the site was inspected on 6 July 1988, one of the birds was constantly swooping at the intruder and the other one also demonstrated anxiety, but in a more cautious way. The nest was empty. On 9 August 1988, 1 bird was sighted in the area. On 16 August 1993, a pair of Peregrines pursued by a Rough-legged Buzzard was seen in a river valley, also near a cliff with a Gyrfalcon nest (Yu. Goryaev, unpublished). These contacts suggest that the Peregrine Falcon may be breeding in the western part of the Kola Peninsula as well. Single individuals were seen on 14 June 1990 and on 17 June 1990 near Tichka river mouth and in the upstream of River Jokanga: once sitting on a perch, and the other time carrying prey southwards, presumably to the nest.

Table 2. Gyrfalcon and Goshawk diet judging by prey remains and cast pellets.

Prey species	Composition of prey remains, %		Composition of cast pellets, %	
	F. gyrfalco n = 193*	*A. gentilis* n = 226*	*F. gyrfalco* n = 111	*A. gentilis* n = 307
Rangifer tarandus	-	0.2	-	-
Sciurus vulgaris	-	0.6	-	3.5
Lepus timidus	0.6	2.8	-	-
Lemmus lemmus	3.4	-	5.4	-
Clethrionomys, Microtus	1.7	0.6	56.1	29.6
Mustela nivalis	0.6	-	-	1.3
Aves sp.	-	2.8	14.3	11.1
Anatinae sp	8.4	2.9	-	0.3
Buteo lagopus, Accipiter sp.	1.1	1.1	-	1.3
Tetraonidae sp.	-	-	2.7	1.6
Lagopus lagopus, L. mutus	42.1	56.4	10.7	7.2
Tetrao tetrix	2.3	5.6	-	-
Tetrao urogallus	9.0	12.3	-	0.3
Bonasa bonasia	0.6	0.6	-	0.3
Charadriiformes	1.2	5.0	-	1.0
Larus sp., Sterna sp.	10.6	2.9	8.0	-
Uria aalge	1.1	-	-	-
Columba livia	0.6	-	-	-
Cuculus canorus	0.6	-	-	-
Strigiformes	2.9	-	0.9	0.7
Piciformes sp.	2.3	0.6	-	1.3
Passeriformes sp.	6.1	4.5	0.9	18.2
Corvidae	4.4	1.1	-	0.3
Insecta	-	-	1.0	22.0
Total:	100	100	100	100

*Note: the data do not include birds killed in the city in winter: 17 Feral Doves taken by the Gyrfalcon, 45 Feral Doves and 4 Hooded Crows taken by the Goshawk.

DISCUSSION

Changes in the population of raptors in the Lapland reserve since 1930 are generally similar for all species, and mostly negative. The primary reason for that is human-induced destruction of natural habitats. In the 1960s, the Leningrad–-Murmansk highway was constructed along the eastern boundary of the reserve. Forest fires accompanied road construction. Areas crossed by the highway became more easily accessible. As a result large raptors, the White-tailed Sea Eagle, Golden Eagle and Osprey, which nests had earlier been known, stopped breeding in the area since the 1960s–1970s. When not persecuted and disturbed by people, and when foods is available, any raptor species is potentially capable of adapting to life in human vicinity. An example is regular wintering of the Goshawk and, occasionally, the Gyrfalcon in cities of the Murmansk region.

The abundance of most raptor species showed a decline until the 1960s–1980s, with stabilization or an upward tendency thereafter. This is the case for migratory species, the Osprey, White-tailed Sea Eagle, Kestrel and Merlin. The situation is apparently due to an improving attitude towards the nature in general, as well as to factors such as the ban on pesticide use and termination of the raptor fighting campaign. For the Rough-legged Buzzard – a migrant – no decline has been recorded. It is only lately that the number of breeding pairs has become low, like in adjacent areas of Finland (Koskimies 2003), the reason being low vole abundance. Vole abundance has been decreasing in the Lapland reserve since 1987 (Kataev 2003). The numbers of sedentary species, and the Golden Eagle, Goshawk, and Gyrfalcon in the reserve remained more stable than that of migrants. In the past two decades, these species have demonstrated the same upward tendency in the abundance as migrants do, and the reasons are the same, too.

The finds of previously unknown nests, even of very noticeable species such as the White-tailed Sea Eagle, which live close to fish-rich waters often visited by people, prove the coverage of the Kola Peninsula territory by ornithological studies is insufficient.

The limiting factors for raptors in the Murmansk region area include the following:

Osprey – logging of old-growth forests, decreasing food resources, water pollution, disturbance during breeding, poaching, accidental netting;

Golden Eagle – food deficit, especially in the winter season, accidental trapping in baited traps, disturbance (the species is the most cautious of all the raptors at nest), logging, poaching;

White-tailed Sea Eagle – same factors as for the Osprey and Golden Eagle;

Gyrfalcon – food deficit, commercial exploitation, disturbance during the breeding season;

Peregrine Falcon – accumulation of chlorine organic compounds and other contaminants along flyways and in wintering grounds, food deficit, commercial exploitation, disturbance during the breeding period.

The factors influencing other raptor species are generally the same.

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DIURNAL RAPTORS AND OWLS IN THE MURMANSK REGION

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The list of diurnal raptors and owls recorded from the Murmansk region territory is provided. The status of the species in the area is briefly described.

Key words: diurnal raptors, owls, Murmansk Region, Russia.

ХИЩНЫЕ ПТИЦЫ И СОВЫ МУРМАНСКОЙ ОБЛАСТИ. Корякин А.С. *Кандалакшский государственный природный заповедник.*

Приведен список видов хищных птиц и сов, отмеченных к настоящему времени на территории Мурманской области, кратко охарактеризован статус видов на данной территории.

Ключевые слова: хищные птицы, совы, Мурманская область, Россия

The paper briefly reports about the status of birds of two orders – *Falconiformes* and *Strigiformes* – in the Murmansk region.

Since the 1930s, information about birds in the Murmansk region has been gathered predominantly by the Kandalaksha and Lapland state strict nature reserves. After the Pasvik strict nature reserve had been designated in 1992 and formed a single transboundary protected area with the Norwegian reserve bearing the same name, extensive ornithological information accumulated by Norwegian colleagues became available. That is why the reserves are constantly mentioned in brief species accounts.

So far, 17 species of diurnal raptors (12 breeding) and 9 species of owls (7 breeding) have been recorded from the region (table 1). The basic review on birds of the Kola Peninsula published by F. Pleske (1887) reported of 12 diurnal raptor species (3 breeding) and 6 owl species (2 breeding) for the territory of the present-day Murmansk region, but one should note that the status of some species was not specified clearly enough. Despite considerable fluctuations in the abundance of many of the species over the past 125 years, no significant changes have occurred in the fauna of the orders. For most species, the change in the status (see tab. 1) is an artefact, reflecting better information coverage rather than actual population changes in the area.

Table 1. Checklist of diurnal raptors and owls in the Murmansk region.

No	Species	Status	
		Pleske, 1887	current
1.	*Falconiformes*		
1.1	*Pandion haliaetus*	breeder	breeder
1.2	*Pernis apivorus*	absent	vagrant
1.3	*Milvus migrans*	absent	breeder
1.4	*Circus cyaneus*	present	migrant
1.5	*Circus aeruginosus*	absent	vagrant
1.6	*Accipiter gentilis*	present	breeder
1.7	*Accipiter nisus*	present	breeder
1.8	*Buteo lagopus*	breeder	breeder
1.9	*Buteo buteo*	present	vagrant
1.10	*Aquila chrysaetos*	present	breeder
1.11	*Haliaeetus albicilla*	present	breeder
1.12	*Falco rusticolus*	breeder	breeder
1.13	*Falco peregrinus*	present	breeder
1.14	*Falco subbuteo*	absent	breeder
1.15	*Falco columbarius*	present	breeder
1.16	*Falco vespertinus*	absent	vagrant
1.17	*Falco tinnunculus*	present	breeder
2	*Strigiformes*		
2.1	*Nyctea scandiaca*	present	breeder
2.2	*Bubo bubo*	present	breeder
2.3	*Asio otus*	absent	vagrant
2.4	*Asio flammeus*	breeder	breeder
2.5	*Aegolius funereus*	breeder	breeder
2.6	*Glaucidium passerinum*	absent	nomadic
2.7	*Surnia ulula*	present	breeder
2.8	*Strix uralensis*	absent	breeder
2.9	*Strix nebulosa*	present	breeder

1. Order *Falconiformes*

1.1. Osprey *Pandion haliaetus*. Breeder. Abundance in the region is 25 pairs at maximum (Gilyazov & Kokhanov 2003a). Red-listed in the Murmansk Region (category 3 – rare species). Nests in forest areas little disturbed by human activities around large lakes and lake systems rich in fish, as well as on the islands and coast of the Gulf of Kandalaksha. The northernmost breeding area is the Pasvik reserve (Makarova et al. 2003, Frantzen et al. 1991, Wikan et al. 1994). The species has not been recorded from the tundra zone or the Murman coast.

1.2. Honey Buzzard *Pernis apivorus*. Rare vagrant species. First recorded on 24 October 1938 in the Chuna tundra, Lapland reserve (Semyonov-Tyan-Shansky & Gilyazov 1991). Breeding not confirmed but possible in the southwest of the region.

1.3. Black Kite *Milvus migrans*. Rare breeder. First recorded on 29 May 1950 from Chunozero, Lapland reserve (Semyonov-Tyan-Shansky & Gilyazov 1991); the same year breeding was recorded on Lake Rugozero, at the border with Karelia (Zimin et al. 1993). Breeding has not been recorded thereafter, although a few pairs may be nesting in the southwest of the region. Thus, Black Kites have lately stayed at the head of the Gulf of Kandalaksha, near Luvenga in the summer season (E. Shutova, personal communication). A vagrant Kite was noted on Harlov Island, Seven Islands (Sem' Ostrovov) Archipelago, Eastern Murman (Gerasimova et al. 1967).

1.4. Hen Harrier *Circus cyaneus*. Rare migrant. Breeding has been recorded from an area in the Norwegian part of the Pasvik reserve by the border with Russia (Frantzen et al. 1991, Giershaug et al. 1994). Breeding in the Ponoi depression area has been surmised but no nests found (Ganusevich 1988). Recorded from the White Sea bottleneck by the Three Islands Archipelago (Pleske 1887). A visit to the Ainovy Islands, Western Murman (Kohanov & Skokova 1967) and the Gavrilovskiy Archipelago area, Eastern Murman (Paneva 2001) has been recorded.

1.5. Marsh Harrier *Circus aeruginosus*. Visitor. Observed in the Pasvik reserve in 1986 (Wikan et al. 1994).

1.6. Goshawk *Accipiter gentilis*. Uncommon breeder. The breeding range covers the forest zone and forest tundra. Nesting was first recorded in the tundra zone in 1999 – Eastern Murman, mainland coast by Gavrilovskiy Archipelago, and since 2002 – on islands of the archipelago (Paneva 2001, personal communication). Migratory and nomadic birds were observed on the Murman coast, islands and archipelagoes along the coast – Ainovy, Kildin, Gavrilovskiy, Seven Islands (Kartashev 1948, Kohanov & Skokova 1967, Nikolskiy 1885, Spasskiy 1925, Formozov 1929). Some individuals overwinter in the area, in human settlements as well (Kohanov 1985, Semyonov-Tyan-Shansky & Gilyazov 1991, Shutova & Kohanov 2001).

1.7. Sparrowhawk *Accipiter nisus*. Rare breeder. Nesting was first recorded in 1937 in Chuna tundra (Vladimirskaya 1948). The breeding range is within the forest zone. Encounters are known on the Kildin Island and the White Sea bottleneck (Smirnov 1926, Formozov 1927). In Kandalaksha the Sparrowhawk was recorded in the winter season (Shutova & Kohanov 2001).

1.8. Rough-legged Buzzard *Buteo lagopus*. Breeder. Occurs throughout the region, but avoids large closed-canopy forest areas. The number of breeding pairs and their distribution depends on the abundance of *Muridae*.

1.9. Common Buzzard *Buteo buteo*. Vagrant. Breeding presumed in the south of the region (Kohanov 2003a), but no nests have been found. The species was recorded in the Pasvik reserve (Wikan et al. 1994), by Lake Notozero (Pleske 1887), by Lake Bolshoi Vudjavr (Kohanov 2005), on the downstream of Ponoi (Mikhailov & Fil'chagov 1984), in the Chavanga area (Kvartal'nov et al. 1984), but most encounters occurred in the Kandalaksha area and further south (Blagosklonov 1960, Kohanov et al. 1987).

1.10. Golden Eagle *Aquila chrysaetos*. Breeder. There are no more than 10 pairs in the Murmansk region (Gilyazov & Kohanov 2003b). Red-listed in the Murmansk Region (category 3 – rare species). Nests in the western part of the region, namely in the Pasvik and Lapland reserves (Vladimirskaya 1948, Semyonov-Tyan-Shansky & Gilyazov 1991, Wikan et al. 1994). Nesting presumed around Ondomozera lakes, Tersky coast (Kvartal'nov et al. 2004). Some birds may overwinter in the area (Vladimirskaya 1948). Known to have visited Ainovy Islands, Gavrilovskiy and Seven Islands Archipelagoes (Paneva, personal communication; Tatarinkova & Chemyakin 1975, Tatarinkova et al. 1989).

1.11. White-tailed Sea Eagle *Haliaeetus albicilla*. Breeder. Red-listed in the Murmansk Region (category 3 – rare species). Abundance estimated at 30–35 pairs (Gilyazov & Kohanov 2003c). The main breeding areas are the Ponoi depression (Ganusevich 1988), Gulf of Kandalaksha coast and islands (Koryakin & Boyko, ibid., Kohanov & Bianki 1986). The species breeds also in the Pasvik and Lapland reserves (Vladimirskaya 1948, Semyonov-Tyan-Shansky & Gilyazov 1991, Wikan et al. 1994). Occasional visits have been recorded from the tundra zone and Murman coast islands (Kartashev 1948, Kishchinskiy 1960, Mikhailov 1972, Nikolskiy 1885, Tatarinkova & Chemyakin 1975, Formozov 1929). May overwinter in the area (Flyorov 1970).

1.12. Gyrfalcon *Falco rusticolus*. Breeder. Red-listed in the Murmansk Region (category 2 – vulnerable species). There are 12–15 nest areas known from the region (Gilyazov et al. 2003). Nests mainly in forest tundra and tundra (Pleske 1887), including archipelagoes Gavrilovskiy and Seven Islands, Eastern Murman coast (Dementiev 1951, Shklyarevich & Krasnov 1980). Some birds may overwinter in the area (Kohanov 1970, Semyonov-Tyan-Shansky & Gilyazov 1991).

1.13. Peregrine Falcon *Falco peregrinus*. Breeder. Red-listed in the Murmansk Region (category 2 – vulnerable species). No more than 20–30 pairs nest in the region (Bianki et al. 2003). The main breeding area is the Ponoi depression (Ganusevich 1988). Cases of overwintering in the head of the Gulf of Kandalaksha are known.

1.14. Hobby *Falco subbuteo*. Rare, occurs irregularly, occasional breeder. First recorded officially in August 1951 from the Severnyi Archipelago, Gulf of Kandalaksha (Kohanov et al. 1987). Red-listed in the Murmansk Region (category 3 – rare species). Nesting reported from the Gulf of Kandalaksha area: Velikiy Island (1957 & 1984), Karelian Coast opposite the Tarasikha Archipelago (1980 & 1981) (Kohanov 1987). In addition to the Gulf of Kandalaksha, the species was noted in the Pasvik reserve in 1973 (Wikan et al. 1994), on Harlov Island, Seven Islands Archipelago, Eastern Murman coast in 1986 (Krasnov & Nikolaeva 1992).

1.15. Merlin *Falco columbarius.* Breeder. Red-listed in the Murmansk Region (in need of surveillance). Estimated abundance is 100–200 pairs. The most abundant species among falcons. Occurs throughout the region, but rare in the tundra zone, although in 1955 nesting was recorded even from Harlov Island (Kishchinskiy 1960). Winter encounters have been recorded from Kandalaksha (Shutova & Kohanov 2001).

1.16. Red-footed falcon *Falco vespertinus.* Vagrant. First recorded on Imandra Island in July 1921; the same August recorded on the Khibines, later on a dead bird was found in the Gulf of Kola area (Shibanov 1927). No records thereafter.

1.17. Kestrel *Falco tinnunculus.* Breeder. Red-listed in the Murmansk Region (category 3 – rare species). Breeding reported from SW parts of the region, from the Pasvik reserve to the Gulf of Kandalaksha (Blagosklonov 1960, Vladimirskaya 1948, Semyonov-Tyan-Shansky & Gilyazov 1991, Wikan et al. 1994). The species abundance is closely related to the dynamics of *Muridae*. The species abundance in the Gulf of Kandalaksha – the main breeding area – has decreased several times since the 1950s–1960s (Bianki & Boyko 1985), and breeding in the area is now not annual. The species has been noted in the tundra zone and on Murman Coast islands (Mikhailov & Fil'chagov 1984, Paneva 1992, Tatarinkova et al. 1989).

2. Order *Strigiformes*

2.1. Snowy Owl *Nyctea scandiaca*. Uncommon migrant and nomadic species, accidental breeder. Red-listed in the Murmansk Region (category 3 – rare species). Previously, the first case of nesting was recorded only in 1982 from coastal tundra near Dalnije Zelentsy village (Krasnov 1985). No case of breeding recorded thereafter.

2.2. Eagle Owl *Bubo bubo.* Very rare, accidental breeder. Red-listed in the Murmansk Region (category 1b – endangered species). The species was noted quite a few times in the Kandalaksha area in the 1950s but became very rare afterwards (Kohanov 2003b). Nesting first noted in 1961–1964 on Velikiy Island, Gulf of Kandalaksha (Kohanov et al. 1987), but not recorded thereafter. Visits by the species to the Gulf of Kola area (Spasskiy 1925) and Harlov Island, Seven Islands Archipelago, Eastern Murman coast (Karpovich 1985) are known. Recorded from the Lapland reserve in wintertime as well (Semyonov-Tyan-Shansky & Gilyazov 1991).

2.3. Long-eared Owl *Asio otus.* Rare vagrant. The first registration was on 20 August 1921, the bird was taken from the Murmansk area (Shibanov 1927). In 1973, the species was observed on Velikiy Island, Gulf of Kandalaksha (Kohanov 1987). In the Norwegian part of the Pasvik reserve, the species was observed in 1930 and 1967 (Wikan et al. 1994).

2.4. Short-eared Owl *Asio flammeus.* Uncommon breeder. The breeding range covers the forest zone and reaches slightly into forest tundra. The species was recorded from the Barents Sea coast (Kishinskiy 1960, Mikhailov 1993, Paneva 1992), from Ainovy Islands (Kohanov & Skokova 1967) and from the Seven Islands Archipelago (Kartashev 1948).

2.5. Tengmalm's Owl *Aegolius funereus.* Uncommon breeder. The breeding range is limited to the forest zone. All cases of breeding were registered from the Kandalaksha and Lapland reserves and their surroundings; of 16 known nests 13 were in nest boxes made for the Goldeneye *Bucephala clangula* (Boyko & Shutova, ibid., Semyonov-Tyan-Shansky & Gilyazov 1991). No contacts have been reported from forest tundra or tundra. May overwinter in the area.

2.6. Pygmy Owl *Glaucidium passerinum.* Rare species. First officially registered from Lake Chunozero, Lapland reserve in December 1930 (Semyonov-Tyan-Shansky & Gilyazov 1991). Red-listed in the Murmansk region (in need of surveillance). Breeding not confirmed yet, but quite possible in the southwest of the region. The report of the species breeding in the Murmansk region (Bianki et al. 1993) is not based on direct observations. The species registered from the forest zone only. May overwinter.

2.7. Hawk Owl *Surnia ulula*. The most common owl species in the Murmansk region. Its abundance is closely related to the dynamics of small rodent numbers (Semyonov-Tyan-Shanskiy & Gilyazov 1985). The breeding range covers the forest zone but may reach into forest tundra as well. Vagrant visits to the Eastern Murman coast (Gebel 1903, Kishinskiy 1960), including the Seven Islands Archipelago (Kartashev 1948) have been registered.

Tawny Owl *Strix aluco*. The only published observation of the species (Makarova 2003) was a technical error (Khlebosolov, E.I., personal communication).

2.8. Ural Owl *Strix uralensis.* Rare accidental breeder. First official registration of the species was on 14 June 1932 from the Kurki River valley (Semyonov-Tyan-Shanskiy & Gilyazov 1991). Red-listed in the Murmansk region (category 2 – vulnerable species). Abundance declined considerably since the 1950s. Only one case of breeding is known: Luvenga village area, Gulf of Kandalaksha, 1982 (Kohanov 2003c). Does not reach outside the forest zone, but a vagrant having visited the Ainovy Islands is known (Tatarinkova 1985). The species was registered from the region in March–November, one registration was made in January (Semyonov-Tyan-Shanskiy & Gilyazov 1991, Kohanov et al. 1987).

2.9. Great Gray Owl *Strix nebulosa*. Rare breeder. Red-listed in the Murmansk region (category 3 – rare species). Breeding registered only from Kandalaksha, Lapland, Pasvik nature reserves. The species was recorded there in all months except December (Kohanov 1990, Kohanov et al. 1987, Makarova et al. 2003, Semyonov-Tyan-Shanskiy & Gilyazov 1991). Not observed outside the forest zone.

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THE WHITE-TAILED SEA EAGLE *HALIAEETUS ALBICILLA* AND THE COMMON EIDER *SOMATERIA MOLLISSIMA* IN THE GULF OF KANDALAKSHA, WHITE SEA

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In the past several decades, mortality of Common Eider clutches and incubating females due to predation has increased notably in the Kandalaksha strict nature reserve sites in the Gulf of Kandalaksha. At present, predation by the White-tailed Sea Eagle is the main factor undermining Eider reproduction success in reserved areas. The impact of other raptors, corvids, and predatory mammals is less significant, although it has also grown lately.

Key words: White-tailed Sea Eagle, diet, predation, Common Eider, reproduction, Gulf of Kandalaksha, White Sea, *Haliaeetus albicilla*, *Somateria mollissima*.

ОРЛАН-БЕЛОХВОСТ *HALIAEETUS ALBICILLA* И ОБЫКНОВЕННАЯ ГАГА *SOMATERIA MOLLISSIMA* В КАНДАЛАКШСКОМ ЗАЛИВЕ, БЕЛОЕ МОРЕ. Корякин А.С., Бойко Н.С. Кандалакшский государственный природный заповедник.

На участках Кандалакшского заповедника в Кандалакшском заливе в последние десятилетия значительно возрос отход кладок обыкновенной гаги и, одновременно, увеличилась гибель насиживающих самок из-за хищничества. В настоящее время хищничество орланов – основной фактор, снижающий успешность воспроизводства гаг на заповедных участках. Влияние других видов хищных птиц, врановых, хищных млекопитающих менее значимо, но и оно также выросло в последние годы.

Ключевые слова: орлан-белохвост, питание, хищничество, обыкновенная гага, воспроизводство, Кандалакшский залив, Белое море, *Haliaeetus albicilla, Somateria mollissima.*

The White-tailed Sea Eagle *Haliaeetus albicilla* is the most noticeable raptor in the Gulf of Kandalaksha area. The species is red-listed in the Russian Federation and the Murmansk region (category 3 – rare species).

Data on the ecology and abundance of the White-tailed Sea Eagle in the Kandalaksha strict nature reserve in the 1950s–1980s were published by Blagosklonov (1960), Flyorov (1970), and Kohanov & Bianki (1986).

The paper presents materials on the species's abundance thereafter and information about the White-tailed Sea Eagle impact on another red-listed species, the Common Eider *Somateria mollissima* (species subject to biological surveillance in the Russian Federation and the Murmansk region). The paper is based on data contained in the Kandalaksha reserve Nature Chronicles for years 1978–2005. Data on the White-tailed Sea Eagle abundance come from direct observations over breeding and nest site occupancy control by the reserve research staff, as well as from accidental contacts registered by any staff working in the field. Material on the species diet is limited to observations of actual hunting activity and information about prey remains found during annual counts of breeding seabirds on islands in the reserve (see study area map in fig. 1). Data on the abundance and breeding success of the Eider were also obtained during these counts.

Data for the Nature Chronicles were gathered by researchers from the reserve, V. Bianki, N. Boyko, A. Koryakin and E. Shutova (areas at the head of the Gulf of Kandalaksha), V. Kohanov and A. Panarin (Vachev Archipelago, Lake Velikoye area, Kemludy Archipelago), F. Shklyarevich and N. Panarina (Porja Guba Bay area), as well as by reserve rangers, of whom the most valuable observations were made by V. Voshchikov. Students from various higher educational institutions and schoolchildren from young naturalist groups took part in seabird counts. The authors would like to thank all of them.

The White-tailed Sea Eagle abundance in the Gulf of Kandalaksha area has been growing rapidly since the mid-1980s, as clearly indicated by accidental registrations (fig. 2; see fig. 3 for total distribution of contacts by months). The number of breeding pairs started to increase later, in the early 1990s (tab. 1; minimal abundance estimates are given). The distribution of nest areas (fig. 1) changed little,

Table 1. Number of breeding pairs of the White-tailed Sea Eagle *Haliaeetus albicilla* on the Gulf of Kandalaksha, 1978–2005.

Year	Areas of the Kandalaksha reserve					Karelian Coast	Kandalaksha Coast	Total
	Oleniy Archipelago	Severnyi Archipelago	Tarasikha Archipelago	Kovdskiy Peninsula	Velikiy Island			
1978				2		2	n/d	4
1979				2	1	2	n/d	5
1980				1	2	2		5
1981				2	1	1	1	5
1982		1		1	1	1	1	5
1983		1		1	1		1	4
1984				1	2	1	1	5
1985		1		1	2			4
1986		1			2		1	4
1987		1			2		2	5
1988				1	1		2	4
1989		1			2		2	5
1990					2	1	1	4
1991					2	1	1	4
1992		1			2		3	6
1993	1	1			2		3	7
1994	1	1			3		3	8
1995	1	1		1	2		3	8
1996	1	1		1	2		2	7
1997	1	1		1	1		2	6
1998	1	1		1	1		2	6
1999	1	2		1	1		2	7
2000	1	2	1	1	2		2	9
2001	1	3		1	2		1	8
2002	1				1		1	3
2003		2		2	1	2	1	8
2004	1	3		1	1		1	7
2005	1	3		2	2	2	2	12

Note: empty cell = 0; n/d = no data

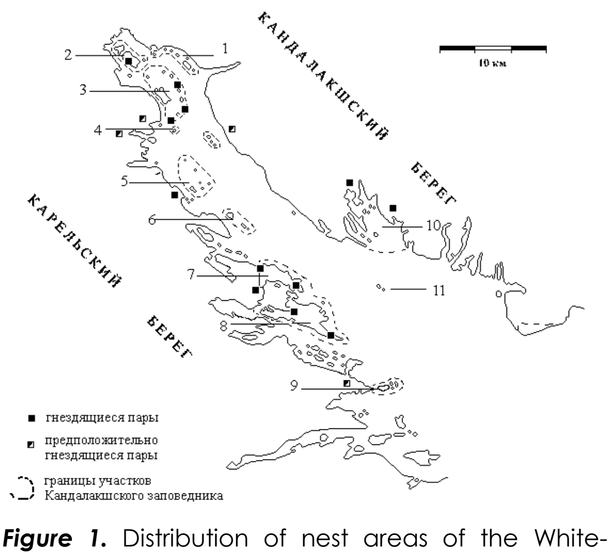

Figure 1. Distribution of nest areas of the White-tailed Sea Eagle *Haliaeetus albicilla* in the Gulf of Kandalaksha, 2005 (black – verified breeding).
1 – Luvenga Archipelago, 2 – Oleniy Archipelago, 3 – Severnyi Archipelago, 4 – Knyazhegubskaya Sedlovataya Island, 5 – Tarasikha Archipelago, 6 – Vachev Archipelago, 7 – Kovdskiy Peninsula, 8 – Velikiy Island, 9 – Kemludy Archipelago, 10 – Porja Guba Bay, 11 – Sredniye Ludy Archipelago.

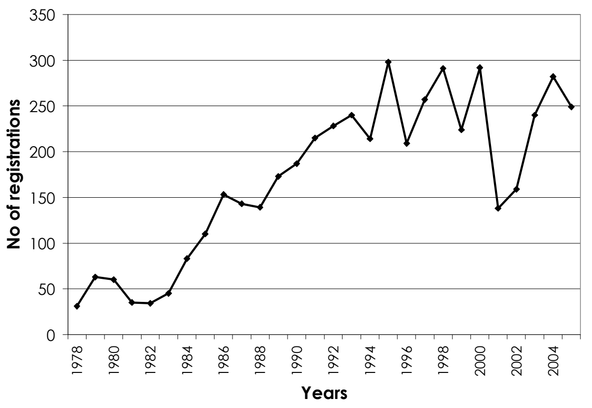

Figure 2. Number of registrations of the White-tailed Sea Eagle *Haliaeetus albicilla* in the Gulf of Kandalaksha, 1978–2005 (n = 4792).

most of them known since the 1950s–1970s (Flyorov 1970, Kohanov & Bianki 1986), but the nest occupancy rate increased, this being particularly obvious from the very top of the Gulf (Oleniy and Severnyi archipelagoes), where direct evidence is available for most breeding attempts (tab. 2).

Table 2. Number of breeding pairs of the White-tailed Sea Eagle *Haliaeetus albicilla* on the Oleniy and Severnyi archipelagoes, Gulf of Kandalaksha, 1978–2005.

Year	Oleniy Archipelago	Severnyi Archipelago			Total
	Oleniy Isl.	Malaya Demenikha Isl.	Malyi Lomnishnyi Isl.	Kruglyi Isl.	
1978					0
1979					0
1980					0
1981					0
1982			1		1
1983				1	1
1984					0
1985				1	1
1986				1	1
1987				1	1
1988					0
1989				1	1
1990					0
1991					0
1992			1		1
1993	1		1		2
1994	1			1	2
1995	1			1	2
1996	1			1	2
1997	1			1	2
1998	1			1	2
1999	1	1	1		3
2000	1	1	1		3
2001	1	1	1	1	4
2002	1				1
2003		1		1	2
2004	1	1	1	1	4
2005	1	1	1	1	4

Note: empty cell = 0

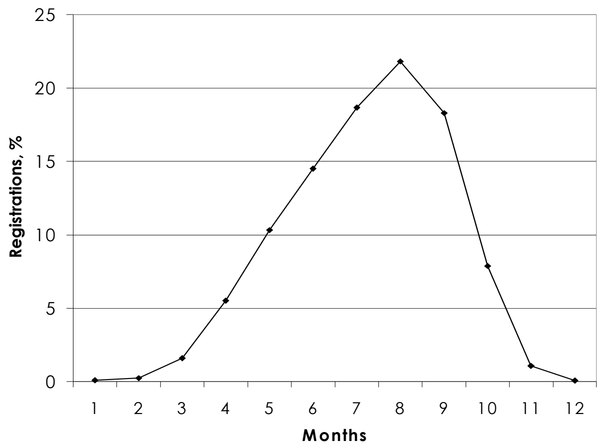

Figure 3. Distribution of the White-tailed Sea Eagle *Haliaeetus albicilla* registrations in the Gulf of Kandalaksha by month, 1978–2005 (n = 4792).

The diet of the White-tailed Sea Eagles in the Gulf of Kandalaksha area is known to include dozens of bird, mammal and fish species (Flyorov 1970). Judging by the remains of birds taken by Sea Eagles on islands (1996–2005; combined data on Severnyi, Kibrinskiy, Tarasikha archipelagoes and Knayzhegubskaya Sedlovataya Island), the species preys mostly on incubating Eiders (males contribute no more than 1–2%), which account for 50–90% (78% on average) of the total number of all prey (tab. 3). Variations among years are related first of all to changes in the proportion of Herring Gull *Larus argentatus* and Common Gull *L. canus* chicks in the ration. Clear preference for incubating Eiders is seen also when the spatial aspect of the data is analysed: the proportion of Eiders drops sharply only when there is plenty of even more easily taken and vulnerable prey – large chicks in the Great Cormorant *Phalacrocorax carbo* colony on Sredniye Ludy islands (tab. 4).

The information above concerns Sea Eagle hunting on islands during the breeding season of abundant seabird species. Observations of actual hunting of Sea Eagles over water yield a similar picture – 66% of all prey is Common Eider females and yearlings (tab. 5).

Naturally, the predation impact on prey species populations increases alongside with the White-tailed Sea Eagle population growth. As the frequency of Sea Eagle occurrence in the Gulf of Kandalaksha area increased, the amount of Eider remains found during surveys on islands started growing as well (fig. 4, 5). An overwhelming majority of the birds were killed for sure by the White-tailed Sea Eagle.

Table 3. Diet (%, no. of individuals) of the White-tailed Sea Eagle *Haliaeetus albicilla* in the head of the Gulf of Kandalaksha determined from prey bird remains, 1996–2005.

Species			Year										
			1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	1996–2005
Goldeneye	*Bucephala clangula*	ad		0.5			0.9						0.2
Common Eider	*Somateria mollissima*	♂ ad	1.8	0.5		0.6	0.6	1.3	1.9	0.9	1.0	2.9	1.2
		♀ ad	83.7	70.4	89.4	90.5	64.5	80.6	52.4	74.7	92.6	80.9	77.0
Common Scoter	*Melanitta nigra*	ad								0.5			0.0
Willow Grouse	*Lagopus lagopus*	ad		1.0									0.1
Capercaillie	*Tetrao urogallus*	ad		0.5						0.5			0.1
Oystercatcher	*Haematopus ostralegus*	ad	2.3	2.5	0.6	2.2	2.1	3.0	0.9		0.5	1.1	1.5
Herring Gull	*Larus argentatus*	ad	10.0	13.3	8.9	2.2	5.9	8.4	8.0	15.4			7.1
		juv		3.4			20.1	2.5	22.2	6.3		4.0	6.7
Common Gull	*Larus canus*	ad	2.3	7.9	1.1	4.5	5.9	4.2	5.2	1.4	0.5		3.4
		juv							9.4	0.5	5.4	11.2	2.8
	Total	%	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
		n	221	203	180	179	338	237	212	221	203	277	2271

Table 4. Diet (%, no. of individuals) of the White-tailed Sea Eagle *Haliaeetus albicilla* in different localities on the Gulf of Kandalaksha determined from prey bird remains.

Species			Locality						Total
			Severnyi Archipelago	Knyazhegubskaya Sedlovataya Isl.	Kibrinskiy Archipelago	Tarasikha Archipelago	Porja Guba Bay	Sredniye Ludy Archipelago	
Great Cormorant	*Phalacrocorax carbo*	juv						92.7	1.6
Goldeneye	*Bucephala clangula*	ad	0.3						0.2
Common Eider	*Somateria mollissima*	♂ ad	1.6	1.1	0.4	0.4	0.9		1.2
		♀ ad	71.3	90.1	89.5	81.1	98.2	7.3	76.8
Common Scoter	*Melanitta nigra*	ad	0.1						0.0
Willow Grouse	*Lagopus lagopus*	ad	0.1						0.1
Capercaillie	*Tetrao urogallus*	ad	0.1						0.1
Oystercatcher	*Haematopus ostralegus*	ad	2.3		1.2	0.2			1.4
Herring Gull	*Larus argentatus*	ad	7.5	3.3	6.6	7.3	0.9		6.6
		juv	7.5	5.0		8.8			6.3
Common Gull	*Larus canus*	ad	4.3	0.6	2.3	2.2			3.1
		juv	4.7						2.6
Total		%	100.0	100.0	100.0	100.0	100.0	100.0	100.0
		n	1341	181	258	491	111	41	2423
Study period			1996–2005	1996–2005	1996–2005	1996–2005	1996–2004	1996–1997	

Note: empty cell = 0.

Table 5. Diet of the White-tailed Sea Eagle *Haliaeetus albicilla* in the Gulf of Kandalaksha determined by visual observations of successful attacks, 1997–2004.

Species			N	%
BIRDS	AVES			
Great Cormorant	*Phalacrocorax carbo*	ad	1	1.5
Wigeon	*Anas penelope*	juv	1	1.5
Goldeneye	*Bucephala clangula*	ad	5	7.7
Common Eider	*Somateria mollissima*	♀	29	44.6
		juv	14	21.5
Goosander	*Mergus merganser*	ad	2	3.1
Oystercatcher	*Haematopus ostralegus*	ad	2	3.1
Herring Gull	*Larus argentatus*	ad	2	3.1
Herring Gull	*Larus argentatus*	juv	6	9.2
Common Gull	*Larus canus*	ad	1	1.5
Hooded Crow	*Corvus corone*		1	1.5
FISHES	PISCES			
Cod	*Gadus morhua*		1	1.5
		Total	65	100.0

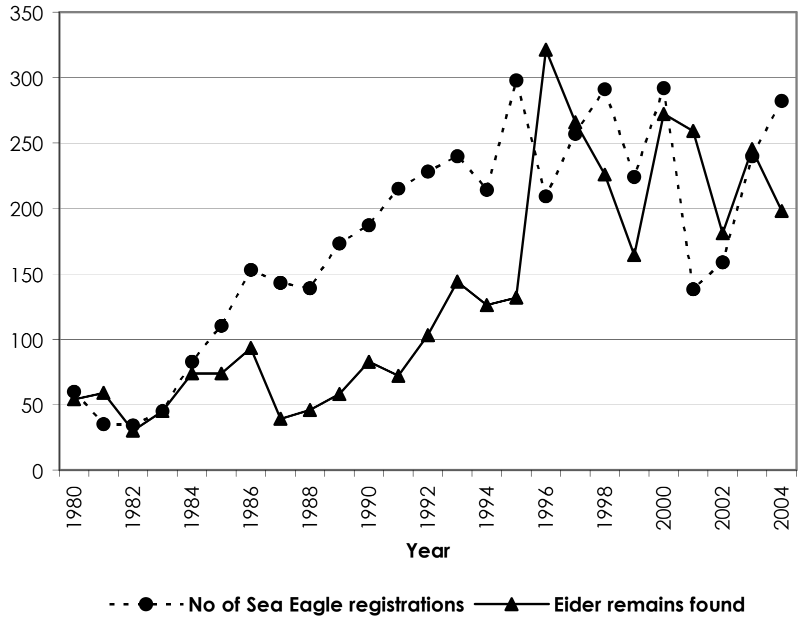

Figure 4. Changes in the number of the White-tailed Sea Eagle *Haliaeetus albicilla* registrations and number of Common Eider *Somateria mollissima* remains found on breeding islands in the Gulf of Kandalaksha, 1980–2004.

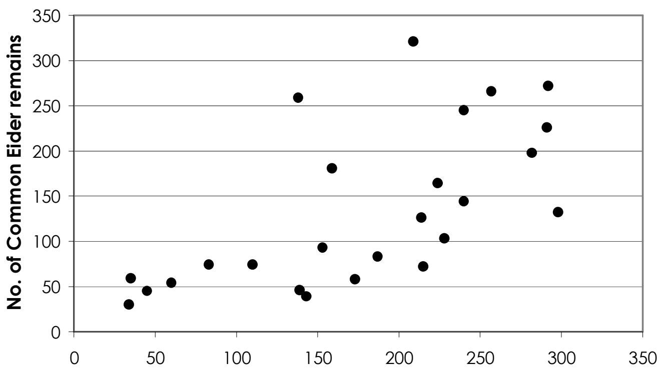

Figure 5. The number of White-tailed Sea Eagle *Haliaeetus albicilla* registrations related to the number of Common Eider *Somateria mollissima* remains found on breeding islands in the Gulf of Kandalaksha, 1980–2004
($r = 0.64$; $p < 0.001$).

Other predators, namely the Goshawk *Accipiter gentilis*, mink *Mustela vison*, red fox *Vulpes vulpes*, and brown bear *Ursus arctos*, may also prey on Eiders, but the scope of their impact is markedly lower than that of the White-tailed Sea Eagle.

Another very significant consequence of Sea Eagle hunting in breeding colonies is an increase in the mortality of Eider clutches. During Sea Eagle hunts, many females leave their nests, and the clutches fall easy prey to Herring and Great Black-backed Gulls *Larus marinus*, Ravens *Corvus corone* and Hooded Crows *Corvus cornix*. As a result, not only the clutch of the female taken by the Sea Eagle but also neighbour ones are lost. The clutch mortality rate in the Eider has lately been growing parallel to the rate of female loss to predation by Sea Eagles (index used is the number of killed females per 1000 inspected nests, ‰; fig. 6, 7).

We are not considering long-term consequences of growing Sea Eagle predation for the status of the Eider population now. Let us just note that one must not neglect them. Today already, predation has a sure impact not only on the survivorship of adult females, but also on the population's reproductive rate. In the 1930s, when the Kandalaksha reserve was designated, the population was undergoing a depression caused by persecution by humans, and the birds could breed successfully only on forested islands of the Severnyi Archipelago, where nests were mostly scattered around. By the 1980s, as a network of reserved areas has been established in the Gulf of Kandalaksha, Eiders recovered the breeding areas they had lost and started breeding in colonies on treeless islands in increasing numbers (Koryakin et al. 1989). The predation impact in the period was low, and the population was thriving. In the 1990s, the total predation pressure started to increase. The number of foxes and bears staying on forested islands in summer increased. They hardly ever take adult birds, but destroy accessible clutches instead, thus inducing, first of all, redistribution of Eiders within breeding areas. So far, their impact at the Gulf level is of local scope.

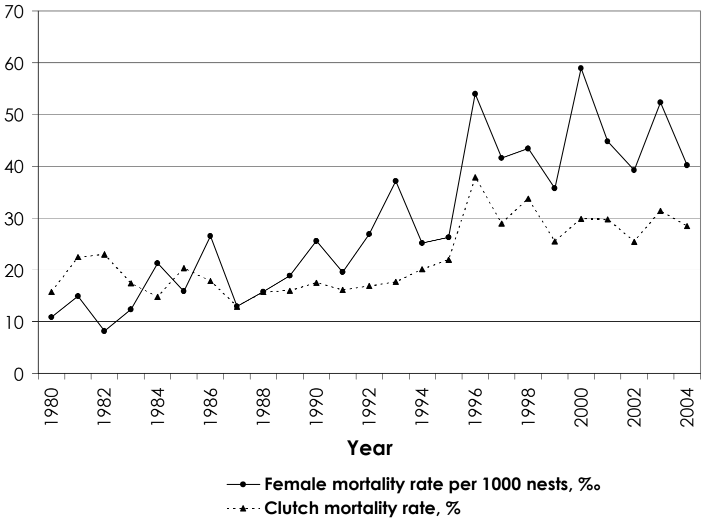

Figure 6. Changes in female mortality rate in the Common Eider *Somateria mollissima* due to predation by the White-tailed Sea Eagle *Haliaeetus albicilla,* and in Eider clutch mortality rate in the Gulf of Kandalaksha, 1980–2004.

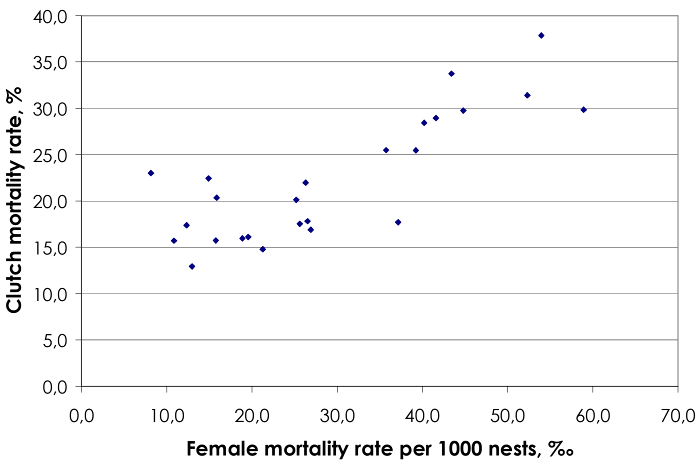

Figure 7. Female mortality rate in the Common Eider *Somateria mollissima* due to predation by the White-tailed Sea Eagle *Haliaeetus albicilla,* and Eider clutch mortality rate in the Gulf of Kandalaksha, 1980–2004 ($r = 0.81$; $p < 0.001$).

A new phenomenon that has appeared at the head of the Gulf in the past decade is predation by the American mink, which is capable of taking an adult Eider and destroying clutches. This predator's impact is now insignificant, although it may seriously destabilize the situation on some islands. Luvengskiy and Oleniy archipelagoes, which adjoin human settlements, feature a notably increased abundance of corvids, which raise clutch mortality significantly, especially if incubating Eiders get flushed. Corvids prey predominantly on forested islands since treeless islands usually have breeding colonies of gulls, which can drive both Hooded Crows and Ravens away. All the predators mentioned above, with an addition of the relatively rare Goshawk *Accipiter gentilis*, have promoted the tendency for the shift of Eider breeding grounds to the safer treeless islands. In total, the activity of predators, including large gulls, normally causes a loss of 15–20% of Eider clutches and no more than 1% of incubating females. White-tailed Sea Eagles hunt mostly on treeless islands, where most Eiders still nest. The raptor causes the death of another 15–20% of clutches and 5–10% of breeding females. It takes also large chicks. Thus, the Sea Eagle predation impact on the Common Eider population is now greater than the combined impact of all the other predators.

Let us note in conclusion that the rise in the abundance of the White-tailed Sea Eagles in the Gulf of Kandalaksha is probably related to changes in the circumstances in their wintering grounds in southwestern Europe. Cessation of persecution of raptors all around Europe, stepwise resolution of the pesticide pollution problem, and effective conservation of overwintering waterfowl concentration sites in western Europe could not but tell positively on reproduction of raptors, including the White-tailed Sea Eagle.

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RESEARCH ON CONSERVATION BIOLOGY OF THE GYRFALCON *FALCO RUSTICOLUS* IN NORTHERN FENNOSCANDIA: PRESENT STATUS AND FUTURE PROSPECTS

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Recent research and future research needs of the Fennoscandian Gyrfalcon populations for conservational purposes are reviewed. At present we have a much better knowledge on population size, annual fluctuations in pair numbers and breeding productivity in large study areas than in former decades, because the national monitoring projects have been intensified considerably in northern Finland, Sweden and Norway. Although many aspects of the ecology of the Gyrfalcon are better understood than 10–15 years ago, there remains still serious gaps in our knowledge especially on the viability of the populations, and on the key environmental factors related to the natality, mortality and dispersal of the Gyrfalcons in different parts of northern Fennoscandia. Preliminary re-evaluation of old data sources from the 19th century indicate a probable exaggeration of the decline of the Gyrfalcon´s population in former studies. The article presents also a new integrated project for more intensive monitoring and conservation of the Fennoscandian Gyrfalcon populations.

Key words: Gyrfalcon, conservation, population changes, Fennoscandia.

ИССЛЕДОВАНИЯ ПРИРОДООХРАННОЙ БИОЛОГИИ КРЕЧЕТА *Falco rusticolus* В СЕВЕРНОЙ ФЕННОСКАНДИИ: СОСТОЯНИЕ И ПЕРСПЕКТИВЫ. П. Коскимиес. Кирккконумми, Финляндия.

В статье дан обзор исследований последних лет и обоснована необходимость дальнейших исследований популяций кречета в Фенноскандии в природоохранных целях. В последнее время все более активно ведутся национальные проекты по мониторингу вида на севере Финляндии, в Швеции и Норвегии. Многие аспекты экологии кречета стали нам более понятны, чем 10-15 лет назад, но осталось немало серьезных пробелов в наших знаниях, особенно в том, что касается жизнеспособности популяций и основных факторов окружающей среды, обуславливающих рождаемость, смертность и расселение кречетов в различных частях северной Фенноскандии. Представлены последние данные о размере, межгодовых колебаниях численности и продуктивности популяций. Предварительная оценка литературных источников по 19 веку говорит о том, что в прежних исследованиях сокращение популяции кречета, вероятно, преувеличивалось. Кроме того, в статье представлен новый комплексный проект по более интенсивному мониторингу и охране популяций кречета в Фенноскандии.

Ключевые слова: кречет, природоохранная биология, Фенноскандия.

INTRODUCTION

The Gyrfalcon has a long and exceptional history in connection with man. It was the most valued raptor species among falconers at least since the beginning of the second Millennium. In his famous book, *De Arte Venandi cum Avibus*, Frederick II of Hohenstaufen (ca. 1248) praised the bird as follows (translated by Wood & Fyfe 1943): "Out of respect for their size, strength, audacity, and swiftness, the gerfalcons shall be given first place in our treatise". He continued that the Gyrfalcon "…holds pride of place over even the Peregrine in strength, speed, courage, and indifference to stormy weather". The falcons came from "… a certain island lying between Norway and Gallandia, called in Teutonic speech Yslandia", and "… in our experience the rare white varieties from remote regions are the best". Olaus Magnus (1555) tells the Gyrfalcon to be so strong and furious that it rushes to hunt up to five Common Cranes *Grus grus*, and it does not stop until it has killed them all.

From the 14th to the 18th century Denmark ruled northeastern Atlantic with varying success. With the help of Dutch falconers, the Danish court organized an effective trade of Gyrfalcons from Iceland and northern Scandinavia to Copenhagen especially in the 17th and 18th century (Oorschot 1974, Vaughan 1992, Christensen 1995). Gyrfalcons, and especially the Greenlandic white morph birds migrating to Iceland for winter, became gifts of the first rank from Danish kings to other European courts, for making peace and other diplomatic purposes. Russian tsars had a similar monopoly of falcon trade in northwestern Russia.

From 1664 to 1806, for example, much over 6 200 Gyrfalcons were exported from Iceland to Copenhagen, less than 10% of them of the white morph (Oorschot 1974, Christensen 1995). The number of falcons fluctuated considerably, with peaks ca. every tenth year. This cyclical fluctuation most probably reflected population changes of the main prey in Iceland, the Ptarmigan *Lagopus mutus* (Nielsen & Pétursson 1995). This statistics is the oldest time-series of mutual fluctuations of a prey and a predator documented in a scientifically accurate manner.

In addition to falconers, egg-collectors valued Gyrfalcons over other northern birds in the early decades of the scientific ornithology (e.g. Newton 1864–1907). In northern Fennoscandia, in the late 19th and early 20th century, hundreds of falcon clutches were taken by tens of collectors who employed local people for intensive "egg-hunting" of all northern birds (e.g. Wibeck 1960).

Long-lasting and large-scale trapping of Gyrfalcons and collecting of their eggs are thought to have caused a serious population decline since the 19th century in northern Fennoscandia (e.g. Cade et al. 1998). In addition, Willow Grouse *Lagopus lagopus* and Ptarmigan populations are possibly markedly smaller nowadays than decades ago, which is said to have a negative effect on falcons´ food supply (e.g. Tømmeraas 1994, Holmberg & Falkdalen 1996).

Because of these and many other threats, the Gyrfalcon has been classified as endangered all over the European range (Koskimies 1999, 2006, BirdLife International 2004). The European Union regards the Gyrfalcon as a priority species in need of special conservation concern (listed in Annex I of EU Birds Directive).

In recent years, research on the Fennoscandian populations has given much new data to re-evaluate the conservational status of the Gyrfalcon, as well as to plan more effective management methods than previously. In this article I discuss the present status of the Fennoscandian Gyrfalcon population and its long-term changes. I also review recent studies and future research needs.

Experience and results from monitoring studies in Finland, Norway and Sweden can be applied also in northwestern Russia to widen our knowledge of this top-predator, one indicator on the status of the Subarctic and Arctic food webs and ecosystems. For a modern review of the general ecology of the Gyrfalcon, the reader should look especially for Clum & Cade (1994), Cade et al. (1998) and Potapov & Sale (2005).

MONITORING PROJECTS IN NORTHERN FENNOSCANDIA

Finland

Long-term quantitative changes of bird populations have been monitored in Finland with a comparable methodology since the beginning of the 20th century (e.g. Merikallio 1958, Koskimies 1989a, Väisänen et al. 1998). The Finnish bird monitoring system (Koskimies 1987, 1989b, Koskimies & Väisänen 1991) has been founded on long-lasting, representative and nation-wide censuses of all bird groups, including a special mapping project for birds of prey (e.g. Honkala & Saurola 2006, Saurola 2006).

Due to the low breeding density and uneven distribution, the Gyrfalcon can not be monitored either by ordinary bird census methods or those used for common raptors, with voluntary bird ringers and bird-watchers looking for all raptor nests in 10x10 km sample grids (e.g. Saurola 2006). To get reliable results of the Finnish Gyrfalcon population of only 20–35 pairs (Koskimies 1999), annual monitoring must cover all territories and nest-sites.

In the beginning of the 1990s I started a special project to search for and monitor Gyrfalcon´s nest-sites, and to study the ecology of the species for conservational purposes. The Finnish population was poorly known up to that time. For years I collected data on nest-sites from various sources and checked hundreds of cliffs. It took nearly ten years to localize most of the nest-sites in Finland by walking and skiing, and to learn details on the ecology and ethology of the Gyrfalcon necessary for effective monitoring. It was necessary to learn also geology, geography as well as history of Lapland and its fauna.

In the late 1990s also Metsähallitus, responsible governmental authority for conservation and monitoring of threatened animals and plants in state-owned lands in Lapland, started to map Gyrfalcon´s nest-sites for site-specific conservation activities (Mela & Koskimies 2006). Since then, it was possible to join our efforts and resources to control all nest-sites several times a year and look for new ones in a more intensive way.

Since the year 2000 I have worked systematically also in northernmost Sweden (north of the River Lainio–Lake Råstojavri), and in eastern Finnmark, which were not covered by Swedish and Norwegian monitoring projects, respectively. In addition to enlarge my study area for more reliable results, an important reason was the fact that many "Finnish pairs" have alternative nest-sites beyond our borders.

Sweden

In Sweden, ornithologists became more interested in systematic population monitoring locally in the 1980s (e.g. Lindberg 1983). The free hunting of *Lagopus sp*. and other small game raised worries on its possible impact on Gyrfalcons´ prey base (Holmberg & Falkdalen 1996).

The longest ongoing project for monitoring Gyrfalcons in Sweden started in the counties of Jämtland, Härjedalen and Dalarna, Central Sweden, in the year 1994 by the Sveriges Ornitologiska Förening (the Swedish Ornithological Society). The population is estimated at 24–37 breeding pairs, monitored annually by 20 voluntary bird-watchers (Falkdalen 2004, Falkdalen et al. 2005).

Further north in Norrbotten, covering half of the Swedish fjell area and Gyrfalcon range, a monitoring project began in 1996, funded by private funds and environmental authorities (Ekenstedt 2004, 2006a, 2006b, Falkdalen et al. 2005). During the first four years birds were monitored in two subareas, one with free access for hunters, the other including vast national parks where hunting is forbidden. Since 2000, the whole county has been covered up to the River Lainio in the north. In total, 42–51 pairs have been estimated to breed in Norrbotten.

The remaining part of the Swedish Gyrfalcon range, Västerbotten, has been covered since 2000 in a monitoring project run by the local environmental administration (Danielsson 2004, Falkdalen et al. 2005). The number of occupied territories varied from 12 to 21 in 2000–2004, but many breeding pairs have probably remained unnoticed so far due to the short time span of the project.

Norway

As in Finland and Sweden, many egg-collectors and local ornithologists collected information on the occurrence of the Gyrfalcon in various parts of Norway in the 1800s and early 1900s (e.g. Collett 1921). Special studies of the species were started by Hagen (1953) in southern Norway. Since the late 1960s, Per J. Tømmeraas (e.g. 1993, 1998) specialized on the species especially in northernmost Norway. His field studies have been continued in Alta and Kautokeino, western Finnmark, by Kenneth Johansen and Arve Østlyngen with co-workers (Johansen & Østlyngen 2004).

A very active monitoring project has also been started in recent years in Troms county, west of Alta–Kautokeino study area (Johnsen 2004, Karl-Birger Stann & Trond Johnsen unpublished). A major contribution of the project, also for widening knowledge on the general ecology and conservation status of the Gyrfalcon, is the inventory of nest-sites in the archipelago and along the coast of the Atlantic Ocean from Troms county to Finnmark. Seaside habitats, providing high numbers of seabirds as prey for falcons the year round, have not been studied before in such a large scale and with similar intensity.

Regional monitoring has been started also in Nordland, south of Troms county. Tømmeraas (1998) estimated the population in Nordland as 48–65 pairs, in Troms county 29–53 pairs, and in Finnmark 60–81 pairs. Karl-Birger Strann (unpublished) estimated the average numbers in autumn 2005 similarly as 50 pairs in Nordland and 70 pairs in Finnmark, but 100 pairs in Troms county. According to the newest data these estimates may be too low.

As my study area covers inland of eastern Finnmark, and the inventories by Strann, Johnsen, Østlyngen, Johansen and their co-workers cover the rest of Finnmark, Troms county and Nordland, we will have the whole population of northern Norway monitored in a comparable manner within the coming years. Further south in Norway, there has been some local monitoring projects of more limited scale. One of the longest and most intensive has been running in Telemark (Frydenlund-Steen 1998, Frydenlund-Steen & Sørli 2005).

FIELD METHODS OF GYRFALCON MONITORING IN FINLAND

Monitoring of population size and productivity

All the Fennoscandian projects aim to monitor primarily the annual numbers of territorial Gyrfalcon pairs, and the numbers of nestlings produced. These parameters are meant to measure the size, trend, conservational status and productivity of the populations. As they are in central focus in most raptor studies all over the world, general methods for raptor field studies have been applied (e.g. Postupalsky 1974, Pendleton et al. 1987).

In detail, however, field work must be suited for the ecology, behavioural traits, observability and other species-specific properties, as well as environmental factors of the study areas. A few methodological details applied in Finland will be discussed briefly. Similar methods in controlling of nest-sites have been used in Sweden and Norway to guarantee comparability of our results (e.g. Ekenstedt 2006a, 2006b). In the following chapters I will present also the methods I use for documenting the quality of nest-sites, collecting prey remains, and measuring availability of food.

Controls of nest-sites

Gyrfalcon nest-sites and potentially suitable cliffs with Raven *Corvus corax* nests have been looked for and controlled all the year round. Observations from other people have been useful for continuous up-dating of the data base of available nest-sites (c.f. Mela & Koskimies 2006).

The falcons visit nest-sites throughout the year. Occupied territories can be identified from signs left by the birds. In addition to falcons, special interest has been paid to human traces in the neighbourhood of the nest-sites. If visitors are supposed to come to a site intentionally, for the sake of the Gyrfalcon, at any time of the year, their motives have been inspected.

In recent years, regularly occupied nest-sites and home ranges have been visited several times in February and March, to get information on both breeding and non-breeding pairs and lone birds, either territorial or wandering individuals ("floating population").

All territories have been controlled systematically in the first standard visit in mid or late April, during egg-laying or early incubation, to confirm the number of pairs starting to nest (see Postupalsky 1974). The nests have been checked by binoculars or telescopes further away to avoid disturbance. If birds are not present, alternative nest-sites have been visited. Faeces, prey remains, down, traces in snow, and all other kind of signs of the presence of falcons have been recorded according to a detailed protocol. Active nest-sites have been controlled at irregular time-table also later from April to June especially to warden them against intentional or un-intentional disturbance, and both authorities and local people monitor moving of people in nesting areas to prevent disturbance.

The second standard visit to active nest-sites has been made in mid or late June, to count the nestlings, which are then usually 5–7 weeks old, and will fledge with high certainty within 0,5–2 weeks. If climbing does not take a long time and disturb the birds too much, the nestlings have been ringed with ordinary metal rings and special colour rings, the codes of which could be read with telescope from longer distance.

Parent birds at site during controls have been photographed and video-filmed, and their behaviour and appearance have been described in detail for individual recognition. This material is used to monitor site-tenacity and pair fidelity of nesting adults, and to get a rough estimate of population turnover. Recording voices is also under consideration as a non-invasive technique for separating individuals from each other. Moulted feathers have been collected at nest-sites for a forthcoming DNA analysis on individual identity, started by Johan Ekenstedt in Umeå University (unpublished). Nest-controls give also data on timing of nesting, quality of nest-sites, cause of unsuccessful nesting, and other topics on breeding biology.

Successful nest-sites have been visited in late summer or early autumn to confirm fledging of young, by inspecting signs left by them. At the same time, the neighbourhood of the nest-sites have been checked thoroughly for looking for prey remains and possible human traces.

Estimating quality of nest-sites

Availability of high-quality nest-sites is a necessary prerequisite for successful breeding of the Gyrfalcon (Koskimies 1999). Falcons prefer twig-nests built by Ravens, on ledges of abrupt cliff walls safe from mammalian predators. Almost all nests have a rocky overhang for protecting the nest from snowfalls and rain.

If optimal Raven nests are not available in a territory, some pairs have accepted Rough-legged Buzzard *Buteo lagopus* and Golden Eagle *Aquila chrysaetos* nests. Those nests usually do not have an overhang, and they are easier for land predators to access. Some Finnish pairs breed also more or less regularly in twig-nests in pines, especially in eastern Lapland (Cade et al. 1998, Mela & Koskimies 2006).

In spite of the importance of old twig-nests for the Gyrfalcons, no detailed studies have been published so far to describe their availability and quality in an extensive scale in Fennoscandia. In Finland, eastern Finnmark and northern Sweden, I have measured ca. 20 parameters from occupied nest-sites, as well as those Raven nests which have not been used by the Gyrfalcon. In the 1990s I used a simpler method by Barichello (1983), but in recent years I have applied a more sophisticated methodology by Wightman (2001).

According to my preliminary results, quality and safeness of available nests varies considerably. In many parts of the Finnish range there are not very many optimal nest-sites, which has a negative effect on the density and dispersion of the Gyrfalcons. Nest-site distribution may have a stronger effect on Gyrfalcon's distribution than on other cliff-nesting raptors with less strict nest-site requirements (e.g. Newton 1979).

Collecting and analysing of prey remains

Prey remains have been collected in an effective and standard manner both in June, when nestlings are close to fledging, and in early September, when fledglings have left the natal territory (Koskimies & Sulkava 2002). All bones, feathers and other remnants of prey animals have been picked from the nest, from nearby cliff ledges and below them.

Prey remains have been looked for also on top of cliff above the nest, and on cliffs and high terrain opposite to it. Parent birds prefer to sit and guard their nest in those kinds of sites, as well as eat and pluck prey animals before taking it to the nest. Near many nests there are also dead trees, horizontal tree trunks and other kinds of popular sitting places, under which remnants have been searched for. These methods are similar to those used in Icelland in the most thorough study of Gyrfalcon´s food in the world (Nielsen 2003, 2004).

All prey remains have been dried and stored for further analysis. A Finnish expert of the art, Prof. emer. Seppo Sulkava, has identified the specimens and counted the number of individuals (Koskimies & Sulkava 2002).

Monitoring availability of prey

Abundance of the Willow Grouse seem to be a key factor for successful breeding of the Gyrfalcon, in addition to undisturbed nest-sites (e.g. Cade et al. 1998, Koskimies 1999, Potapov & Sale 2005). On average, *Lagopus sp*. form generally over 90% of the Gyrfalcon´s diet throughout the breeding season in many parts of the European range (Koskimies & Sulkava 2002, Nielsen 2004, Nyström et al. 2005). The grouse are almost the only prey for half of the year in Lapland, and at least in Iceland their availability is the most critical factor regulating the proportion of falcon pairs which start to breed in early spring (Nielsen 2003). A similar relationship most probably exists in Fennoscandia.

The total population of the Willow Grouse in Finland has been estimated recently at 60 000–150 000 pairs, and that of the Ptarmigan at 3 000–6 000 pairs (Koskimies 2005). The Willow Grouse is supposed to be much more important prey for the Finnish Gyrfalcons compared to the Ptarmigan, but in higher mountain areas in Sweden and Norway the Ptarmigan is naturally very important (Nyström 2005).

Finnish grouse populations have been monitored annually by special censuses in late summer since the mid-1960s, and with the so called wildlife triangle censuses since the late 1980s (Lindén et al. 1996). Density estimates based on nation-wide line transect censuses exist from the 1940s (Merikallio 1958, Väisänen et al. 1998). Although the Willow Grouse population fluctuates cyclically, in the longer run it has declined in recent decades (Väisänen et al. 1998). During the first years of the 21st century, however, the population in northern Finland recovered locally to the highest level for decades (Helle et al. 2005).

A basic problem with grouse monitoring data for my research purposes is that there are too few census routes in northern Lapland. For that reason I have estimated relative fluctuations of the Willow Grouse population from year to year by recording all grouse seen or heard along my permanent routes to and from the falcon nests. Because I ski during winter and spring, and walk in summer and autumn, I can freely observe all birds the day round. I visit the same falcon territories from year to year, and several times a year in the same manner and along the same routes.

Because weather and time of the day may vary, however, and because these factors have effect on the observability of grouse, the total number of individuals can not be taken as such to indicate the real density of grouse. My statistics, however, can be used to classify each breeding season into categories of abundance (e.g. peaks and lows, as well as years with increasing or declining populations).

Other kind of data may be found to indicate the relative abundance of Willow Grouse in recent decades in northern Lapland. There are still many professional or semi-professional hunters, and they will be interviewed to get additional information on the changes of grouse populations in former years. Northernmost line transects and local bird censuses also give extra knowledge to evaluate fluctuations of grouse populations (Väisänen et al. 1998).

Other prey species do not have such a marked impact on the percentage of breeding pairs, and the number of nestlings they produce (e.g. Nielsen 2003, Nyström et al. 2005). Fledged young, on the contrary, probably hunt commonly other birds like waders, waterfowl, gulls and terns. Information on their abundance in different parts of the range, and in different habitats, are available from general bird censuses. As we do not have good knowledge on prey selection of young and immature Gyrfalcons, however, there remains a problem to evaluate the impact of abundance of various bird species on the survival of falcons.

GYRFALCON POPULATIONS IN NORTHERN FENNOSCANDIA

Number of pairs

I review shortly the recent status of the Gyrfalcon populations in northern Finland, Sweden and Norway, according to the results of the national monitoring projects described above (e.g. Falkdalen et al. 2005, Ekenstedt 2006a, 2006b, Mela & Koskimies 2006, Karl-Birger Strann unpublished). The present population in northern Fennoscandia, from Nordland and Jämtland–Härjedalen in the southwest to Finnmark in the northeast, is estimated at about 330 pairs. A general impression is that earlier population estimates have been too low, especially in poorly inventoried regions.

Comparable data on the number of pairs is available at the moment from Finland and Sweden, from the year 2000 to 2005 (table 1, fig. 1). Except in Västerbotten, field work effort has been at the same general level in all study areas during those years. Thus, the annual variation reflects mostly true natural fluctuations in Gyrfalcon populations. The proportion of successful nests has varied from about 40% to about 70% (fig. 2).

I have also compared preliminarily the density of the Willow Grouses in Finnish Lapland with the number of Gyrfalcon pairs (fig. 3). Grouse densities are based on wildlife triangle censuses in August (Lindén et al. 1996, Helle & Wikman 2006). Most of the data, however, comes from southern Lapland, south of the breeding range of the Gyrfalcon. But also in the north grouse population reached its peak in 2002–2004. Fig. 3 tends to indicate that good grouse years are followed by an increasing number of occupied territories and successfully breeding pairs 2–3 years later, probably when the nestlings raised in good years mature. In Iceland, the number of occupied Gyrfalcon territories was correlated with Ptarmigan density with a 3-year time-lag (Cade et al. 1998). A more critical analysis of our data will be made later.

Table 1. The number of occupied Gyrfalcon territories in Finland and in the three northernmost counties of Sweden in 2000–2005.

Year	2000	2001	2002	2003	2004	2005
Finland	16	23	23	22	31	32
Norrbotten	33	32	35	27	42	37
Västerbotten	12	12	14	15	21	?
Jämtland–Härjedalen	14	19	24	30	26	?
Total	75	86	96	94	120	?

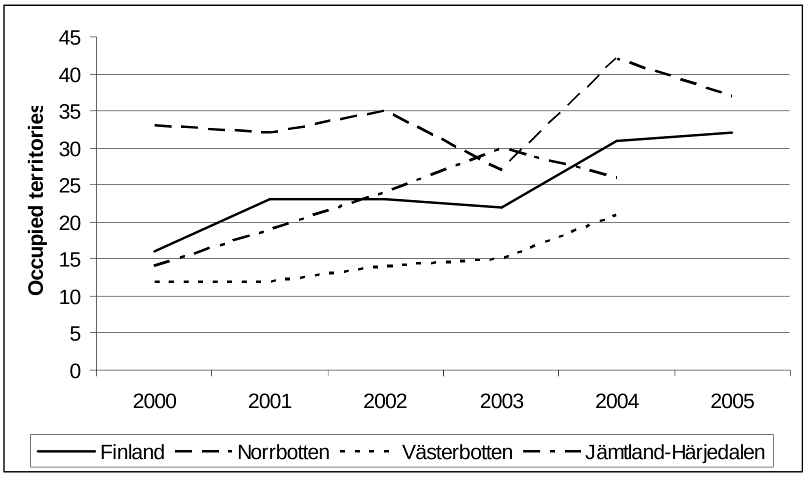

Figure 1. The number of occupied Gyrfalcon territories in Finland and in the three northernmost counties of Sweden in 2000–2005 (for Sweden, in 2005 data available only from Norrbotten).

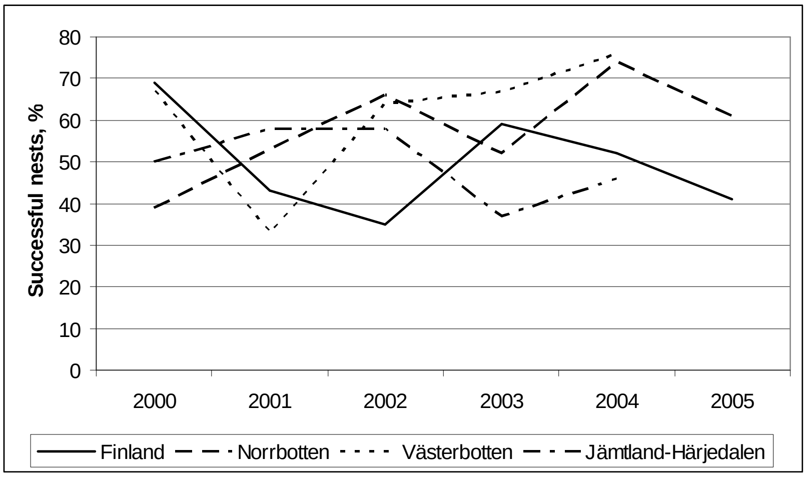

Figure 2. The percentage of successful nests of the occupied Gyrfalcon territories in Finland and in the three northernmost counties of Sweden in 2000–2005 (for Sweden, in 2005 data available only from Norrbotten).

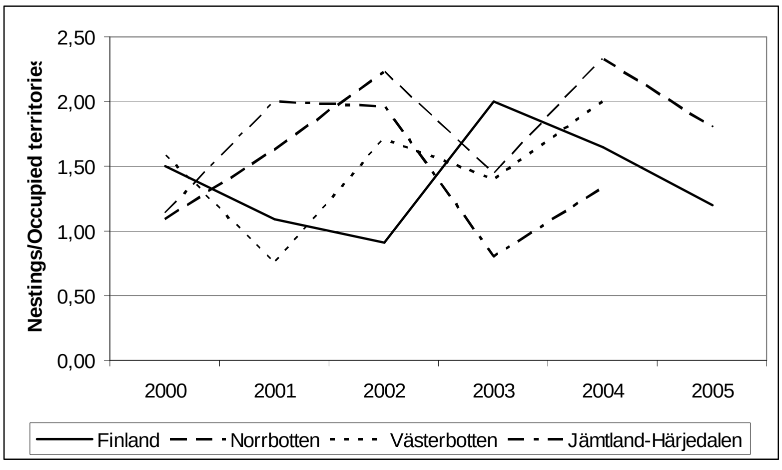

Figure 3. The mean number of big nestlings per occupied Gyrfalcon territory in Finland and in the three northernmost counties of Sweden in 2000–2005 (for Sweden, in 2005 data available only from Norrbotten).

Breeding productivity

The number of big nestlings per occupied territory has varied considerably between study areas and years, from ca. 1.0 in poor years to ca. 2.2 in best years (table 2, fig. 4). The time-series in fig. 4 is too short to make any firm conclusions, but it shows that in such a vast area the best and the worst years are not identical. In addition, the amplitude of annual variation is of the same order of magnitude from region to region. The same holds true also for the average number of big nestlings per successful nest, varying typically from ca. 2.1 to 3.5 (fig. 5).

The density of the Willow Grouse may have some effect on the number of nestlings. The preliminary data from Finland shows a similar time-lag in this respect than in the number of pairs (fig. 6). The same reservations concerning the grouse data must be taken into account than said above.

Table 2. The mean number of big nestlings per occupied Gyrfalcon territory in Finland and in the three northernmost counties of Sweden in 2000–2005.

Year	2000	2001	2002	2003	2004	2005
Finland	1.50	1.09	0.91	2.00	1.65	1.22
Norrbotten	1.09	1.63	2.23	1.44	2.33	1.86
Västerbotten	1.58	0.75	1.71	1.40	2.00	?
Jämtland–Härjedalen	1.44	2.00	1.96	0.80	1.34	?

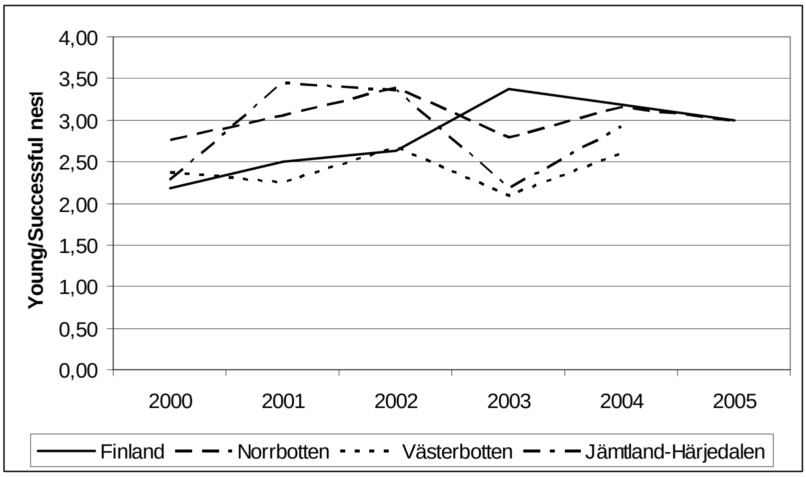

Figure 4. The mean number of big nestlings per successful Gyrfalcon nests in Finland and in the three northernmost counties of Sweden in 2000–2005 (for Sweden, in 2005 data available only from Norrbotten).

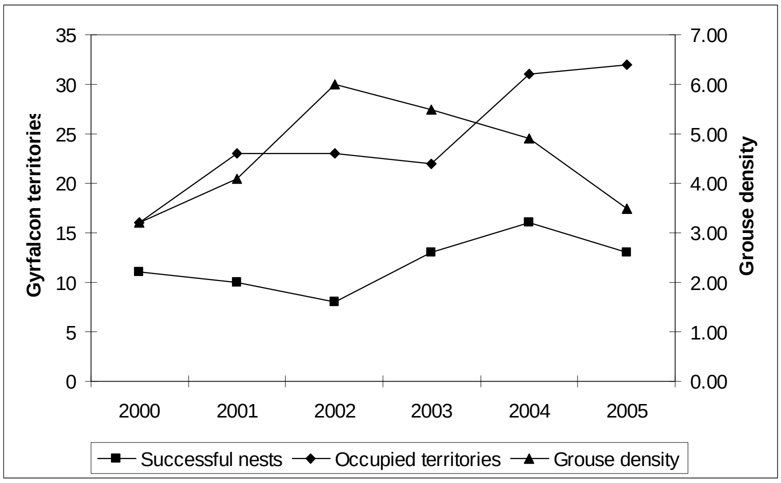

Figure 5. The number of occupied territories and successful nests of the Gyrfalcon in Finnish Lapland in 2000–2005 compared to the mean density of the Willow Grouse (individuals/km^2).

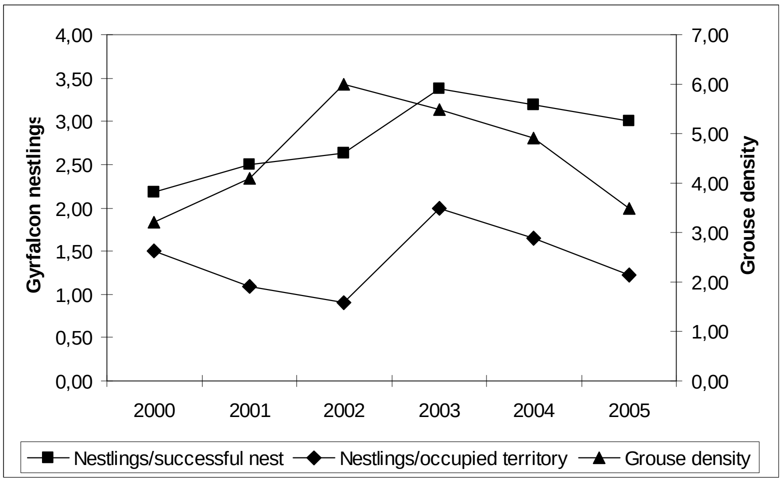

Figure 6. The mean number of big nestlings per occupied territory and successful nest of the Gyrfalcon in Finnish Lapland in 2000–2005 compared to the mean density of the Willow Grouse (individuals/km^2).

LONG-TERM TRENDS OF THE GYRFALCON POPULATIONS

Data sources from past decades

Due to intensive egg-collecting, in parts of northern Fennoscandia the size and density of Gyrfalcon populations can be estimated at some certainty back to 150 years ago (e.g. Newton 1864–1907, Sjölander 1946). For other bird species, quantitative data exist not earlier than in the 1910s and 1920s (Väisänen et al. 1998).

The Gyrfalcon was one of the most highly prized and intensively sought birds among egg-collectors in Lapland. Most Fennoscandian clutches were collected in western Lapland and Finnmark. Collecting was an international business and field of interest, and the eggs taken were dispersed into tens of museums and private collections. Much fewer clutches were collected in eastern and northern Lapland and eastern Finnmark. The majority of the clutches known to me from various sources have been taken from the 1850s to the 1930s. To relocate the origin of them reliably one needs versatile professional knowledge. In addition to abundance of Gyrfalcons, egg-collections give data on clutch size, egg-size and timing of breeding.

Additional data on the occurrence of the Gyrfalcon in Lapland from the late 1800s to the mid-1900s can be found from tens of regional bird faunas, which were based mostly on non-systematic and non-quantitative observations by local or travelling naturalists. The information on all birds breeding in Lapland increased considerably from the 1960s to the 1980s because of markedly increased number of bird watchers. The two atlas projects in 1974–1979 (Hyytiä et al. 1983, Koskimies 1989a), and in 1986–1989 (Koskimies & Väisänen 1991, Väisänen et al. 1998), provided some new information on the occurrence of the Gyrfalcon in Lapland.

Earlier interpretation of population changes

Earlier authors have published more or less anecdotal information indicating a negative trend of both Gyrfalcons and their prey (e.g. Sjölander 1946, Tømmeraas 1993, Cade et al. 1998, Väisänen et al. 1998, Koskimies 1999). I have preliminarily re-thought old data sources more critically, and compared them with my modern knowledge. I doubt that especially Tømmeraas (1993, 1994) exaggerated the population decrease due to invalid methodology and non-representative sampling.

In the early 1990s Tømmeraas (1993) controlled 29 Gyrfalcon nesting sites, which were occupied in western Lapland and Finnmark in the mid-1800s according to egg-collections. Because he found a pair nesting in only three of those cliffs in a single year, and older traces of Gyrfalcon´s in another three sites, he concluded that there were only 19% of the pairs left. He repeated this statement in later publications (Tømmeraas 1994, 1998).

Gyrfalcon pairs do not breed every year, however, especially if the densities of Willow Grouse and Ptarmigans are under a certain limit. In Iceland, for example, the amplitude of variation of the Ptarmigan population has been 4.2, while the amplitude of the Gyrfalcon territorial population has been 1.5, and that of the of Gyrfalcon breeding population 3.6, respectively (Cade et al. 1998). This same data by Ólafur K. Nielsen from 1981 to 1996 shows that, of the 804 observation years for occupied territories, 355 (44%)had no sign of breeding, 72 (9%) had failed breeders, and 377 (47%) had successful breeders. Every year a significant part of the territorial birds remain non-breeding, as confirmed by myself also in Lapland. In addition, during the last 15 years I have found several territories with a breeding pair in only one or two years. They have found a better territory further away, or remained non-breeding, or a lone bird has remained un-paired at the site for years for many possible reasons. Some territories, occupied in the early 1990s, remained without a single sign of a visit by a Gyrfalcon, and then abruptly a pair appeared and started to breed in successive years.

It is common that breeding pairs change often nest-sites, which makes it difficult to monitor the true number of pairs if all suitable nest-sites in the study area are not controlled annually. A high number of pairs have up to 3–5 alternative nest-sites, in many cases up to 10–17 kilometres away (Cade et al. 1998). Those nest-sites used in the mid-1800s may have become unsuitable for several reasons during the past 150 years. Only a thorough search for all available nest-sites within the territories under control could verify whether falcons were breeding in other nest-sites of the same territories or not.

A serious flaw of the straightforward comparison between old data and a single-year check of the traditional nest-sites is also the fact that not all territories within a coherent study area were controlled by Tømmeraas (1993). The nest-sites from old sources were distributed in western Lapland and Finnmark in a region which have more breeding pairs than those inspected; egg-collectors did not find every nest in a certain geographical area. It is possible that the locations of occupied territories have changed during decades for several reasons, and checking only the classical ones does not give reliable information of the total population. Actually, I and the present Norwegian colleagues (Arve Østlyngen, Karl-Birger Strann et al. unpublished) have found that there really exist many other active territories than those controlled by Tømmeraas (1993) in the same area. In addition, for many of the pairs which he did not find 15 years ago, an alternative active nest-site has been found in the very same territories later on. Thus, the Gyrfalcon population has been markedly higher in the early 1990s than suggested by Tømmeraas (1993).

Further methodological aspects for trend re-evaluation

In order to make a methodologically valid and more reliable evaluation of the long-term population trends, a critical researcher must study all available old data sources (egg-collections, archives, literature etc.) from various parts of the Fennoscandian range. Comparison of a group of single nest-sites does not give reliable results, if for some reason or other, a number of nest-sites have changed over the decades. A multi-year data base from both old times and the present is needed to estimate the probable number of breeding pairs and their density in the same geographical areas during several periods in the history, to counterbalance impact of short-term fluctuations on the long-term trend.

One example of a questionable interpretation of the long-term, permanent population decline is based on a comparison of the present densities with those published by Sjölander (1946) from northern Sweden a century ago. His highest densities were recorded in fairly small areas in a peak year of the Norwegian lemming *Lemmus lemmus*. In general, during those years populations of *Lagopus sp*. and other grouse species are also at their peak, because predators concentrate to prey on abundant vole populations. Gyrfalcon populations were probably exceptionally dense during the exceptional lemming years, when, for example, Suomalainen (1912) saw 29 falcon clutches at one dealer in Karesuando, Sweden (see also Cade et al. 1998).

To make a reliable density estimate of the Gyrfalcon, a long study period is necessary. In parts of the study area of Tømmeraas (1993), for example, we have recently found markedly more pairs with a higher density than he found about 15 years ago. Part of the reason is our better knowledge and coverage of the study area and population (see above). In addition, very many new pairs have settled to territories which were unoccupied for years or even decades. Neighbouring pairs have nested in several occasions from five to ten kilometres from each other. The density of the Gyrfalcon has not been higher than that in many parts of the species' range without any human threats and plausible population declines (Clum & Cade 1994, Cade et al. 1998, Potapov & Sale 2005). Tømmeraas (1994) most probably exaggerated also the long-term decline of the Willow Grouse populations. In northern Finland, for example, in 2002–2004 the density of grouse reached temporary peaks comparable to those in the mid-1900s (Helle & Wikman 2002, 2006).

PROSPECTS FOR FUTURE RESEARCH

Research topics

Most researchers of the Gyrfalcon in northern Fennoscandia have focused on the number of nesting pairs and breeding success. This kind of monitoring projects are necessary for conservation and management, but a more versatile research programme is needed to implement effective conservation measures in the future (Koskimies 1999).

When preparing the Action Plan, the world experts of the Gyrfalcon recognized many topics with inadequate knowledge (Koskimies 1999). I have listed those and some additional research needs in table 3, as well as proposed some species-specific management techniques in relation to the same themes (see also Koskimies 2006).

The highest priority in the future research needs should be set to topics which are connected to identifying limiting environmental factors and density regulation of Gyrfalcon populations, and to their ability to renewal. The poorly known parameters include, for example, habitat use, home range and dispersal ecology, genetics of a population and genetic relationships between neighbouring populations, wintering ecology, energetics, pair formation, and integration of immatures into breeding populations.

Table 3. Threats, conservation measures and research needs of the Gyrfalcon (importance in parenthesis according to Koskimies 1999: I = high, II = medium, III = low). This list includes only the most important threats in the Nordic countries and special research needs to study them more properly than at present. In addition, population dynamics of the Gyrfalcon (population size, natality, mortality, movements) should be an integral part of research and monitoring.

Threats	Conservation measures	Research needs
• **Reduced prey numbers** (I) - hunting - degradation of habitat - disturbance - mammalian predators - reindeer fences	* **Grouse conservation** - hunting regulations - protected areas - land use planning - trapping of other predators	* **Food availability** - grouse abundance - effects of hunting - food of falcons
• **Disturbance of nest sites** (I) - snow mobile traffic - ecotourism - hiking - bird watching and photographing - rock climbing	* **Land use planning** - snow mobile routes - tracks, skiing routes - cottages, huts - photography licenses - education - artificial nests	* **Susceptibility to dist.** - quality of nest sites - use of artificial nests
• **Habitat destruction** (II) - new roads - snow mobile routes - tourism infrastructure - cottages - reindeer fences - powerlines	* **Habitat protection** - protected areas - management of other areas	* **Habitat quality** - use of habitat - critical habitat needs
• **Robbing of nests** (II) - egg-collecting - falconry - falcon production in captivity (incl. hybrids)	* **Concealing of nests** - wardening - education - artificial nests	* **Falcon trade** - captive breeding - DNA-identification
• **Shooting adults, destroying nests** (III) - game keeping	* **Education** - wardening	* **Attitudes by public**
• **Reduced Raven nest numbers** (III) - decline of Raven population	* **Artificial nests** - feeding of Ravens	* **Artificial nests** - Raven monitoring - availability of nat. nests
• **Collisions** (III) - reindeer fences - powerlines	* **Land use planning**	* **Susceptibility**
• **Chemical contamination** (III) - long-distance fallout - waterfowl (esp. coastal in winter)	* **Reducing of chemicals**	* **Analysis of chem.**

Intensifying monitoring of natality and mortality, and factors influencing them is of basic importance. One of the most important gaps in our knowledge is the almost total lack of data on survival rates of both adults and young. As changes in mortality have more direct and stronger effect on the number of breeding pairs than changes in natality, information on mortality is essential to analyse more securely the viability of the Fennoscandian populations. Dispersion and site-fidelity, also poorly studied, are closely connected to survival and population turnover, as well as recruitment of new birds into a population.

It seems that the present reproduction will counter the mortality, but we cannot prove it adequately. In addition to demographic factors, there also exist geographic, genetic, habitat-specific, food-specific and other environmental factors, whose impact on the viability of populations we cannot evaluate adequately.

Research on the Gyrfalcon is not solely biology. As many types of human activities have effect on the habitat, food, nest-sites and other key factors in the life of falcons, studies should include also non-biological objects, methods and expertise.

Availability of food

The Gyrfalcon is totally dependent on Willow Grouse and Ptarmigan populations for food during most of the year. Knowledge on grouse population dynamics is very important for Gyrfalcon research and conservation (Koskimies 1999). In Sweden and Norway, ecology of these key prey species has been studied actively for decades (e.g. Steen 1989, Hörnell-Willebrand 2005), but in Finland data is more scanty.

We should know more especially on the critical habitat requirements of grouse in various parts of the Gyrfalcon´s range. Natural and human-caused factors affecting on natality, mortality and dispersal should be studied more carefully. Hunting has at least in some circumtances negative effects on grouse populations (Brøseth et al. 2005, Hörnell-Willebrand 2005), but this problem must be studied more extensively to get truly representative results. Unfortunately, there is only limited information on the possibilities of increasing the density of grouse populations.

Although there is no precise, comparable and quantitative data on the long-term trends of *Lagopus sp*. populations in northern Fennoscandia, some indirect data point to higher peak densities in the late 1800s and the early 1900s (Tømmeraas 1994, Koskimies unpublished). Local and regional variation has been typical for population fluctuations of grouse, and there are both natural and human-induced factors affecting on them. Low densities have been recorded also decades ago.

As Tømmeraas (1994), Holmberg & Falkdalen (1996), Cade et al. (1998), Koskimies (1999), Nielsen (2003), Nyström et al. (2005), Potapov & Sale (2005) and other authors stress, the density of *Lagopus sp*. is of critical importance of the viability of Gyrfalcon populations all over the range. We do not know, however, what is the critical regional grouse density, below which Gyrfalcons have significant difficulties to find enough food for starting to breed and to feed young. Partly this problem is due to poor data on the size of the home range in various habitats. In Iceland, Nielsen (2003) has data on the density level of Ptarmigans needed for successful breeding of the Gyrfalcon, but in Fennoscandia hunting habitat of the falcons is different from his area.

Food choice

Prey selection has been studied in many parts of the Gyrfalcon´s range (e.g. Clum & Cade 1994, Cade et al. 1998, Koskimies & Sulkava 2002, Nielsen 2003, Nyström et al. 2005, Potapov & Sale 2005). The most popular method has been collecting prey remains at and near nest-sites. There are some sources of error in this method, and it should be compared with more accurate and precise methods like video-filming and observations from a hide to get a better idea of the reliability and representativity of the results. Modern camera technology allows monitoring via camera set even in as arctic conditions as in Greenland (Booms & Fuller 2003).

Almost all information on food of Gyrfalcons comes from the breeding period. Automatic cameras, telemetry and other innovative techniques should be developed to study food also outside the breeding season. These techniques also help to study behaviour of the Gyrfalcon, e.g. related to feeding and other behaviour at nest-sites (e.g. Tømmeraas 1989, Booms & Travis 2003)

Availability of nest-sites

In addition to food, availability of safe twig-nests built by Ravens is another critical factor having effect on the viability of Gyrfalcon populations. Monitoring of Raven populations is an important part of a valid Gyrfalcon monitoring and conservation project. Recently, worries have been expressed on the viability of wintering Raven populations especially in Finland and Sweden where there might be lack of winter food for Ravens due to new EU legislation forbidding slaughter of reindeers outside of a few central slaughterhouses (Koskimies 1999).

Unintentional disturbance of nest-sites is a growing problem for Gyrfalcons. Ecotourism and other outdoor activities have led to a growing number of people who visit wilderness and high cliffs especially in the most critical period in late winter and early spring which pose a threat of high importance to Gyrfalcons (table 3, Koskimies 1999, Mela & Koskimies 2006).

Reactions towards humans, and susceptibility to disturbance, varies between falcon pairs, but the information on reactions to various human activities is still too anecdotal and unsystematic. As we can not make scientifically controlled experiments with such a threatened species like the Gyrfalcon, all random experience collected in monitoring projects should be gathered and analysed thoroughly. A territory- and nest-site-specific evaluation of susceptibility to disturbance should be made, as a part of applying the general Action Plan regionally and locally.

Gyrfalcons accept artificial nests (e.g. Tømmeraas 1978, Hansen 1994, Johansen & Østlyngen 2004, Frydenlund-Steen 2005). Building of artificial nests as a method for transferring disturbed pairs to safer nest-sites should be studied in a systematic way.

Habitat quality

In addition to food and nest-sites, we should study also other key factors of Gyrfalcon´s habitat, and the use of home range by both breeding and non-breeding falcons. Better understanding of the habitat requirements of both the falcons and their main prey are essential to plan and implement effective management measures. We should study various types of human activities and their versatile effects on all types of habitat factors. Many kinds of construction, tourism and other activities deteriorate at least locally the quality of the habitat, and they pose serious threats to many pairs (Koskimies 1999).

One example of a poorly-documented threat are reindeer fences, totalling to tens of thousands of kilometres all over northern Fennoscandia. They might be detrimental directly to many Gyrfalcons, but especially to Willow grouse and Ptarmigans. They may kill hundreds of thousands of grouse in northern Fennoscandia every year (Bevanger & Brøseth 2000). Red foxes *Vulpes vulpes* patrol along the fences, which has considerably helped these animals to survive over the subarctic winter. In summer, an expanding and increasing fox population may have a growing negative effect on breeding success of Willow Grouse and other land birds.

The study of habitat use and evaluation of the most critical habitat needs requires telemetry. The Gyrfalcon, however, has been regarded as a very sensitive species to any extra disturbance, like a transmitter, especially in cold and dark wintertime. That is why researchers in Fennoscandia have retained from fitting transmitters on these birds living over winter in harsh conditions. Many successful studies in Greenland and Alaska, e.g. by the Peregrine Fund, however, point to possibilities of this technique, especially when the transmitters get smaller and lighter, and can be monitored via satellites. Because of controversial arguments over the suitability of this methodology to the Gyrfalcon, specialists on this technique must carefully plan a non-harmful study for Gyrfalcons.

Intentional destroy

Although illegal all over the Gyrfalcon´s European range, taking of eggs and young for collections and falconry still seems to continue (e.g. Frydenlund-Steen & Sørli 2005). True scale of robbing of clutches and broods shall be examined carefully in the field during the nest-site controls.

Recently, both environmental administration and non-governmental organizations have started to work together in Scandinavia and Finland to map the present scale of bird crime. At the same time, covering all nest-sites under monitoring and most susceptible nests under intensive wardening (Frydenlund-Steen & Sørli 2005), robbing business will become much more risky than before.

To evaluate the extent of robbing eggs and nestlings, as well as shooting of wild birds and the whole trade of living and dead falcons, conservationists should control falconry birds, captive breeding programmes, various collections etc. to study the origin of individuals, most effectively with modern DNA analysis (Cade et al. 1998, Koskimies 1999).

Chemical contamination and climatic warming

There are controversial results of the amount of chemical contamination in the eggs and tissues of the Gyrfalcon in northern Europe (e.g. Cade et al. 1998, Koskimies 1999, Potapov & Sale 2005). Although pesticides and other harmful contaminants probably do not pose as serious a threat to Gyrfalcon populations as to Peregrine Falcons *Falco peregrinus*, their levels and possible impacts should be monitored regularly and in different habitat types. Although DDT, PCB and other dangerous compounds are not allowed anymore at the same scale than during the past decades, new compounds like bromide flame retardants may become harmful to this kind of top predators.

Climatic warming may become the most extensive and serious environmental threat to Subarctic and Arctic Gyrfalcon populations, as well as whole northern ecosystems. Koskimies (1999) could not evaluate its future impact in any detail. Lately a growing number of studies has been published on the possible impact of warmer climate on many animal and bird species in the Arctic, where the climate is supposed to warm up by over five degrees centigrade by the year 2100. Recently, e.g. ACIA (2005) and Lovejoy & Hannah (2005) have reviewed the newest knowledge.

Long-time data sets of the Gyrfalcon have proved to be very valuable both for the research and conservation of the species itself, as well as indicating human-caused changes in the food web and environment in which falcons form an integral part. Museum specimens, egg-collections and other types of old data on the numbers, distribution and breeding biology can be used also for evaluating the effect of large-scale environmental changes like chemical contamination and climatic warming.

The Fennoscandian Gyrfalcon project

A co-Nordic research project planned by Pertti Koskimies (Finland), Karl-Birger Strann (Norway) and Johan Ekenstedt (Sweden) will be started in its full scale in 2007, after two preliminary years of development. The main aim is to standardize the long-term monitoring and management of Gyrfalcon populations in northern Fennoscandia. The study includes several special projects which are integrated to form a coherent work for collecting necessary information for effective and practical conservation of the total population, in lines with the need of further research delineated by Koskimies (1999) and reviewed above.

The main aims of the study include:

-Standardizing field work in detail and combining results in a very large, ecologically meaningful and versatile range, so that the results can be applied to other parts of the circumpolar breeding area.

-Intensive mapping of breeding pairs and measuring of breeding productivity for evaluating the absolute population size and its fluctuations, as well as the factors behind the changes.

-Measuring habitat requirements, home range and habitat use, nest-sites, food availability and other critical factors and threats of the species, and studying the use of habitats.

-Developing population model for estimating the viability of both national populations and the meta-population in the whole of northern Fennoscandia.

-Studying migration and dispersal patterns, site-tenacity, longevity, causes of death and population turnover, as well as gene flow and genetic relationships between different parts of the range, by ringing, telemetry, DNA analyses and other non-invasive methods.

-Measuring the levels of pollutants in Gyrfalcons, their eggs and young, and in food animals.

-Evaluating the impacts of conventional threats, and including proposed effects of climatic warming, for the population development and conservation status, and developing effective conservation measures against their influence.

The Gyrfalcon is a top predator, and the study aimed at effective conservation of viable populations must include the whole food chain on which the species is dependent. Our project will include a very interesting comparison between inland and coastal populations, whose habitats, prey selection and other ecological parameters differ in many respects. In spite of this, the populations and individuals interact with each other, because especially immature birds from Finland and Sweden migrate towards the Norwegian coast for winter (Koskimies unpublished).

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ACTION PLAN FOR THE GYRFALCON (*FALCO RUSTICOLUS*) IN EUROPE

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The Gyrfalcon is one of the rarest diurnal bird of prey in Europe. Its breeding range is confined only to the Arctic and Subarctic regions in the north. The Gyrfalcon has been classified as vulnerable in Europe (recently provisionally as rare) due to low population numbers, past population decline and susceptibility to versatile threats. An expert group compiled an Action Plan on behalf of BirdLife International and the Commission of the European Union to direct and implement practical conservation measures needed to guarantee the viability of the Gyrfalcon populations in northern Europe. This paper is a shortened review of the Action Plan aimed to set the guidelines also for further research.

Key words: Gyrfalcon, conservation, action plan, Europe.

ПЛАН МЕРОПРИЯТИЙ ПО ОХРАНЕ КРЕЧЕТА (*FALCO RUSTICOLUS*) В ЕВРОПЕ. П. Коскимиес. Кирккконумми, Финляндия.

Кречет – один из самых редких видов дневных хищных птиц Европы. Его гнездовой ареал ограничивается арктическими и субарктическими районами. В Европе, кречет отнесен к категории уязвимых видов (а в последнее время предварительно классифицируется как редкий) из-за низкой численности популяции, ее сокращения в прошлом, а также восприимчивости к различного рода негативным факторам. От имени организации BirdLife International и Комиссии Евросоюза, экспертная группа составила План мероприятий по координации и реализации мер по охране вида с тем, чтобы обеспечить выживание популяций кречета в северной Европе. В данной работе представлен краткий обзор этого Плана, где оговариваются и направления для будущих исследований.

Ключевые слова: кречет, охрана, план мероприятий, Европа.

PREFACE

The European Union has published action plans for conservation of the 23 globally endangered bird species living in Europe (Heredia *et al*. 1996). In addition, similar plans have been published also for eight priority bird species of special conservation concern in Europe (Schäffer & Gallo-Orsi 2001). At present there are several additional plans of the priority species recently published or under preparation. The Gyrfalcon belongs to this third group of species.

In 1998 EU Commission asked BirdLife International to prepare a European-wide action plan for the Gyrfalcon, according to general guidelines set by the Commission. I was asked to act as a compiler for the plan, to write a draft, gather a specialist group for a workshop, and write the final draft after consultation of the attending specialists and other major experts of the species.

This paper describes the action plan, published in the European Commission's Internet pages (Koskimies 1999), as a shortened version. It includes some up-dated information on the present status and classification of this threatened species, as well as recent conservation measures, country by country, based on the material at my disposal. The list of threats and conservation measures and their evaluation have remained exactly the same as in the original action plan, including a summary of reasoning for each of them. I have excluded the Annex of the original action plan, listing the recommended measures by country.

The plan intends to provide a framework of action for the governments, non-governmental conservation organizations, and individuals responsible for, or interested in, the conservation of the Gyrfalcon. The Gyrfalcon is a site-tenacious species breeding in traditional sites which can be preserved by national legislation and other measures.

This Action Plan is primarily targeted to and needs active implementation in those European countries where the Gyrfalcon breeds: Iceland, Denmark (Greenland), Norway, Sweden, Finland and Russia west of the Ural Mountains. The Gyrfalcon often remains resident on its breeding range throughout the year, but some birds, especially juveniles and also a minority of adults, disperse hundreds of kilometres south of the breeding range or to the coastal regions in winter.

INTRODUCTION

The Gyrfalcon is distributed circumpolarly in the Arctic. It does not belong to the world list of threatened birds by BirdLife International and The World Conservation Union, IUCN (BirdLife International 2000, Hilton-Taylor 2000). In Europe, however, the species was classified as vulnerable by Tucker & Heath (1994), having fewer than 2,500 breeding pairs (Greenland included). Recently, BirdLife International (2004) classified it provisionally as rare, after slightly modified criteria. In addition, BirdLife International classified it as category 3 among the Species of European Conservation Concern: species whose global populations are not concentrated in Europe, but which have an unfavourable conservation status in Europe (Lindberg 1994, BirdLife International 2004).

The Gyrfalcon is listed in Annex I of the EU Birds Directive (1979), and it has been included in the list of priority species of the directive. It belongs also to the species listed in Appendix I of the Convention on the Conservation of European Wildlife and Natural Habitats (Bern Convention, 1982) and the Convention on International Trade in Endangered Species of Wild Fauna and Flora (Washington Convention or CITES, 1975). The Gyrfalcon belongs to species of special European concern in the 1997 list by the Council of Europe. These conventions, together with the Biodiversity Convention (1992), provide an adequate legal framework for the international cooperation in conservation of the Gyrfalcon and its habitat, and all the countries where the species occurs are encouraged to implement them fully.

In Europe the Gyrfalcon is a rare species (e.g. Lindberg 1994, Falkdalen & Blomqvist 1997, Cade et al. 1998). As a breeding species it is confined to Greenland, Iceland, Fennoscandia and northern Russia. At least in northern Fennoscandia the population seems to have declined considerably in the late 19th and early 20th century, possibly due to intensive and large-scale egg collecting and simultaneous shooting of adults for decades, decline of the Willow Grouse *Lagopus lagopus* and Ptarmigan *L. mutus* populations, and habitat deterioration (e.g. Rassi et al. 1992, Tømmeraas 1993, 1994, 1998, Väisänen et al. 1998). Gyrfalcon populations continued to be stressed at least locally up to the late 1900s due to shortage of food, habitat destruction, disturbance of nest sites, and illegal removal of eggs and young for collections and falconry (e.g. Tømmeraas 1993, 1998, Cade et al. 1998, but see Koskimies 2006).

Preparation of the action plan

A workshop to compile this action plan was organized at Kilpisjärvi biological station, Finnish Lapland, on 6–7 March 1999. Representatives from the following countries were present: Finland (Pertti Koskimies), Iceland (Ólafur K. Nielsen), Norway (Karl-Otto Jacobsen, Kenneth Johansen, Arve Østlyngen), Sweden (Johan Engström (†), Ulla Falkdalen, Peter Lindberg), and USA (Tom J. Cade). The Gyrfalcon´s status and threats were thoroughly discussed, and the most important actions to safeguard its future in Europe were outlined.

In addition to above listed contributors, Tom Christensen (Greenland), Torsten Stjernberg (Finland), Eugene Potapov (Russia), and Torsten Larsson and Martin Tjernberg (Sweden) commented on the first draft. The information on especially the life history in this action plan is based on a thorough literature review by Cade et al. (1998).

The conservation status and threats to the Gyrfalcon are fairly well understood, although there is very limited knowledge on many basic population parameters such as mortality, longevity, dispersal and main reasons of death. The most important aims of research in the near future are to make a demographic population model and to study the use of habitat by the species. Information on these aspects is badly needed to conserve viable populations effectively. Gyrfalcon populations respond to long-term, more or less cyclic fluctuations of the grouse populations, and ecology of the falcon must be studied and populations monitored preferably for several decades to get reliable results throughout a cycle. The number of territorial pairs in Iceland, for example, has changed by a factor of 1.5 from low to high years (Nielsen 1999). Fluctuations of the number of breeding pairs and of the breeding success are much higher.

Table 1. Estimated number of territorial pairs of the Gyrfalcon in the European range states in the late 1990s.

Finland	20–30
Greenland	500–1000
Iceland	300–400
Norway	250–385
Russia	100–300
Sweden	80–135
Total	1250–2250

BACKGROUND INFORMATION

Distribution and population

The Gyrfalcon is distributed circumpolarly over the large part of the tundra zone and at the northern limit of the coniferous forest zone, including Arctic-alpine mountainous regions. In Europe it breeds in Greenland, Iceland, Norway, northwestern Sweden, northern Finland, northern half of the Kola Peninsula and along the timber line east of the Kanin peninsula. Within EU the species breeds only in northern Finland and Sweden. The majority of the adult population probably stays in the breeding area, except for high Arctic, throughout the year, but at least part of the immature and some adult birds winter in coastal areas of the Atlantic or Arctic Ocean.

The population is fairly well known in Fennoscandia and Iceland but poorly so in Greenland and especially Russia. According to the most recent information compiled for this report, there are 1250–2250 territorial pairs in the whole of Europe (table 1). Earlier estimates do not deviate markedly from this (Lindberg 1994, Cade et al. 1998, see also Gensbøl

& Koskimies 1995, Falkdalen & Blomqvist 1997, Frydenlund–Steen 1999). The total population in Europe has probably remained at the same general level since the mid-1900s, although numbers appear to have declined at least locally in northern Fennoscandia and northwestern Russia also during the late 20th century (Tømmeraas 1993, 1994, Lindberg 1994, Gensbøl & Koskimies 1995, Ahlén & Tjernberg 1996, Koskimies & Kohanov 1998, Väisänen et al. 1998, Koskimies 2006).

Life history

Breeding

The Gyrfalcon breeds on a ledge or in a cavity of a steep cliff, usually in an old stick nest of another species, in particular Raven *Corvus corax*, but sometimes Rough-legged Buzzard *Buteo lagopus*. The nest site has to provide shelter from mammalian predators, wind, rain (snow cover) and extreme exposure of sunlight by a well-developed overhang. Birds also accept artificial stick nests (e.g. Tømmeraas 1978). If Gyrfalcons are short of suitable cliffs they breed sometimes in stick nests in trees, more commonly in Arctic Russia and Siberia than in northwestern Europe. Usually a pair has 2–5 alternate nest sites within ca. 10 kilometres (Cade et al. 1998).

The female starts laying already in April. The normal clutch size is 3–4 eggs, and they are incubated 34–36 days mostly by the female. The young are brooded still up to the age of 10–32 days. Fledging period is 45–50 days, but after that the young are dependent on their parents for several weeks. They disperse from the natal territory usually 3–4 weeks after fledging.

In most populations the mean productivity is 1–2 fledglings per breeding attempt or 2–3 fledglings per successful pair. The number of successful pairs, more variable annually than the average number of young, varies usually from ca. 30 to 80% and is dependent on weather conditions during the early phase of nesting and the abundance of food. Heavy snowstorms or low temperature lasting for days during March and early April may prevent the female from reaching the required condition for egg-laying. Most birds probably start breeding at 2–3 years old, some at 1 year old in good grouse years (Cade et al. 1998).

Feeding

The Willow Grouse and the Ptarmigan are the main prey of the Gyrfalcon in the whole range and throughout the year (Cade et al. 1998, Koskimies & Sulkava 2002). During courtship, laying, incubation, and early nestling period falcons in some areas feed almost 100% on *Lagopus sp.*, as well as during winter. A pair has been estimated to consume ca. 470 g of grouse per day (Tømmeraas 1994). A pair with four young requires, on average, 1160 g biomass/day (a little more than two adult grouse, Lindberg 1983). During the nestling period the falcons start to take other prey in varying degrees, e.g. waders, larids, ducks and goslings, and even passerines.

Breeding Gyrfalcons may hunt in an area of at least 300–600 km^2 and often many times larger, thus ranging some dozens of kilometres from their nest. They probably concentrate, however, in the most productive parts of the home range. The proportion of waterfowl, waders, larids and other medium-sized birds is higher, on average, for pairs nesting near coast, lake, wetland or peatland areas than in homogenous heathland habitats (Cade et al. 1998).

Habitat requirements

The Gyrfalcon breeds in cold, Arctic and Subarctic latitudes, and in Arctic-alpine zones at or above treeline, including sea-cliffs and islands. In Fennoscandia and Russia it breeds also in broken and barren pine or birch forests along river valleys and near mountain bases.

The most important habitat requirement is a safe nest site on a shelf of an abrupt cliff. Unless based on seabird colonies near-by, Gyrfalcons normally hunt over wide area of open terrain with short, sparse vegetation or willows and other shrub, or around large bodies of water.

THREATS AND LIMITING FACTORS

The following probable threats to the European Gyrfalcon population in the next few decades are listed in their order of importance. There is also a general more hypothetical threat than the others: climate change. The Gyrfalcon, confined to the Arctic zones of the Earth, may be one of the species affected most negatively by marked warming of the Arctic zone (e.g. Green et al. 2001). Climate change may also have a considerable effect on its prey populations. Because this change probably affects the Gyrfalcon more slowly than the following threats, and due to the difficulties in estimating its effect, it has not been taken into further account in the action plan.

Reduced prey numbers

The Gyrfalcon is peculiar among raptors for going from courtship to late nestling period by preying on the adult segment of the main prey populations, the Willow Grouse and Ptarmigan, during annual low point in their numbers, even in the harsh environment of the high Arctic. Grouse are usually the only available prey during the most critical periods in winter and spring, and their decline may cause serious difficulties for the birds to over-winter and reach necessary physical condition for breeding.

Especially in Fennoscandia, *Lagopus sp*. populations seem to have declined at least locally in recent decades (Väisänen et al. 1998). Possible reasons for the reduced food supply are said to be excessive hunting, expanding red fox *Vulpes vulpes* populations, disturbance by snow mobile traffic, and changes in vegetation from overuse of forage by livestock and reindeer (e.g. Tømmeraas 1993, 1994), but the problem needs further study.

Importance: high

Disturbance of nest sites

The Gyrfalcon is a sensitive species to human activities near its nest site. Pairs are confined to traditional nest sites which are scarce in many areas. Due to a long breeding season and the time required for the young to become independent, the female seldom has time enough to lay a repeat clutch if the first has been lost (Cade et al. 1998).

Hiking, rock climbing, bicycling, skiing, driving snow mobiles, and all other kinds of outdoor activities have become more popular all over northern Europe. Also too eager bird-watchers and nature photographers as well as scientists, rangers and other field workers may unintentionally disturb birds.

Importance: high

Habitat destruction

In addition to availability of prey, also other environmental factors of a habitat must remain in a natural state to hold a viable Gyrfalcon population. The most serious changes include building of dams and reservoirs, roads, snow mobile and skiing routes, and other tourist infrastructure, as well as cottages, reindeer fences and powerlines (Cade et al. 1998). Forest cutting, military activities and reindeer husbandry can also cause problems. If exploration and development of petroleum industry should be intensified anew in Russia since the collapse in the 1990s, it may cause disturbance to falcons and their prey.

Importance: medium

Robbing of nests for egg-collections, falconry, and captive-breeding programmes

The Gyrfalcon belongs to the most highly prized bird species among egg collectors and falconers. Thus, robbing of nests might extend to such a spatial and temporal intensity that it could cause a population to decline seriously, especially with many other negatively affecting factors acting simultaneously. In Germany, for example, there were probably about 500 Gyrfalcons in captivity in the early 1990s, 70–80% of which originated from the wild (Forslund 1993). In 1992, for example, more than 35 Gyrfalcons, all collected from wild in Fennoscandia, were confiscated by police. The number of birds robbed and smuggled from Russia is probably much higher and growing rapidly. In Britain the number of captive Gyrfalcons is estimated at ca. 400, of which two thirds are hybrids of different sorts.

Illegal robbing of eggs and young has been confirmed in several parts of Norway, and up to the mid-1980s also in Iceland. There are also some hints of nest robbing in Sweden and Finland. Young Gyrfalcons have been robbed illegally in several areas in northern Russia, leading to at least temporary disappearance of a local population in the late 1980s (Morozov 1991). In Kola Peninsula robbing of eggs and young is considered as the most severe threat by Koskimies & Kohanov (1998). The disintegration of the former Soviet Union in 1991 led to a decline of the general control of the laws protecting wildlife, although the collapse of infrastructure in the high Arctic at the same time may give protection to birds in many regions (Flint 1995).

An increasing problem for both wild populations of Gyrfalcons and Peregrine falcons *Falco peregrinus* is the risk of gene-contamination from escaped captive-produced hybrid falcons, which have paired and nested with wild birds at least in Sweden.

Importance: medium

Shooting adults and destroying nests

Shooting of adult Gyrfalcons and destroying their nests mainly for game protection was formerly a more common threat all over the range. Persecution probably continues locally, especially in Russia.

Importance: low

Lack of nests due to decline of Raven populations

Possible decline in Raven populations may cause lack of stick nests accessible to Gyrfalcons. Availability of winter food is critical for the arctic Raven populations. They have benefited by the increasing populations of both reindeer and moose and lessening of persecution in many parts of the range during recent decades (Väisänen et al. 1998). New EU Directives, however, restrict considerably the leaving of slaughtered offal and use of carcasses by nature photographers, reducing availability of the main food sources accessible to the Ravens. Persecution of Ravens is still going on in some regions, e.g. fairly intensively in Iceland (Hardardottir & Nielsen 1999).

Importance: low

Collision with cars and fences, and electrocution by power lines

At least in Fennoscandia the total length of reindeer fences will increase still in the future. According to preliminary data, thousands of Willow Grouse and Ptarmigan die each year after collision with fences, which may have locally an effect also on the prey populations. Also Gyrfalcons may collide with fences. Collision with power lines and electrocution have most probably only marginal effect on Gyrfalcons.

Importance: low

Trapping of adults

Up to the early 1990s as many as 2000 Gyrfalcons have been estimated to have been killed each winter in Russian Arctic by traps set for arctic fox *Alopex lagopus* (Ellis & Smith 1993). Fur farms and most individual trappers have ceased to operate in the 1990s, however. Outside Russia trapping of Willow Grouses and Ptarmigans by snares has probably a minor effect on Gyrfalcons.

Importance: unknown

Chemical contamination

Pesticides seem to have affected Gyrfalcon populations considerably less than many other raptors, probably due to the remoteness of the breeding range and the sedentary habits of the Gyrfalcon (e.g. Lindberg 1984, Ólafsdóttir et al. 1995). Also acid rain and radioactive fallout may be potential problems needing more study, especially in Russia (Cade et al. 1998). More study is needed to evaluate the importance of chemical contamination, however, because there are some new sampled eggs with high levels of chemicals.

Importance: unknown

CONSERVATION STATUS AND RECENT CONSERVATION MEASURES

Finland

The Gyrfalcon has been protected by the Nature Conservation Law in Finland since the year 1926. It is listed as vulnerable in 1985 and 1991, and endangered by different, standardized IUCN criteria in 2000 (Rassi et al. 2001).

The species breeds very sparsely in northern Lapland, and fewer than a quarter of the pairs breed in national parks and other strictly protected areas, The majority of the pairs, however, live in areas protected by the Wilderness Law, which regulates e.g. forest cutting, building of roads and cottages etc. The Finnish population has been monitored since the early 1990s (Koskimies 1995, 1998, 2006).

Greenland

The Gyrfalcon´s eggs were first totally protected in Greenland in 1958, and in the following year export of live or dead birds was prohibited. From 1960 to 1976 the bird and its eggs were fully protected from 15 May to 31 August, and throughout the year since 1977. These Greenlandic prohibitions were replaced in 1988 by countrywide laws under Greenlandic Home Rule (Information from K. Kampp and D.M. Boertmann).

Gyrfalcons breed widely but sparsely throughout the ice-free coastal lands, with only a few pairs in protected areas. A population has been monitored around Sondre Stromfjord from 1972 (e.g. Burnham & Mattox 1984). Since the late 1990s The Peregrine Fund has organized large scale monitoring and conservational studies in various parts of Greenland (Cade & Burnham 2003).

Iceland

The Gyrfalcon was protected for the first time in Iceland from 1919 to 1929, and permanently since 1951. It has been listed as an endangered species. There are ca. 30 occupied territories in nature reserves. The most important conservation efforts are the laws giving to the Gyrfalcon a total protection and prohibiting disturbance at the nest site. A population in northeast Iceland has been monitored since 1981 (e.g. Nielsen 1999).

Norway

The Gyrfalcon has been protected by law in Norway since 1971. It has been listed as vulnerable in the 1990s. In northern Norway ca. 15–20% of the pairs breed in protected areas. The breeding range extends from south of Hardangervidda to Finnmark. In western Finnmark and northern Troms county, a monitoring project has been continued for over 30 years (e.g. Tømmeraas 1998). An intensive monitoring has been going on in the whole northern Norway since the early 2000 (Koskimies 2006).

Russia

In the Russian Federation the Gyrfalcon has been listed as a rare species. It has also been protected by various hunting regulations. The order by the General Game Management Committee (1964) prohibits the shooting, capturing and nest control of birds of prey in land where game hunting is allowed. According to general hunting regulations, adopted in March 1979, shooting of all birds of prey and owls is forbidden. These rules were inherited in the new federal law on the protection of Animal Kingdom since 1995, prohibiting also other actions which may result in the death or decrease in numbers of the Gyrfalcon, or the destruction of its habitat (Danilov-Daniljan et al. 2000).

Sweden

The Gyrfalcon has been totally protected since 1957 and has been classified as vulnerable in 1996 and endangered in 2000 (Gärdenfors 2000). The species breeds in the mountain area of northwestern Sweden, and about 25% of the population is found in areas protected as national parks or nature reserves. However, these parks are used for several activities which disturb birds.

A monitoring project started in Jämtland-Härjedalen in 1994, as concern was raised about the long term survival of the Gyrfalcon due to new hunting regulations (1993) increasing the pressure on grouse populations (e.g. Danielsson et al. 2002). It has been followed by large-scale intensive surveys further north in Västerbotten and Norrbotten since 1996 (e.g. Ekenstedt 2003).

AIMS AND OBJECTIVES OF THE ACTION PLAN

Aims

The action plan has both short term and long term aims.

1. In the short term, to maintain the present numbers of the Gyrfalcon throughout its present range.

2. In the medium to long term to ensure range expansion and population growth in areas where the species has disappeared due to human factors.

Objectives

1. Policy and legislation

1.1 To promote policies which ensure long-term conservation of the habitat of the Gyrfalcon

1.1.1 Including territories in protected areas

The most important habitats of the Gyrfalcon, including nest sites and productive hunting areas, should be protected as thoroughly as possible. In protected areas the quality of the habitat can be protected and improved through appropriate management, and the species-specific requirements can be taken fully into account. As many Gyrfalcon territories as possible should be included in national parks and other protected areas. In addition to extensive nature reserves, possibilities of founding local and smaller protection zones around individual eyries should be encouraged.

Priority: high
Time-scale: ongoing

1.1.2 Increasing food supply by hunting regulation and other measures

Every effort should be tried to increase the numbers of Willow Grouse and Ptarmigan, including conservation of their habitats and regulation of excessive hunting. The most productive grouse habitats should be protected by all disturbing factors. Hunting should be more restricted especially in midwinter compared to the present.

Priority: high
Time-scale: short

1.1.3 Taking Gyrfalcon into account in management plans

Habitat and other requirements of the Gyrfalcon should be taken into account in management and utilisation plans for protected areas. An environmental impact assessment should be prepared for any work or project that might alter or have an effect on the Gyrfalcon or its habitat in a non-protected area.

Data on exact nest sites should neither be collected in a public register nor given freely and in detail to authorities, however. If the amount of people knowing traditional nest sites increases, the risk of this kind of information going to “wrong hands” and intentional disturbance will increase as well. In areas where human activities may lead to habitat deterioration of the Gyrfalcon, and where nature conservation authorities are really able to influence these plans, they should be in contact with researchers and other specialists of the Gyrfalcon to solve these kinds of site-specific problems.

Photographing birds at nest or access to nest sites in other non-conservation purposes should be prohibited without special permits in all range countries, whether the nests lie in a nature reserve or not.

Priority: medium
Time-scale: ongoing

1.1.4 Wardening of sensitive nest sites

There are some nest sites robbed or disturbed for years. The primary effort should be attracting the birds to a new secret site by providing them an artificial nest in a safer place. If this is not possible, the most seriously disturbed nests should be under watch. Automatic cameras and other equipment can also be used in surveillance work.

Priority: low
Time-scale: ongoing

1.2 To promote national legislation which adequately protects the species and its habitat

1.2.1 Compiling conservation management plans

Every range state should compile a national plan for management of the Gyrfalcon and its habitat, based on this European-wide plan and taking into account that Fennoscandia and northern Russia have a common metapopulation of the species. The plan should take into account regionally the species-specific habitat and other requirements, threats, and conservation possibilities, monitoring and research.

Priority: high
Time-scale: short

1.2.2 Reviewing and updating national laws

A review and update of national laws and regulations should be encouraged to ensure that the Gyrfalcon is given the maximum level of protection, and heavy penalties are instated for shooting, trapping, taking, poisoning, disturbing, possessing or trading specimens or eggs.

Priority: low
Time-scale: ongoing

1.3 To promote implementation of international conventions and treaties

1.3.1 Implementing international conventions and treaties

All the countries where the species occurs, having ratified the Bern Convention and CITES, together with the Biodiversity Convention and the EU Birds Directive, will be encouraged to implement these conventions into full power.

Priority: medium
Time-scale: ongoing

1.3.2 Controlling of captive-breeding programmes

Captive-breeding programmes should continue to be monitored by DNA methods to discourage the illegal entry of wild birds into captive collections. The hybrids should be sterilised before they are sold or released for hunting.

Priority: medium
Time-scale: ongoing

1.3.3 Intensification of co-operation between nature conservation authorities, customs, and police

Customs officials should be educated more thoroughly than at present in the problems of bird crime by environmental administrators and non-governmental nature conservation organizations. Also co-operation and information exchange between authorities and the general public should be intensified.

Priority: low
Time-scale: ongoing

1.3.4 Activating international co-operation in research and conservation

The entire Eurasian metapopulation could be viewed as a single conservation entity. Conservation of Gyrfalcons benefits from keen international co-operation among researchers and environmental administrators. Resources should be increased co-operatively to monitor and research Gyrfalcons especially in Russia.

Priority: low
Time-scale: ongoing

2. Species and habitat protection

2.1 To ensure that the habitat retains the necessary conditions for the presence of the Gyrfalcon

2.1.1 Improving food availability for the species throughout the year

The availability and numbers of the Willow Grouse and Ptarmigan should be increased by protecting productive habitats, improving degraded range, regulating hunting, and reducing mortality due to reindeer fences and other factors.

Priority: high
Time-scale: short/ongoing

2.1.2 Improving the availability and quality of nests

By providing carcasses in winter Ravens may be attracted to live and probably breed in the same areas as the Gyrfalcons. Other means of improving the quality of nests is to reinforce nests in suboptimal ledges, and to build artificial nests to attract falcons from traditional nest sites which have become unsafe.

Priority: low
Time-scale: ongoing

2.2 To eliminate or control non-natural factors which are affecting the Gyrfalcon

2.2.1 Reducing incidental mortality from trapping

The use of sight-baited leg-hold traps for arctic foxes and other animals should be discouraged in all areas frequently used by falcons, and possibilities to change traps or trapping techniques should be investigated to prevent the falcons getting caught (see Glenn 1998).

Priority: high
Time-scale: short

2.2.2 Preventing human disturbance

Human disturbance may be prevented by constructing snow mobile or skiing routes, paths, cottages and other infrastructure further away from Gyrfalcon nest sites and other core parts of their territories. Because a general archive with exact nest sites should not be founded for local and regional environmental administration – the fewer persons know the exact eyries the better – authorities should contact researchers responsible for monitoring when a land-use planning possibly affects Gyrfalcon habitat in order to receive appropriate data on the occurrence of the species.

Bird-watching tours to Gyrfalcon nests should be prohibited in areas without a good surveillance due to a risk that information on exact eyries may be distributed to potential robbers by visitors. Even then, a “safety zone“ will vary according to the characteristics of the land; 1 km is recommended as a minimum distance if the nest cliff remains invisible from a longer distance, but it may increase to 2–3 km for a visible nest. In nest sites where human disturbance is a persistent cause of breeding failure, wardening should be organized.

Priority: medium
Time-scale: ongoing

2.2.3 Preventing nest robbing and illegal trade

Keeping nest sites secret is the main means against robbers (see also 2.2.2.). Heavy fines for taking birds should be included in national laws, and they should be adequately publicised and enforced. Also the parentage of birds in captive-breeding programmes should continue to be controlled by DNA testing. Also more information needs to be gathered about the way nest robbers operate and the routes of the illegal trade.

Priority: medium
Time-scale: ongoing

2.2.4 Reducing mortality due to intentional hunting and other directly affecting activities

Governments should be urged to enforce control of illegal persecution and increase surveillance especially in protected areas where Gyrfalcons occur. Awareness campaigns targeted at hunters´ associations should be undertaken in those areas where these problems are especially acute.

Priority: low
Time-scale: ongoing

2.2.5 Reducing mortality from collision by reindeer fences and electrocution by powerlines

With the help of environmental impact assessment, reindeer fences, powerlines, windmills and other constructions causing a threat to hunting and flying falcons should be built further away from Gyrfalcon nest sites and most productive hunting areas. Reindeer fences should probably be marked more clearly to warn both Gyrfalcons and grouse, and also their design affect the threat.

Priority: low
Time-scale: long

2.3 To extend the current distribution area and increase density

2.3.1 Surveying of potential recolonisation areas

If a marked part of the Gyrfalcon´s current range becomes unsuitable for the species, or there are other good reasons and practical ways for extending or moving the breeding range, areas where recolonisation would be possible should be identified. All potential recolonisation areas must be carefully identified before any juveniles can be released. In general, the IUCN Species Survival Commission´s guidelines on re-introductions should be followed (IUCN 1998).

Priority: low
Time-scale: long

2.3.2 Maintaining captive breeding programme for recolonisation

If a natural catastrophe or disease brings population levels dangerously low, it may be necessary to have access to a captive-breeding stock to provide for reintroduction. Young and adult birds originating from the respective region, either captive-bred or stolen, victims of accidents etc. can be used in a captive-breeding and release programme.

Priority: low
Time-scale: long

3. Monitoring and research

3.1 Monitoring

3.1.1 Continuing present monitoring projects of the Gyrfalcon populations and initiating new programmes in poorly known areas

Special monitoring projects cover most accurately Finland and Sweden at present, and also central and northern parts of Norway and northern Iceland. Monitoring projects should be extended also in other areas to ensure the representativeness of the present areas. Nature conservation authorities should feel responsibility for funding of the monitoring work to ensure its continuation, but the leading of the field work and data analysing should be done by professional ornithologists to guarantee the scientific validity of the work.

The status of the species is more poorly known in Greenland and especially Russia than in the Nordic countries. Intensive monitoring of populations should be initiated there also in order to evaluate the effectiveness of conservation measures adopted. At least the number of breeding pairs and their productivity should be determined in a standard way.

Priority: high
Time-scale: ongoing

3.1.2 Intensifying monitoring of population parameters

Monitoring projects should be intensified to cover, in addition to population size and natality, also mortality, site fidelity, migration, causes of death and other life history traits.

Priority: high
Time-scale: ongoing

3.1.3 Monitoring grouse populations and availability of nest sites

Intensive monitoring of the Gyrfalcon should cover abundance of prey animals, especially the Willow Grouse and Ptarmigan. Availability and quality of suitable nest sites and other key features of the Gyrfalcon habitat should be evaluated. This information helps in determining how healthy the environment is for the species.

Priority: medium
Time-scale: ongoing

3.1.4 Monitoring levels of chemical pollutants in eggs

The effect of pesticides on the productivity and mortality of the Gyrfalcon is documented imperfectly so far. In addition to eggs, it would be interesting also to monitor the levels of chemical pollutants in adult Gyrfalcons.

Priority: medium
Time-scale: ongoing

3.2 Research

3.2.1 Promoting research of population viability

One of the most important gap in our knowledge of the Gyrfalcon´s ecology is the lack of a usable model for survival rates of both young and adult birds. An intensive and long-lasting population study with identifiable individuals is needed in several study areas. Based on demographic, genetic, geographic and other variables, a viable population analysis should be made as a part of making a more detailed management plan for the Gyrfalcon.

Priority: high
Time-scale: long

3.2.2 Promoting research which helps to identify limiting factors and population renewal

A better understanding of the species´ habitat and energy use, home range of adult pairs, and the movements of the young after leaving the nest would be very helpful for future conservation efforts. The mechanisms regulating population density and requirements for settlement of new pairs in potential habitats are also important research objects. Also the energy requirements of breeding birds need to be investigated: the number of young that can be produced, the cost of the adults, and the amount of food required.

Priority: medium
Time-scale: long

3.2.3 Studying wintering areas and migration routes

Especially adult Gyrfalcons should be marked in different techniques to delineate migration routes, to identify mortality factors outside breeding season, and to locate the wintering areas of birds belonging to different European populations.

Priority: medium
Time-scale: ongoing

3.2.4 Studying techniques for increasing grouse populations

The relationships between grouse populations, habitat changes, hunting pressure and other human-caused factors should be studied to find out techniques for increasing the density of grouse.

Priority: medium
Time-scale: medium

3.2.5 Studying feasibility of reintroducing Gyrfalcons by hacking captive-bred or confiscated young

It would be worthwhile to determine whether or not the same techniques used successfully for the Peregrine Falcon will work for the Gyrfalcon. Small-scale experimental releases should be carried out.

Priority: low
Time-scale: long

4. Public awareness

4.1 To improve and maintain awareness, concern and support for the protection of the Gyrfalcon and its habitat among the public

4.1.1 Implementing awareness campaigns for the general public

All conservation measures will only achieve maximum efficacy when there is a sufficient level of awareness at all social levels involved. It is especially important to tell the people how to avoid disturbance of the nesting birds. This could succeed with educational material like brochures, talks, lectures, round tables and film shows. The willingness of the general, well-informed public to cover the costs of the management of the species should be guaranteed.

Priority: medium
Time-scale: ongoing

4.1.2 Raising awareness of the special problems facing Gyrfalcons

Specific problems such as disturbance by hikers, rock-climbers, photographers, tourists, reindeer people and other drivers of snow mobiles must be resolved by focusing education on specific groups of people. There is a marked interest of bird-watching companies to find nest sites, leading to increasing disturbance by tourists, and by local people (especially in Russia) willing to earn money by guiding (western) visitors. These visits can lead to a wider publicity of nest-sites also among nest-robbers. Nature and ecotourism companies should be informed of the risks of their operation on the birds.

Priority: medium
Time-scale: ongoing

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THE WHITE-TAILED SEA EAGLE *HALIAEETUS ALBICILLA* AND THE OSPREY *PANDION HALIAETUS* IN THE VOLOGDA LAKE DISTRICT AND SOUTHEASTERN ONEGO AREA

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The paper presents data on the current status of the Osprey and the White-tailed Sea Eagle populations in the northwestern part of the Vologda region and south-eastern Onego area. Field trips and studies at permanent plots done between 1988 and 2005 have demonstrated that the study area is inhabited by a uniform population of the White-tailed Sea Eagle, the main distinctive feature of which is the tendency to form compact settlements on the shores of large bodies of water in the forest zone. Its total abundance is ca. 100 pairs. About a third of the population (30–35 pairs) lives on the Rybinsk impoundment reservoir in the Darwin strict nature reserve, forming the largest source from which birds apparently dispersed to other large lakes of the region in the 1980s–1990s. Our estimate of the total Osprey population in the Vologda Lake District and south-eastern Onego area is 150–180 breeding pairs, of which 50–55 nest in the Darwin reserve and its buffer zone. Expeditions outside the area in question have shown that the population density of the species decreases towards all directions, their abundance being limited to occasional pairs. It is demonstrated that this source area with high abundance of the White-tailed Sea Eagle and the Osprey formed as the populations in the Darwin reserve increased in density in the 1950s–1970s. After that the species spread to lakes and reservoirs of the Vologda Lake District and southeastern Onego area, where the natural habitats are similar.

Key words: Osprey, *Haliaeetus albicilla,* White-tailed Sea Eagle, *Pandion haliaetus,* population, Vologda District, Onego area.

ОРЛАН-БЕЛОХВОСТ *(HALIAEETUS ALBICILLA)* И СКОПА *(PANDION HALIAETUS)* В ВОЛОГОДСКОМ ПООЗЕРЬЕ И ЮГО-ВОСТОЧНОМ ПРИОНЕЖЬЕ. Кузнецов А.В., Бабушкин М.В. Дарвинский заповедник, Вологодская обл, Россия; Московский государственный педагогический университет, Москва, Россия.

В работе приводятся данные по современному состоянию популяций скопы и орлана-белохвоста в северо-западной части Вологодской области и юго-восточном Прионежье. В результате экспедиционных и стационарных исследований, проведенных в период с 1988 по 2005 годы, было выяснено, что в пределах обследованной территории располагается единая популяция орлана-белохвоста, основной особенностью которой является склонность к образованию уплотненных поселений на побережьях крупных водоемов лесной зоны. Ее суммарная численность составляет около 100 пар. Примерно треть этой популяции (30–35 пар) обитает в Дарвинском заповеднике на Рыбинском водохранилище, образуя самый значительный очаг, из которого, по всей видимости, и происходило расселение птиц на другие крупные водоемы этого региона в 1980–1990 гг. Общая численность популяции скопы Вологодского поозерья и юго-восточного Прионежья по нашей оценке составляет 150–180 гнездящихся пар, 50-55 из которых гнездится в Дарвинском заповеднике и в его охранной зоне. Экспедиционные обследования, проведенные за пределами указанной территории, показали, что во всех направлениях плотность населения этих видов снижается, а численность их исчисляется отдельными парами. Показано, что этот очаг высокой численности орлана-белохвоста и скопы сформировался вследствие увеличения плотности их населения в Дарвинском заповеднике в течение 1950–1970 гг., из которого в 1980–1990 гг. происходило их дальнейшее расселение на сходные по природным условиям водоемы Вологодского поозерья и юго-восточного Прионежья.

Ключевые слова: скопа, орлан-белохвост, *Haliaeetus albicilla, Pandion haliaetus*, численность, Вологодская область, Прионежье.

INTRODUCTION

Our studies were made from 1988 to 2002 in a vast area between Volga and the cities of Rybinsk, Yaroslavl and Kostroma in the south, Lake Onego, Lake Vodlozero and upper reaches of River Onega in the north (fig. 1).

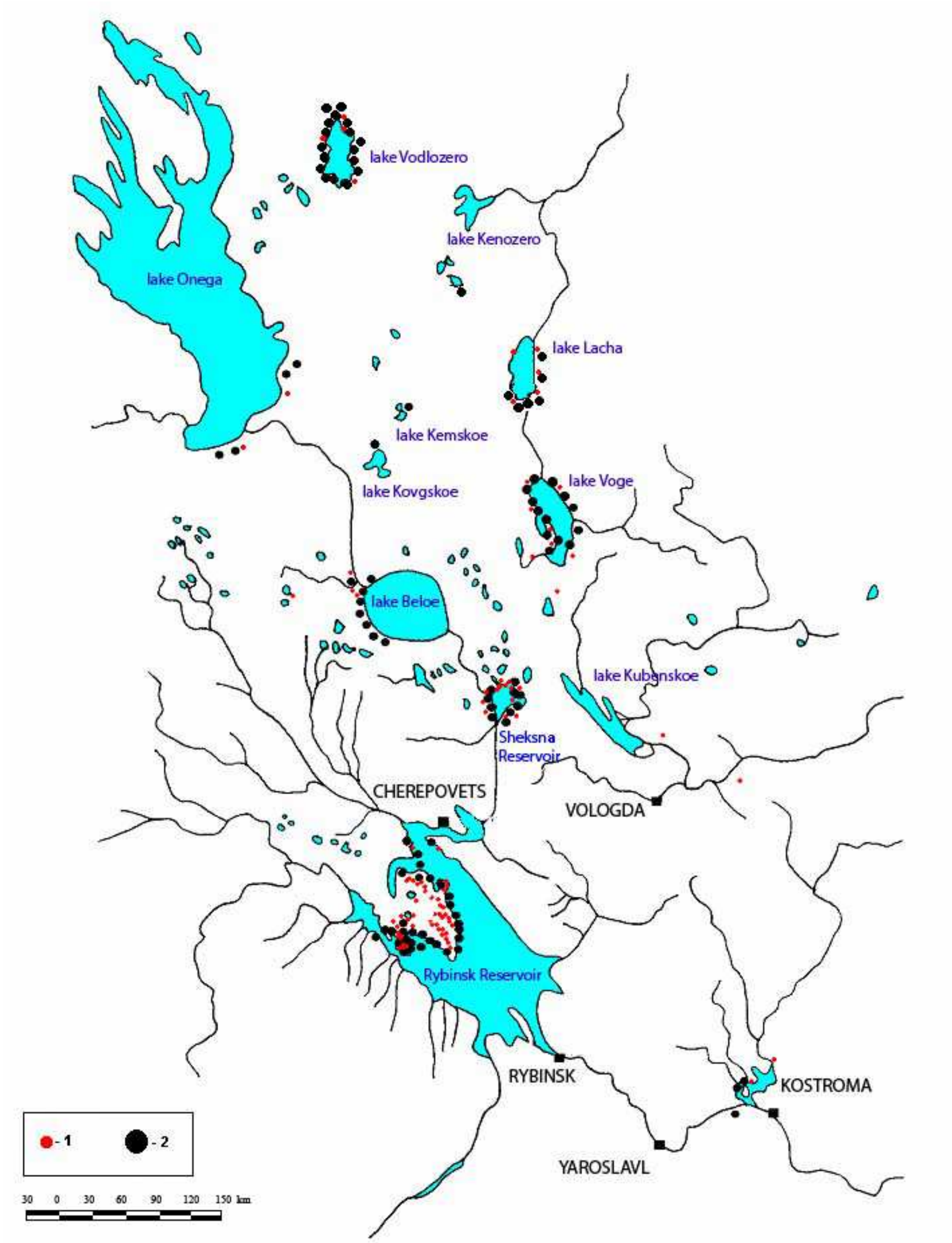

Figure 1. Distribution of White-tailed Sea Eagle (2) and Osprey (1) nests in the Vologda Lake District and southeastern Onego area.

The area belongs to southern and middle taiga and is covered by a dense network of river systems with numerous lakes, the largest ones being Onego, Beloye, Vozhe, Lacha, Vodlozero, Kubenskoye, Kenozero, Lekshmozero, Kovzhskoye and several others. The Volga-Baltic water system includes also two large impoundment reservoirs, Rybinsk and Sheksna. In the very southeast of the area, within the Yaroslavl region Volga area, there is another artificial reservoir, the Kostroma pond of the Gorkovsky reservoir.

Most of the territory belongs to the Vologda Lake District (Poozerje), an area occupying westernmost parts of the Vologda region. The area clearly resembles glaciolacustrine landscapes of Fennoscandia and is their southeastward extension terminating in the Mologa–Sheksna lowland. In the north, the study area covers southern and eastern Onego area including the Prionezhje lowland with the Megra lake group, Vodlozero area, Kenozero area and Vozhe–Lacha lowland. Vast spaces north of the Cherepovets–Vologda gradient are occupied by large forest and mire areas, and human population there grows much sparser, being less than 2–3 persons per square kilometre in northwestern parts. These environments are exceptionally favourable for the life of rare raptors, first of all fish-eating species, the Osprey and the White-tailed Sea Eagle.

Our studies aimed to determine the abundance and spatial distribution of rare raptor species in the area and to find out the measures required for their conservation.

MATERIAL AND METHODS

Summer bird counts were made during expeditions using portable motorboats and kayaks, transported from one water-body to another by an off-road vehicle. River and lake waterways being abundant, surveys were mostly made from water. Radial routes were walked in stopover sites. In winter, the same vehicle was used to transport a snowmobile, from which vast riparian and shoreline forests and mires that are difficult to access in summer were inspected for raptor nests. In addition, the Vologda Lake District was several times surveyed from a helicopter (1993, 1999, 2002). Owing to the use of technical means we significantly raised the efficiency of field activities, managed to cover vast spaces and find dozens of nests within a short time period.

In addition to field trips around the Vologda Lake District and adjacent areas, we surveyed permanent plots in SW parts of the region, Darwin reserve and Cherepovets surroundings.

1. The Darwin Strict Nature Reserve, the total area of which is 1126 km^2 (“Zapovednik” research station), is situated in the northwest of European Russia, in upper reaches of the Volga River, in the northwestern part of the Rybinsk reservoir. The reserve occupies the SE tip of the lowland peninsula in the former Mologa and Sheksna water divide (fig. 2). Most of the peninsula is under raised bogs alternating with pine and mixed forests growing on ridges. Oligotrophic bogs (60–65%) and paludified pine forests prevail in the vegetation of the reserve. Minor areas are occupied by spruce and mixed-spruce forests, meadows and fens (Isakov 1949, 1953, Leontiev 1957).

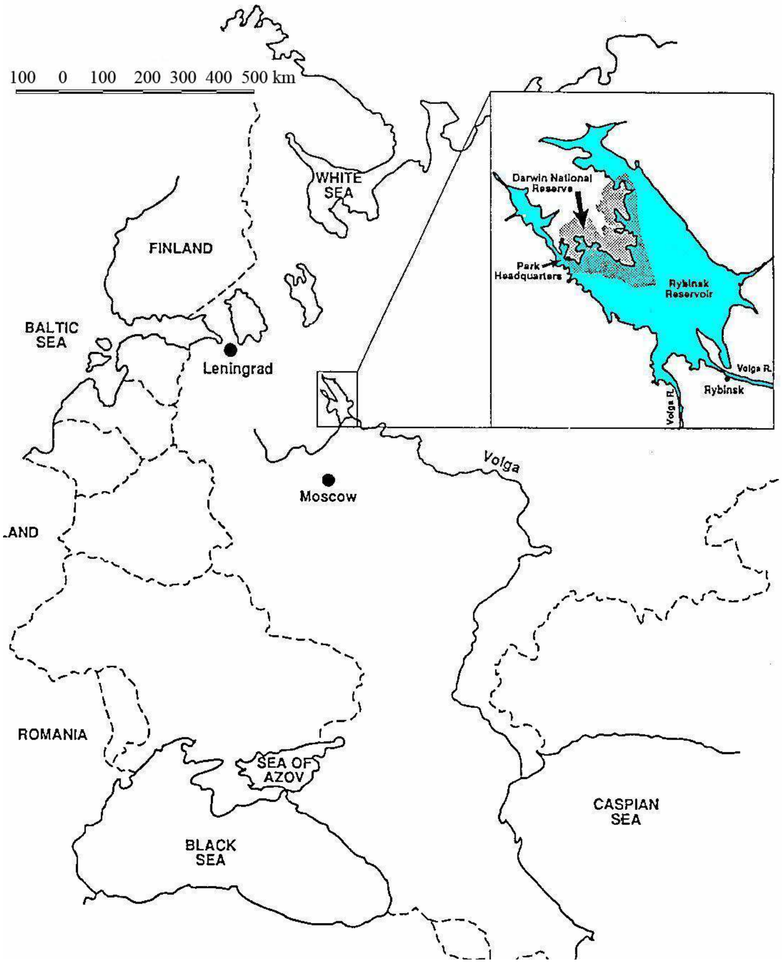

Figure 2. Location of the Darwin reserve in European Russia.

2. The Cherepovets research station area (125 km^2), where *Falconiformes* were studied from 1999 to 2005, is situated in the immediate vicinity of the city of Cherepovets, on the left-hand (SE) shore of the Sheksna branch of the Rybinsk reservoir. The station is NE of the reserve, 15 km away from its boundary. Most of the area is under mixed forests where conifers (pine, spruce) prevail. Raised bogs occupy ca. 35% of the research station territory (Babushkin 2003, 2006).

Between 1999 and 2002, eight expeditions covering an area from Kostroma and Yaroslavl in the south to Vodlozero and Kenozero in the north took place (Kuznetsov 1999, 2000a, 2002, Kuznetsov & Babushkin 2003). In 1999, a winter and a summer expedition to the Sheksna reservoir, and an aerial survey of the Vologda Lake District from the Rybinsk reservoir to the southern Onego area were carried out. In 2000, the Yaroslavl part of the Volga area, the Kostroma lowland and Lake Vozhe were surveyed. In 2001, a summer and a winter expeditions to Lake Vozhe, as well as a survey of the southern Onego area and Vodlozero area, were implemented. In 2002, there was an aerial survey of the Rybinsk and Sheksna reservoirs and an expedition to Lake Lacha and Kenozero area, within which the territory from Lake Beloye to Lake Kenozero was investigated.

Thus, within a short time period we surveyed nearly all large- and medium-size lakes in the vast northern part of the forest zone, finding dozens of nests and nesting areas of the Osprey and the White-tailed Sea Eagle.

RESULTS AND DISCUSSION

The studies have demonstrated that the Osprey and White-tailed Sea Eagle in the study area form high-density source areas around large lakes and impoundment reservoirs. The largest source area with high abundance of the species is on the Rybinsk reservoir in the Darwin reserve and its buffer zone. There now live up to 35 pairs of Sea Eagles and up to 55 pairs of Ospreys.

Since the reserve designation some 60 years ago, the abundance of both species has grown notably. Several factors have played the key part in that.

The first one is the presence of a large, fish-rich body of water, the Rybinsk reservoir, since its impoundment. The next factor is the availability of convenient breeding and hunting grounds. Upon impoundment, the central, paludified parts of the drainage divide drew closer to the reservoir coastal zone. This fact had a significant effect on the Osprey. An essential factor for the White-tailed Sea Eagle was the presence of old high forests along the shore, because it is there where most of the nests of this soecies were located (Kuznetsov 1998, 1999, Kuznetsov & Romanov 2001, Kuznetsov & Reif 1998). The wilderness regime was particularly important for the formation of Osprey and White-tailed Sea Eagle populations. Where the combination of the first two factors made the existence of the two species in the Mologa–Sheksna interfluve feasible, the absence of the disturbance factor enabled them to reach the highest possible abundance in the settlings (Kuznetsov & Nemtsev 1998, 2000).

Prior to impoundment, occasional Osprey pairs nested in mires near large lakes in the least disturbed parts of the Mologa-Sheksna interfluve. Some of these nesting areas are still in use (Kuznetsov 1997). No data are available concerning breeding of the White-tailed Sea Eagle in the territory prior to impoundment (Isakov 1949, Nemtsev 1953, 1988).

In the first decade upon the reserve designation (1945–1955) there were singular pairs of the Osprey and White-tailed Sea Eagle breeding in flooded forests (fig. 3).

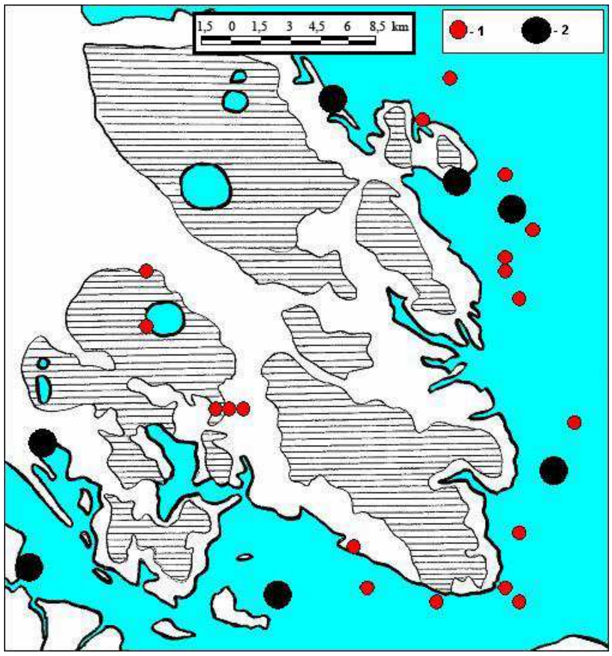

Figure 3. Distribution of White-tailed Sea Eagle (2) and Osprey (1) nests in the Darwin reserve in 1945-1955.

As the forests died, the nests of both species gradually moved closer to the shores, the White-tailed Sea Eagle now nesting on live trees in shoreline forests.

In the following decade (1956–1965), some Osprey nests were situated on mires already, since the flooded forest was dying but still close to the reservoir shoreline. As the Osprey was colonizing mires, its abundance increased. In the same time period, the White-tailed Sea Eagle started nesting on large trees on edges of forests growing on ridges along the shore, also gradually leaving flooded forests (fig. 4).

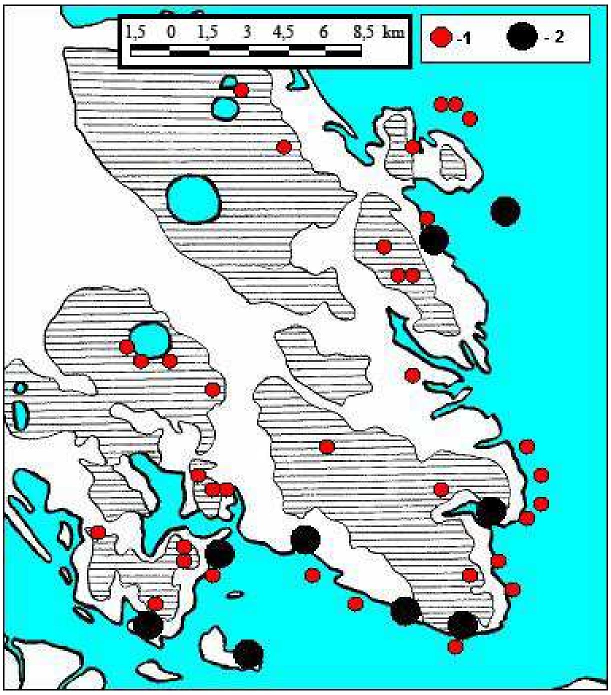

Figure 4. Distribution of White-tailed Sea Eagle (2) and Osprey (1) nests in the Darwin reserve in 1956-1965.

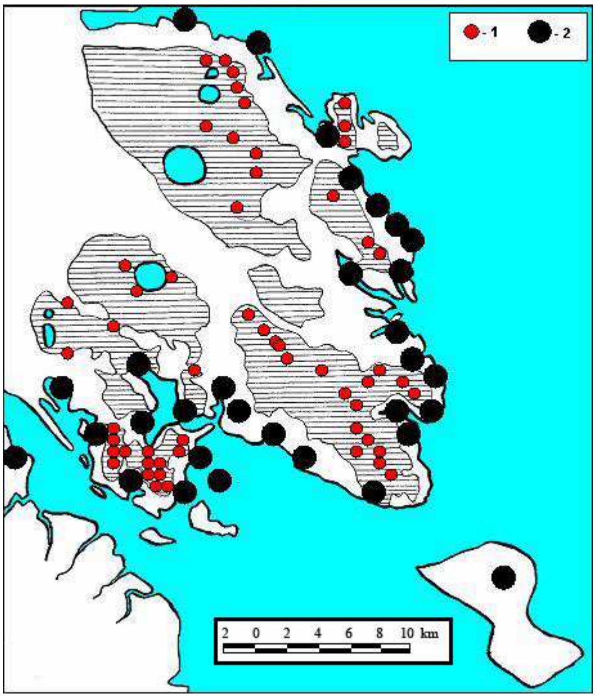

Figure 5. Distribution of White-tailed Sea Eagle (2) and Osprey (1) nests in the Darwin reserve in 2000.

In the 1970s, nearly all Sea Eagle nests were already along the shoreline, and most Osprey nests in raised bogs. There were only very few Osprey nests remaining along the shore (Kuznetsov & Nemtsev 2000). Meanwhile, the White-tailed Sea Eagles occupied all of the shore area, nest spacing being about even (3.5 km on average). The distribution of Sea Eagle nests began to resemble a string of pearls along the upper boundary of the temporarily flooded zone. The evenness of nest distribution along the upper edge of the temporarily flooded zone with nearly equal distances between nests indicates that the White-tailed Sea Eagle population density was close to the carrying capacity (Kuznetsov & Reif 1998). Figure 5 shows the distribution of the White-tailed Sea Eagle and Osprey nests in the reserve in 2000. The distance between the closest nests was from 1.5 to 7 km. The main nesting biotopes for the Sea Eagle in the reserve are areas of chiefly old-growth forest with a low canopy closure (60% on average), and a complex species composition of the tree stand: mixed pine-spruce-birch forests, as well as pine forests and spruce forests mixed with birch and aspen.

There are also some features in the nesting pattern that are common for Sea Eagles of the Darwin reserve and those nesting on Sheksna reservoir, Lakes Vozhe, Lacha and Vodlozero:

1) The capacity to densely populate suitable habitats, when the nests of neighbouring pairs are 2–3 km (sometimes even less than 1 km) apart. Such dense breeding populations of the Sea Eagle are not to be found elsewhere in Europe (northern coast of the Scandinavian Peninsula, Baltic Sea coast, northern Caspian coast, etc.). A notable fact is the lack of areas with closely situated Sea Eagle nests on the southern and western shores of Lake Onego which we have surveyed. Only individual occupied nests large distances apart from each other can be found there, although the Prionezhje lowland is very favourable for breeding of the White-tailed Sea Eagle. Apparently, the Sea Eagle population in the Onego area is mainly composed of local birds incapable of forming compact populations. Only 4 Sea Eagle pairs and 2–3 Osprey pairs were registered from the whole investigated stretch of the Onego shore from Svir to Lake Muromskoye.

2) Multi-year nest fidelity with no alternative nests present. E.g., some nests in the reserve have been occupied by Sea Eagles 10–15 or more years in succession.

3) Nest siting as close to the shore as possible, so that most nests are visible from water. The same peculiarities are characteristic of Sea Eagles from the Sheksna reservoir, Lakes Vozhe and Vodlozero. Sea Eagles inhabiting these areas appear to constitute a single population differing in a number of traits from the populations living on seacoasts and along large lakes such as Lake Ladoga and Onego.

The spatio-ethological structure of the Osprey population in the Darwin reserve established in its present-day form by the early 1990s. Its characteristic feature is the absence of nests in the shore area (not a single one). Osprey nests are arranged in several relatively compact groups, the smallest distance between occupied nests being 140 m, the longest 4 km. Compared to data from previous years (Kuznetsov 2000b), the distribution of Osprey nests has changed somewhat from central parts of the peninsula towards coasts, the total numbers remaining the same. Since counts in recent years do not cover the whole reserve territory, only the part where counts were done in 2002–2005 is shown in the figure (fig. 6). Osprey nest groupings in mires form spatially linear structures arranged along the axes of peninsulas or between the reservoir shore and large inland lakes. We believe that such distribution of nests makes the birds more flexible in choosing hunting locations depending on weather conditions, first of all the wind direction. A probable reason for shifting nests from inland sites remote from the reservoir closer to the shore was a reduction in the reservoir fish production. Long flights for food in combination with a greater catching effort now caused inexpedient energy losses, wherefore pairs stopped nesting too far away from the shore. When in the 1990s Osprey nests were quite often situated 8–9 km away from the reservoir shore, the distance now is 3–4 km.

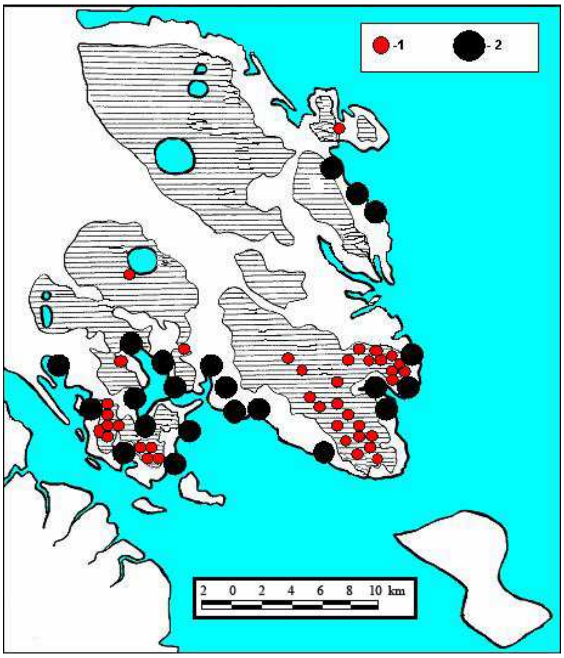

Figure 6. Current (2003–2005) distribution of White-tailed Sea Eagle (2) and Osprey (1) nests in the Darwin reserve.

The unique conditions that have been formed in the peninsula remaining from the former Mologa–Sheksna interfluve promoted a rise in the abundance of both species. There were few Osprey and White-tailed Sea Eagle pairs in the reserve in its early years, there now nest 40–45 pairs of the Osprey and 25–30 pairs of the Sea Eagle. Another 10–15 Osprey pairs and 5–10 Sea Eagle pairs nest outside the reserve, mainly in its buffer zone. The abundance of both species has not stabilized yet, since the numbers keep growing (fig. 7, fig. 8). The Osprey population density in the reserve is 70 breeding pairs per 1000 km^2 of land area at present. The value for the White-tailed Sea Eagle is 45 breeding pairs per 1000 km^2. Another 10–15 Osprey pairs and 4–5 Sea Eagle pairs nest in the parts of the peninsula adjoining the reserve. Only occasional Osprey and Sea Eagle pairs may occur in the rest of the Rybinsk reservoir coast. Thus, the Rybinsk reservoir Osprey population comprises 50–55 breeding pairs, and the White-tailed Sea Eagle population 30–35 breeding pairs. Nearly all nests are situated in the Mologa–Sheksna peninsula, the majority in the Darwin reserve.

By the mid-1980s – early 1990s, the abundance of the two species in the reserve reached a level when juveniles started dispersing actively from this high-density source area to colonize habitats similar to those in the reserve. Knowing data on breeding performance, we estimated the scope of the species dispersal. Breeding success was calculated for the total number of pairs with known breeding outcome and for successfully breeding pairs. Over the past 20 years, this parameter for the Osprey ranged from 1.12 to 2.45 young per a successfully breeding pair, the mean for 133 nests surveyed being 1.77 young per a successfully breeding pair. Osprey breeding success values have been increasing since 1986 (fig. 9). Thus, 40–45 successful nests now annually produce 50–55 juveniles, most of which start nesting outside the reserve. Similar calculations for the White-tailed Sea Eagle based on inspection of 179 nests show that the species breeding success per breeding pair varied among years from 0.54 to 0.82 young, the 20-year mean being 0.75 young per pair. Hence, ca. 20 young White-tailed Sea Eagles leave from 25 occupied nests in the reserve. Each successfully breeding Sea Eagle pair produced 1.22 to 2.00 young, the average being 1.51 fledglings. This steadily high breeding performance indicates a relative well-being of Osprey and White-tailed Sea Eagle populations in the Rybinsk reservoir area. In contrast to the Osprey, the White-tailed Sea Eagle breeding success, expressed as the number of young per a successfully breeding pair, has remained quite stable since 1986 (fig. 10).

The most detailed data on the dynamics of the Osprey and White-tailed Sea Eagle dispersal from the Darwin reserve were gathered in the 1980s–1990s from the Sheksna reservoir. Nowadays, it is the area with the natural habitat closest to those at the Rybinsk reservoir. Sheksna reservoir was formed in 1964 upon impoundment of the water-logged lowland situated where rivers Siz'ma, Slavyanka, Sosha, Lendoma and others emptied into Sheksna. Large forest and mire areas were then flooded. Since the reservoir appeared later than the Rybinsk reservoir, remains of flooded forests can still be found there. On Sheksna reservoir the Osprey nests mainly in flooded forests, as it used to do on Rybinsk reservoir. Like in the Darwin reserve, White-tailed Sea Eagle

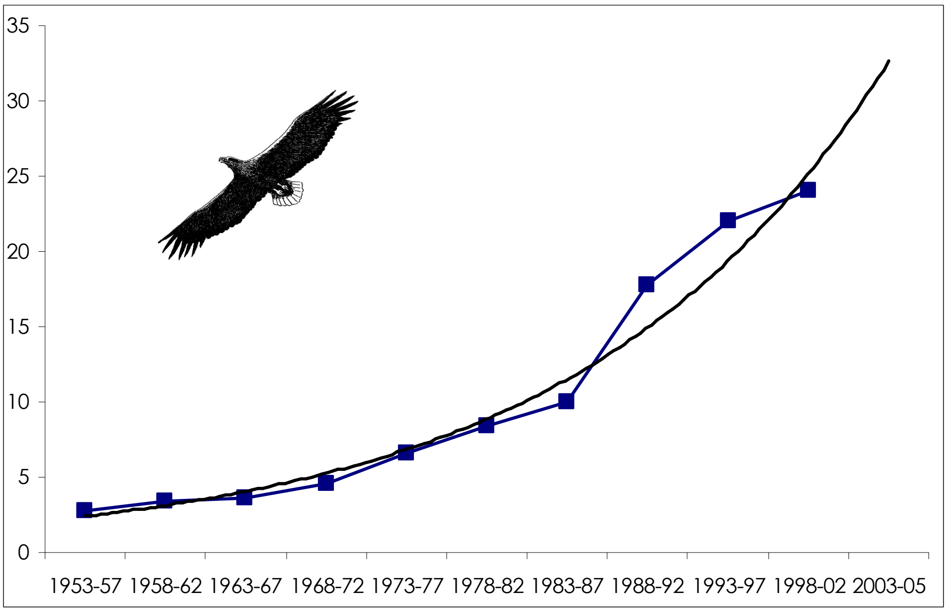

Figure 7. The number of the White-tailed Sea Eagle pairs in the Darwin reserve in 1953–2005 (5-year averages).

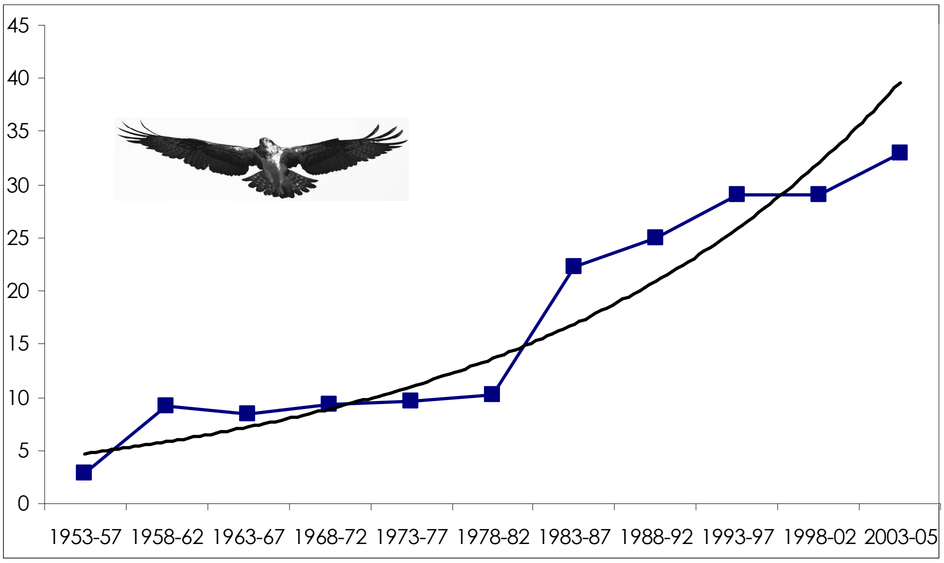

Figure 8. The number of Osprey pairs in the Darwin reserve in 1953–2005 (5-year averages).

nests are confined to the shoreline of the reservoir and its bays, and distributed quite evenly.

Aerial survey of the Sheksna reservoir was made in 1988, 1993 and 1999. Thus, in 1988 (Belko 1990), 3 Osprey nests and 3 White-tailed Sea Eagle nests were discovered (fig. 11). In 1993 there were already 6 Sea Eagle and 9 Osprey pairs nesting around the reservoir (fig. 12), and in 1999 surveys revealed 11 Sea Eagle nests and 13 Osprey nests (fig. 13). Sampling counts in later years proved that Osprey and Sea Eagle abundance did not decrease, but most probably even increased somewhat.

New Osprey nests have lately been found in the northern part of the reservoir, in mires along peninsula axes. This is happening because the flooded forests are dying back and the birds, like on Rybinsk reservoir, are forced to move their nesting areas to raised bogs. A substantial part of Osprey nests, however, still remain on dead standing trees in the flooded zone.

Similar abundance growth processes, most probably related to dispersal from the high-density source area in the Darwin reserve, were underway around other large bodies of water in the region.

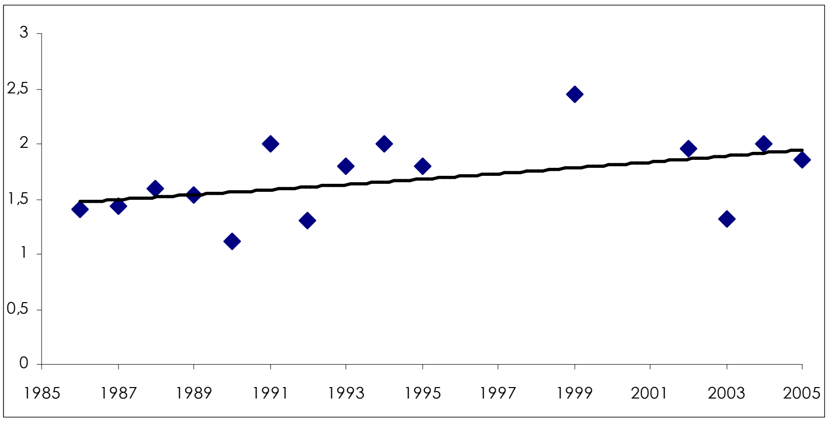

Figure 9. Osprey breeding success in the Darwin reserve (1986–2005). The number of young leaving the nest per a successfully breeding pair.

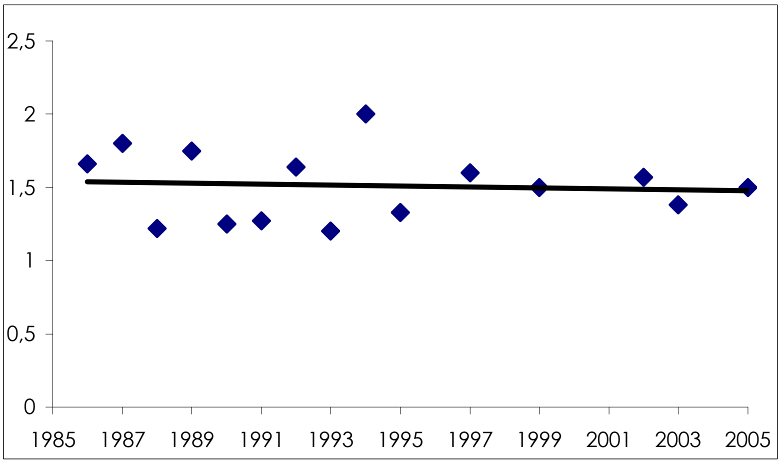

Figure 10. White-tailed Sea Eagle breeding success in the Darwin reserve (1986–2005). The number of young leaving the nest per a successfully breeding pair.

In the 1980s, new areas inhabited by the White-tailed Sea Eagle and Osprey began appearing at Lakes Vodlozero and Beloye. In the late 1980s, the Vodlozero population was estimated at 10 pairs (Sazonov 1995), in the early 1990s at 12–15 pairs (Zimin 1995), in 1995 15–16, and in 1998–1999 23 pairs (Sazonov et al. 2001).

The White-tailed Sea Eagle abundance around Lake Vozhe also started to increase in the late 1980s. We inspected Lake Vozhe shore from helicopter in 1993 and 1999. These reconnaissance surveys revealed the presence of quite a few rare raptor species, wherefore a specialized expedition was organized in the summer of 2000 to survey Lake Vozhe and adjacent lakes and mires.

A helicopter survey of Lake Vozhe shores in 1988 revealed 3 White-tailed Sea Eagle nests, 2 Golden Eagle nests and 1 Osprey nest (Belko 1990). Finds of the 2000 expedition to the lake and its surroundings included 11 breeding White-tailed Sea Eagle pairs and 9 Osprey pairs (fig. 14) (Babushkin et al. 2000).

Lake Beloye shore was surveyed from helicopter in 1988. One White-tailed Sea Eagle nest and 5 Osprey nests were detected (Belko 1990). In 1993, we managed to survey the western shore of the lake only, and sighted 6 breeding pairs of the White-tailed Sea Eagle and one Osprey pair. At present, 6–8 Sea Eagle pairs and 4–5 Osprey pairs nest along Lake Beloye.

Thus, a notable rise in the abundance of the Osprey (by 4.6 times on average) and of the White-tailed Sea Eagle (4.0 times on average) at the Sheksna reservoir, Lakes Vozhe and Beloye was recorded in the 1990s.

In May–June 2001, an expedition was made to southern and eastern parts of the Onego area. We surveyed the Megra River stretch from the Megrsky pogost to the Onego canal, the Onego bypass from Urmozero to Lake Zhabinskoye, and lakes

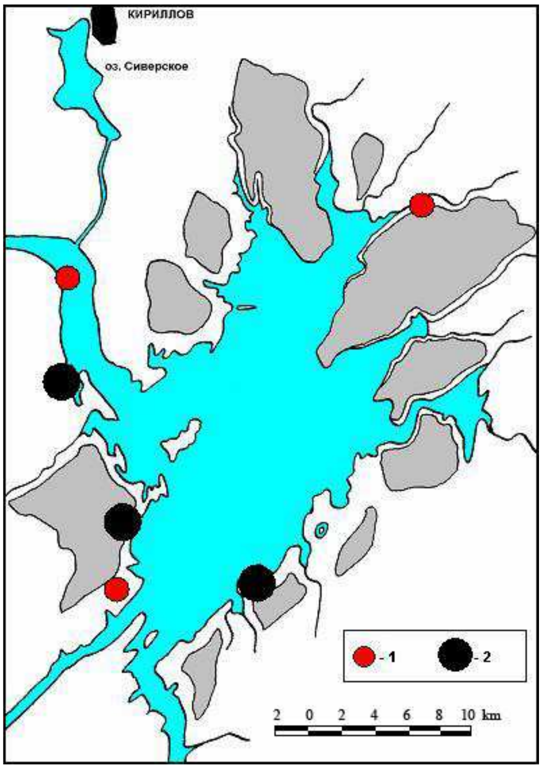

Figure 11. Distribution of White-tailed Sea Eagle (2) and Osprey (1) nests around Sheksna reservoir in 1988, after Belko (1990).

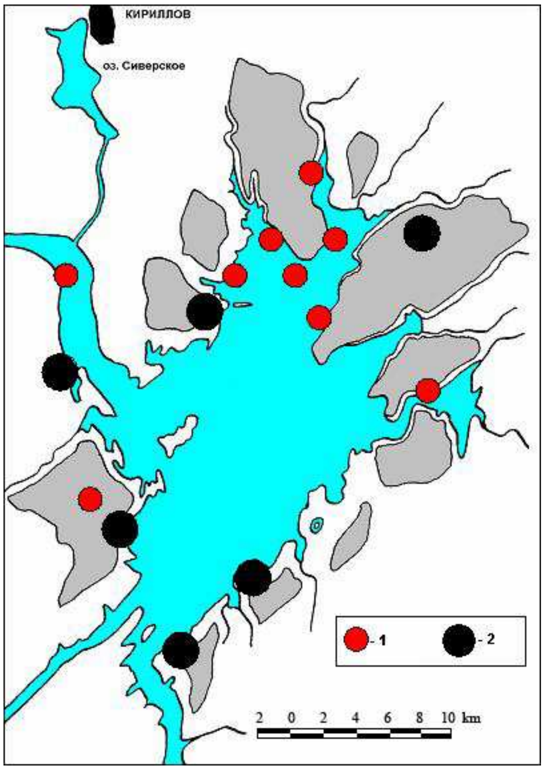

Figure 12. Distribution of White-tailed Sea Eagle (2) and Osprey (1) nests around Sheksna reservoir in 1993.

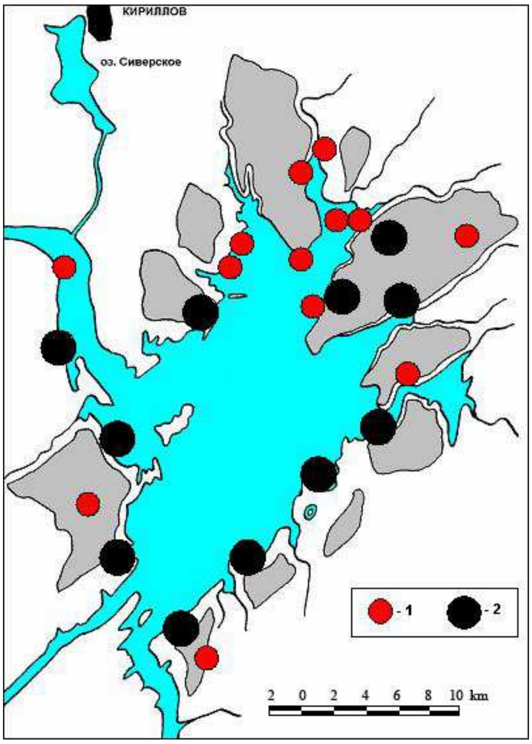

Figure 13. Distribution of White-tailed Sea Eagle (2) and Osprey (1) nests around Sheksna reservoir in 1999.

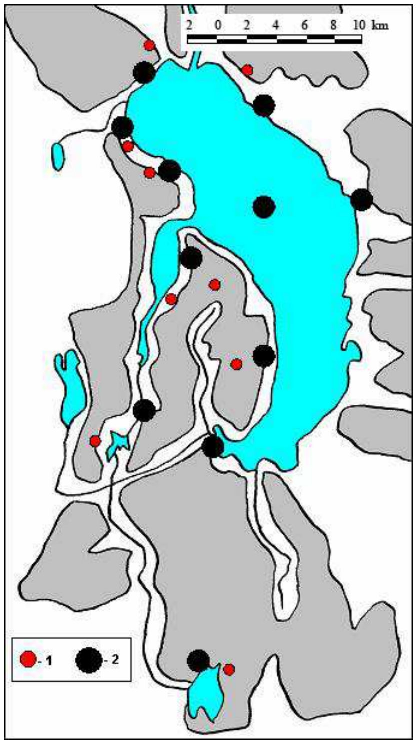

Figure 14. Distribution of White-tailed Sea Eagle (2) and Osprey (1) nests around Lake Vozhe in 2000.

Proezdnoye, Kirgozero, Urmozero, Chagozero, Kobylje, Megrskoye, Kedrinskoye, Vodlitskoye, Igumnovo, Karasevo, Zhabinskoye, Vehkozero, Muromskoye, Vodlozero and lower reaches of River Ileksa.

An 8 to 15 km wide belt comprising depressions and whole systems of residual lakes along Lake Onego shore from River Oshta to Lake Muromskoye is inhabited by no more than 4–5 White-tailed Sea Eagle pairs and 5–6 Osprey pairs. We found 2 occupied nests of the Osprey (one in a Sea Eagle nest) and 3 nesting areas of the species, as well as 2 occupied nests and 2 nesting areas of the White-tailed Sea Eagle.

The highest population density of the White-tailed Sea Eagle was recorded from the Vodlozero area, where we managed, with assistance of the Vodlozersky national park staff, to inspect 13 nests of the species, only 4 of which turned out to be occupied. Taking data from previous surveys (Sazonov 1995, Zimin 1995, Högmander et al. 2001, Sazonov et al. 2001) and data gathered by the national park staff into account, at least 20–25 White-tailed Sea Eagle pairs and 10–15 Osprey pairs nest around Vodlozero. The Vodlozero breeding group of White-tailed Sea Eagles is noted to a high population density and minimal, 3–3.5 km, distance between occupied nests. This feature makes Sea Eagles from the Vodlozero area similar to the birds living on other inland lakes of Northwest Russia (Lakes Beloye, Lake Vozhe, Sheksna and Rybinsk reservoirs).

In 2002, an expedition was held to Lake Lacha and the Kenozersky national park. Lakes of the area such as Druzhinnoye, Kovzhskoye, Lacha, Lekshmozero and Kenozero were surveyed. Only some breeding pairs of the Osprey and Sea Eagle were observed around the lakes. The largest breeding grouping of the species was on Lake Lacha, 7 Osprey and 5 White-tailed Sea Eagle pairs. Registrations from the Kenozero area included 5 breeding pairs of the Osprey and no Sea Eagle pairs. Lekshmozero area and Lake Kovzhskoye harboured 2 Osprey pairs and 2 Sea Eagle pairs each.

One should note that the White-tailed Sea Eagle and Osprey settle almost exclusively in those areas along the shore where the level of disturbance is quite low. Thus, the Sea Eagle is nearly absent from Lake Kubenskoye, from northern parts of the Lake Lacha area near Kargopol, from the northern, eastern and southern shores of Lake Beloye, i.e. from areas with a dense human population and, correspondingly, heavy disturbance. On the other hand, an occupied White-tailed Sea Eagle nest was found in the Cherepovets city green belt in 1999, and in 1998 an occupied Osprey nest was detected just 1.5 km away from the Cherepovets industrial zone (Kuznetsov & Babushkin 2003, Babushkin 2003). The phenomenon is apparently due to the vicinity of the Darwin reserve high-density source area.

The White-tailed Sea Eagle does not nest on small and even medium-size lakes, showing under the study area conditions obvious preference for larger water-bodies. This fact makes species counts much easier. The inland populations of the Osprey and White-tailed Sea Eagle that have formed in the Vologda Lake District and eastern Onego area are essential for the whole NW Russia as a high-abundance source from which juveniles of the species continuously disperse.

The main characteristic feature of the White-tailed Sea Eagle population in the study area is the tendency to form dense settlements along large inland water-bodies (lakes and impoundment reservoirs) in the forest zone. The population totals ca. 100 pairs. About a third of the population lives in the Darwin reserve on Rybinsk reservoir (30–35 pairs), constituting the biggest source from which birds have apparently dispersed to other large water-bodies of the region in the 1980s–1990s. The second largest source is the Vodlozero area, where 20–25 pairs breed. The breeding population at Sheksna reservoir is 10–12 pairs, at Lake Vozhe 10–13 pairs, along the western shore of Lake Beloye 6–8 pairs, at Lake Lacha 5–6 pairs, at the Kostroma pond of the Gorkovksky reservoir 2–3 pairs. One or two pairs were detected on each of Kovzhskoye, Lekshmozero and some other lakes of the region.

Similar tendencies were observed in the distribution of the Osprey, the population of which on the NW shore of the Rybinsk reservoir (Darwin reserve and its buffer zone) is denser than that of the White-tailed Sea Eagle. There breed 50–55 pairs of the Osprey. Including recent nest finds (D. Shitikov, unpublished), up to 20 pairs nest on Sheksna reservoir. On lakes like Beloye, Lacha, Vozhe and Vodlozero, Osprey abundance (4 to 10 breeding pairs) is far lower than that of the White-tailed Sea Eagle. On the other hand, some Osprey pairs nesting at small lakes and in mires near river banks remained outside the counts. Thus, we estimate the total abundance of the Osprey in the Vologda Lake District and south-eastern Onego area to be 150–180 breeding pairs, of which ca. 30% inhabit the Darwin reserve and its buffer zone.

Acknowledgements. The authors dedicate the present paper to the revered memory of V. Nemtsev, PhD, Senior Researcher in the Darwin reserve, ornithologist, who devoted his whole life to the reserve.

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SPRING MIGRATION OF THE *FALCONIFORMES* FAUNA IN THE SOUTH OF RUSSIAN KARELIA

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The species composition, abundance, timing of arrival and spatial distribution of birds of the order *Falconiformes* in the spring season was studied for several years in southern Karelia. There currently occur 21 diurnal raptor species in the territory. For most species in question the present-day status was determined, and the timing of arrival, seasonal dynamics of the abundance and its variation among years were identified using data from counts.

Key words: spring migration, *Falconiformes*, southern Karelia, species composition, abundance.

ВЕСЕННИЙ АСПЕКТ ФАУНЫ ПТИЦ ОТР. *FALCONIFORMES* ЮЖНОЙ КАРЕЛИИ (РОССИЯ). Лапшин Н.В., Артемьев А.В., Зимин В.Б. *Институт биологии Карельского научного центра РАН, Петрозаводск, Россия.*

На протяжении ряда лет в весенний период изучался видовой состав, численность, сроки прилета и распределение по территории представителей отр. Соколообразных *Falconiformes* в южной Карелии. Установлено, что в настоящее время на территории обитает 21 вид дневных хищных птиц. Для большинства изученных видов установлен современный статус, а на основании данных количественных учетов определены сроки прилета, сезонная динамика численности и ее изменчивость по годам.

Ключевые слова: весенний аспект, соколообразные, южная Карелия, видовой состав, численность.

INTRODUCTION

Material was gathered from an area in the very south of Russian Karelia, in the Olonets district, 18 km east of Lake Ladoga shore. It is one of republic's main agrarian districts. Farmland occupies ca. 18,000 ha of drained fields. In April–May, during the spring migration, it is one of the largest staging areas for *Anseriformes* in northern Europe. When monitoring *Anseriformes* in the area for over 10 years, we had a chance to simultaneously gather material on other groups of birds (Zimin et al. 1997a, 1997b). In this period, availability of open habitats (fields, meadows, mires) surrounded by forests, and vicinity of Lake Ladoga are quite favourable also for raptors of the order *Falconiformes*. The main aim of the study was to assess the present-day status of diurnal raptors in the study area, and the following tasks were fulfilled to this end:

- updating the bird species checklist,
- determination of the time of the birds' arrival in and departure from (for passage migrants) the study area,
- determination of the relative abundance of the species and their dynamics over the spring season, as well as dynamics of the abundance across years.

MATERIAL AND METHODS

Reconnaissance 2–3-week trips to the Olonets plain began in 1993. Since 1997, the dates of starting the activities have depended on the characteristics of the spring and the time of geese's stay in the study area, the work usually continuing from mid-April to 25–26 May (time when last geese leave southern Karelia). The techniques of gathering the material remained nearly unchanged since 1997 (Zimin et al. 1998). The procedure included daily bird counts following three methods: 1) circular plot counts (from a birding tower) in the first 4 hours after sunrise, and in the first two years – additional 4-hour afternoon counts, 2) transect counts by walking a fixed 10-km route, 3) from 50–60 to 120 km transect counts by a car. In all cases, birds seen and heard were counted.

RESULTS

As the result of the activities, data on the species composition of *Falconiformes* in southern Karelia were updated (Zimin et al. 2001). There currently occur 21 species (tab. 1) of diurnal raptors, of which 1 species (*Buteo lagopus*) is a passage migrant. The status of 3 species (*Aquila clanga, A. pomarina, Falco peregrinus*) has not been definitely determined, and 1 species (*Circus macrourus*) is a regular visitor. The rest of the species breed either in the study area or in adjacent regions.

Many of the species registered from the study area are red-listed at various levels (tab. 2).

Osprey. The abundance of the Osprey *Pandion haliaetus* in Karelia at large and especially in its southern part causes no serious concern today. Locally, although mainly in protected areas (Tolvajärvi, Suojärvi District), breeding birds can even be said to concentrate. In all periods of the year the species is quite closely associated with waters and appears in agricultural habitats rather rarely.

Honey Buzzard. The Honey Buzzard *Pernis opivorus* is rather rare in the fields, usually occurring as a passage migrant only, although the species is quite common in the region in general.

Black Kite. During the spring migration period the Black Kite *Milvus migrans* is registered from SE Ladoga area in low numbers every year; it was only in 2001 that the species was more common (tab. 1).

Table 1. List of species and number of individuals of order *Falconiformes* registered in farmland in the Olonets District, Karelia in 1997–2005.

Species	Years									
	1997	1998	1999	2000	2001	2002	2003	2004	2005	Total
Circaetus gallicus	0	1	0	0	0	0	0	1	0	2
Aquila chrysaetos	0	1	6	3	0	2	1	1	0	14
Aquila clanga	0	3	0	2	0	0	0	2	0	7
Circus cyaneus	340	72	24	27	16	103	39	86	135	842
C. macrourus	8	12	1	3	8	0	0	3	1	36
C. pygargus	7	42	17	13	7	11	0	10	3	110
C. aeruginosus	69	69	20	31	7	10	19	66	9	300
Circus sp.	69	21	14	18	6	14	1	17	7	167
Haliaeetus albicilla	43	16	82	33	16	43	8	31	33	305
Milvus migrans	2	3	1	5	17	2	1	2	1	34
Pernis apivorus	2	2	1	4	2	8	0	9	0	28
Buteo buteo	139	16	19	13	4	29	4	87	33	344
B. lagopus	220	12	11	2	2	18	11	38	46	360
Buteo sp.	94	4	0	1	0	7	1	18	12	137
Accipiter gentiles	4	1	0	2	0	1	0	1	1	10
A. nisus	32	16	29	25	4	18	5	21	19	169
Pandion haliaetus	2	4	4	0	3	3	0	0	0	16
Falco tinnunculus	196	67	7	31	52	92	24	222	99	790
F. columbarius	19	37	31	47	51	26	15	39	26	291
F. subbuteo	4	4	4	2	6	2	1	0	0	23
F. vespertinus	0	0	0	0	0	1	0	0	0	1
F. peregrinus	15	18	25	1	3	2	3	2	0	69
Falco sp.	1	2	0	0	0	0	0	0	0	3
Total	1266	423	296	263	204	392	133	656	425	4058

Table 2. Nationally and regionally red-listed bird species of the order *Falconiformes* registered in the Olonets District.

Species	Species category in the Red Data Book	
	Russian Federation	Republic of Karelia
Pandion haliaetus	3	3
Milvus migrans		3
Circus macrourus	2	
Circaetus gallicus	2	1
Aquila pomarina	2	
Aquila clanga	2	2
Aquila chrysaetos	3	2
Haliaeetus albicilla	3	2
Falco rusticolus	2	1
Falco peregrinus	2	1
Falco columbarius		4
Falco tinnunculus		4

Harriers. Two species – the Hen Harrier *Circus cyaneus* and the Marsh Harrier *C. aeruginosus* – are common in farmlands in southern Karelia, but the former one is twice as abundant as the latter. Two recently registered species – Montagu's and the Pallid Harriers (*C. pygargus* and *C. macrourus*) – continue colonizing the territory of southern Karelia**.** Montagu's Harrier can already be definitely classified as a breeder in Karelia, whereas for the other species no reliable evidence of breeding is available yet, but there is a video record of display by a male.

Hawks and buzzards. High density of prey birds and abundance of voles in farmland attract raptors breeding in surrounding forests, the Goshawk *Accipiter gentilis,* the Sparrowhawk *A. nisus* and the Common Buzzard *Buteo buteo***.** During the spring migration, Rough-legged Buzzards *B. lagopus,* mostly already gone during the study period, also concentrate in the fields. The abundance of *Buteo* species remained rather low throughout the period of studies with among-year variations.

Short-toed Eagle. Another representative of the southern avifauna – the Short-toed Eagle *Circaetus gallicus,* which is also red-listed in Russia and other counties – was registered in the past decade as a vagrant spring visitor. In the spring of 1997, however, Short-toed Eagles were many times sighted near Olonets. All records come from about the same locality – near Sarmyagi and Rypushkalitsy villages and Chupasuo mire. In June, the birds were encountered there again, but there was a pair of them now, one carrying a snake in its talons. There is thus a probability that Short-toed Eagles nested in the area that year.

Eagles. Since 1997, only 7 reliable spring contacts of the Spotted Eagle *Aquila clanga* have been known from SE Ladoga area. Accurate data on the species breeding in the republic are still missing. A single Lesser Spotted Eagle *A. pomarina* was observed in May 2000 over Olonets grasslands. Two individuals of the species were presumably seen in the same area in the early 1990s (not included in tab. 1). In northern Europe, the Golden Eagle *A. chrysaetos* usually nests in dark coniferous boreal forests. At least 2 pairs of the species now nest around the Olonets grasslands. Single individuals were seen hunting wounded geese over the fields nearly every year.

White-tailed Sea Eagle. In most districts of Karelia, the White-tailed Sea Eagle *Haliaeetus albicilla* population remains very scant (the exception is the Vodlozero National Park), but results from several latest years indicate that the species' abundance in southern Karelia has stabilized and possibly even increased somewhat. New settlements of White-tailed Sea Eagle pairs were detected on Lake Ladoga, in the Olonets and Pitkäranta districts. In April and May, when up to several tens of thousands of geese gather in the Olonets district farmland simultaneously, White-tailed Sea Eagles come there from Lake Ladoga shores to prey on wounded geese. Up to 6 Sea Eagles of different age were seen at a time, and 8 different individuals were identified by a set of features (age-related and individual traits of the plumage) within a short time period.

Falcons. Single Peregrine Falcon *Falco peregrinus* individuals occur in the spring staging areas of waterfowl and shorebirds near Olonets virtually every year. All registrations, however, were made before the end of the spring migration only. No signs of breeding behaviour or observations suggesting the possibility of the Peregrine breeding in the area are known. The Hobby *F. subbuteo* is a typical representative of the district forest avifauna, and occurs in the farmland as an uncommon migrant only.

The most abundant species among falcons is the Kestrel *Falco tinnunculus*. It has almost recovered its former numbers after the depression in the 1970s–1980s, and now nests regularly in fields near Olonets. Another species also breeding there but less abundant is the Merlin *F. columbarius.* The Red-footed Falcon *F. vespertinus* was registered only once, on 15 May 2002. The species is known to have nested for several years at the southern border of the Olonets district, on a tree-grown islet in a mire in the Nizhne-Svirskiy reserve (Kovalev et al. 1996).

Since table 1 shows all data about bird contacts during counts, one can hardly speak about the absolute abundance of the species in the study area. Nonetheless, given that the method remained the same throughout the study period and activities continued annually from mid-April to 25 May, i.e. similar as well, it appears possible to analyze tendencies in the relative abundance of the counted species among years and within seasons. The data on the most common species are shown in fig. 1 and 2.

In the late 1990s and beginning of this century, many species of diurnal raptors whose life is associated with farmland experienced a sharp decline, and the depression still continues (for *Circus pygargus, Buteo lagopus, F. peregrinus,* partially for *Circus cyaneus*), apparently due to the processes underway in the agrarian management techniques of Russia, Karelia included. Thus, burning last-year's grass in April–May lowers the food resources and eliminates the grassland as a foraging habitat for a prolonged (up to 2 weeks) period of time. In addition, it destroys the birds' nests situated on the ground (*Circus sp*.) or low above the ground (*Falco tinnunculus, F. columbarius)*.

Other species which had also undergone a dramatic decline in the same period managed to recover later on (*Buteo buteo, Circus aeruginosus, Falco tinnunculus*). Abundance variations in the latter three species, which are closer associated with shore (*Haliaeetus albicilla*) or forest (*Accipiter nisus, Falco columbarius*) habitats than other raptors, appear to be less dependent on the changes ongoing in farmlands.

Figure 1. Relative abundance dynamics of some *Falconiformes* species in southern Karelia (1997–2005) (n=number of individuals).

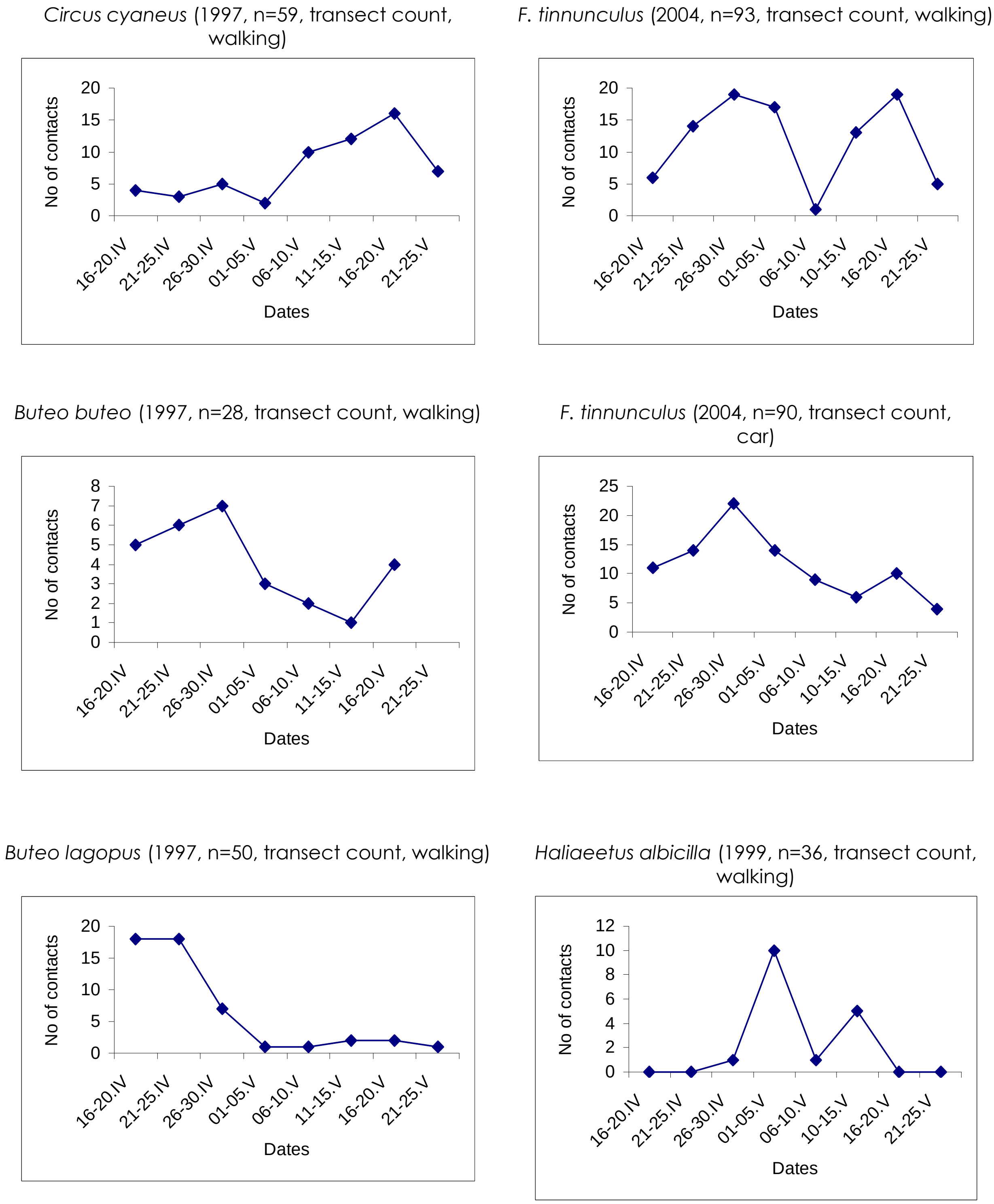

Figure 2. Abundance dynamics (no. of individuals) of some *Falconiformes* species in southern Karelia in the spring season.

Abundance dynamics in the spring season differs among species and depends on their status in the study area and the stage in the annual cycle. Passage migrants *(Buteo lagopus, Falco peregrinus*) totally disappear from counts after the migration is over. Among breeders, only local individuals stay to start producing offspring, becoming less noticeable.

Summarizing the above, the following notes can be made:

- farmland in southern Karelia, which is the core of the republic's agricultural land, is essential for conservation of *Falconiformes* species, many of which are rare, endangered and listed in national, international and regional Red Data Books;
- bird monitoring in grasslands of the Olonets plain should be continued;
- to ensure comparability of results, the material gathering technique should be made uniform;
- it would be good to involve birders, including those from abroad, in making counts.

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MONITORING AND CONSERVATION OF THE GYRFALCON (*FALCO RUSTICOLUS*) IN FINLAND

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Metsähallitus has organized an effective monitoring project of the Finnish Gyrfalcon population since the late 1990s for conservational purposes. During recent years all known territories have been controlled systematically, and new nest-sites have been searched for continuously. Territories have been controlled throughout the year to prevent disturbance and robbing of eggs and young. Except for a few tree-nesting pairs, practically all regularly occupied territories (22–32 per year) have been found. The number of pairs starting to nest, as well as the breeding success, varies considerably from year to year, probably mostly due to density of the Willow Grouse *Lagopus lagopus*. The number of nestlings per occupied territory fluctuated from 0.91 to 2.00 in 2000–2005.

Key words: Gyrfalcon, monitoring, conservation, Finland.

МОНИТОРИНГ И ОХРАНА КРЕЧЕТА (*FALCO RUSTICOLUS*) В ФИНЛЯНДИИ. М. Мела, П. Коскимиес. Служба лесов и парков Финляндии, Рованиеми, Финляндия.

С конца 90х годов прошлого века Служба лесов и парков Финляндии успешно реализует проект по мониторингу популяции кречета в Финляндии, направленный на охрану вида. В последние годы ведется систематический контроль всех известных гнездовых территорий, а также постоянный поиск новых гнездовых участков. Контроль за территориями ведется круглогодично, чтобы предотвратить повреждение гнезд и кражи яиц и птенцов. Были обнаружены практически все регулярно занимаемые территории (22–32 в год), за исключением территорий нескольких пар, гнездившися на деревьях. Количество пар, приступающих к гнездованию, а также успех воспроизводства существенно колеблются в разные годы, вероятнее всего, в связи с плотностью населения белой куропатки (*Lagopus lagopus*). Среднее количество птенцов на одной занятой гнездовой территории варьировало в 2000–2005 гг. от 0.91 до 2.00.

Ключевые слова: кречет, мониторинг, сохранение, Финляндия.

INTRODUCTION

Until the late 1990s, the monitoring of the Gyrfalcon in Finland relied on a few voluntary ornithologists and ringers (Koskimies 2006). There was, for example, no comprehensive national survey or coordination of nest controls by environmental authorities, who in fact are responsible for conservation of Gyrfalcons and other endangered species (Rassi et al. 2001). The Gyrfalcon is listed as a species in need of special conservation concern (Annex I species of EU Birds Directive). Because there was, for example, some proof of illegal robbing of Gyrfalcon eggs and young in Scandinavian countries, the Ministry of The Environment decided to intensify and integrate monitoring and protection of the Finnish population.

The breeding range of the Gyrfalcon is restricted almost exclusively to the three northernmost municipalities in Finland: in Enontekiö, Utsjoki and Inari. Most of the land in this area belongs to the state and is governed by Metsähallitus. Thus, it was natural that the Ministry of The Environment transferred the responsibility for the coordination of the monitoring and protection of the Gyrfalcon to Metsähallitus. In Metsähallitus, the work has been run by its northernmost regional unit, the personnel of which also work for many other species and projects in the breeding range of the Gyrfalcon throughout the year.

Metsähallitus founded a monitoring group in 1998 to control and to compose an integrated programme for the effective monitoring of the Gyrfalcon. This group meets annually in order to discuss the results of nest-site controls and other field-work, and to plan the guidelines of the work for the following year (fig. 1). This expert group, directed by Metsähallitus, consists of environmental authorities and researchers studying the species, and of representatives from several units of Metsähallitus.

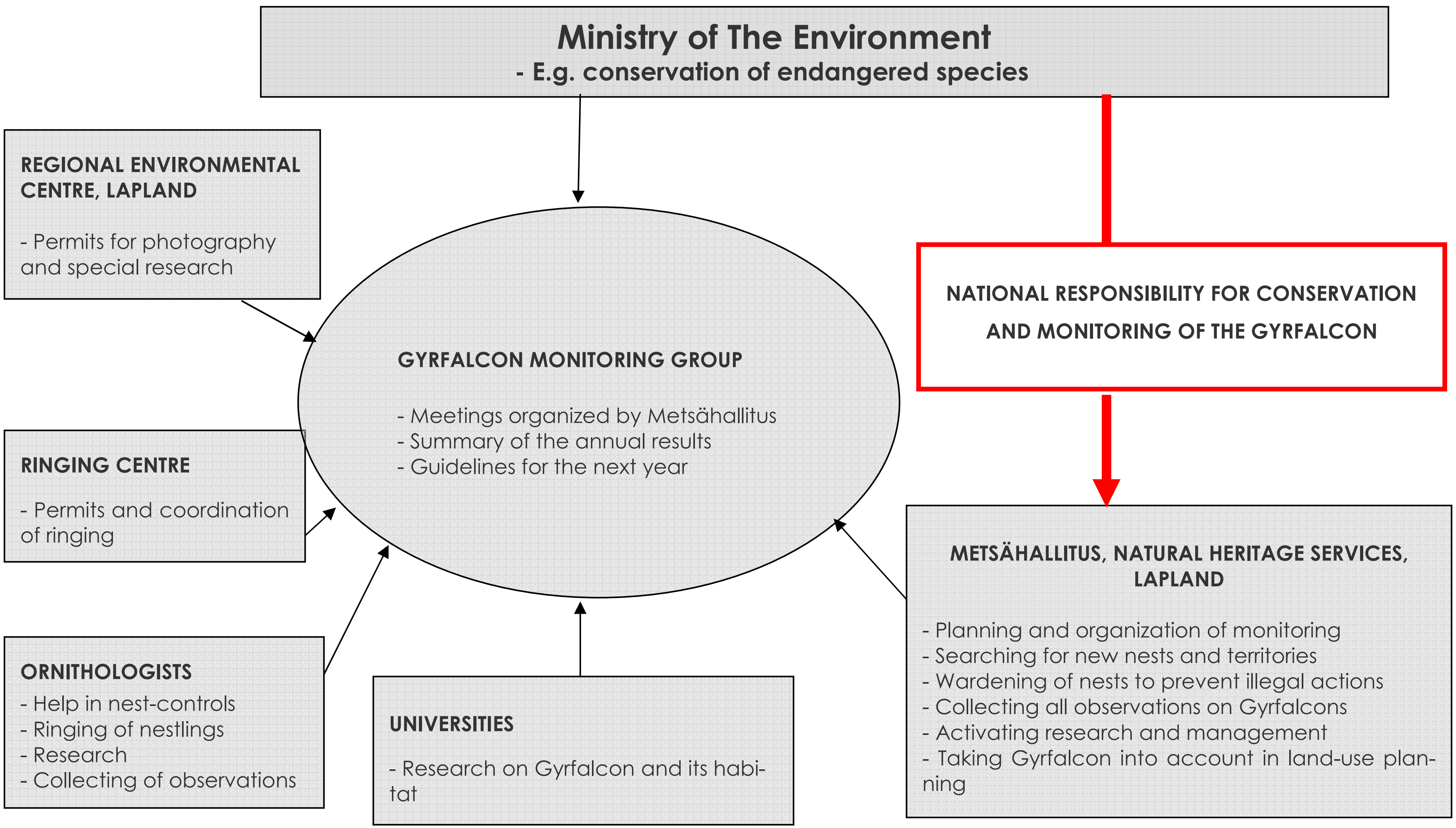

Figure 1. Organization of the Finnish Gyrfalcon monitoring project.

MATERIAL AND METHODS

Monitoring is based on round-the-year controlling and recording of the Gyrfalcons in their home ranges and nest-sites. Number of breeding pairs and young produced are the most important objects of the monitoring project. New pairs and nest-sites are searched for every year. Field work has been done by researchers Pertti Koskimies and Björn Ehrnsten, and the field personnel of Metsähallitus, especially Jari Kangasniemi, Risto Korkalo, Petteri Polojärvi and Jyrki Vähä-Lummukka. Lasse Iso-livari has monitored and ringed Gyrfalcons locally in Utsjoki. Matti Mela has coordinated the field work and collected results for annual reports.

When developing the nation-wide and intensive monitoring system, we started by looking for all the potential nest-sites within the range of the Gyrfalcon and visiting them systematically, as Koskimies (2006) had done in part of the territories since the early 1990s. Occupied territories from recent decades were listed as comprehensively as possible by interviewing people knowing the species. To find previously unknown nest-sites, we mapped and inventoried hundreds of cliffs, the great majority of which proved to be unsuitable for the Gyrfalcon.

The monitoring group has chosen about 75 separate areas with about 150 suitable cliffs to be monitored every year, part of them including occupied territories of the Gyrfalcon (table 1, fig. 2). However, as a typical Gyrfalcon pair has a couple of alternative nest-sites, and as the availability of twig-nests alters annually forcing some pairs to change their breeding site, we continuously have to evaluate the list of the sites to be monitored during the next year.

Table 1. The number of nesting and territorial Gyrfalcons and the breeding productivity in Finland from 2000 to 2005.

Year	2000	2001	2002	2003	2004	2005
Potential cliff areas monitored	64	62	63	66	75	75
Unoccupied areas	52	50	49	48	57	52
1. Successful nests	11	10	8	13	16	13
2. Unsuccessful nests	1	1	2	1	1	4
3. Probable nesting attempts	0	1	4	4	1	6
Active nests min (1+2)	12	11	10	14	17	17
Active nests max (1+2+3)	12	12	14	18	18	23
4. Non-breeding adult(s)	4	11	9	4	13	9
Occupied territories	16	23	23	22	31	32
Adult(s) outside known territories	1	2	12	4	22	17
Nestlings	24	25	21	44	51	39
Nestlings/successful nest (1)	2.18	2.50	2.63	3.38	3.19	3.00
Nestlings/active nest min (1+2)	2.00	2.27	2.11	3.14	3.00	2.29
Nestlings/active nest max (1+2+3)	2.00	2.08	1.50	2.44	2.83	1.70
Nestlings/occupied territory (1+2+3+4)	1.50	1.09	0.91	2.00	1.65	1.22

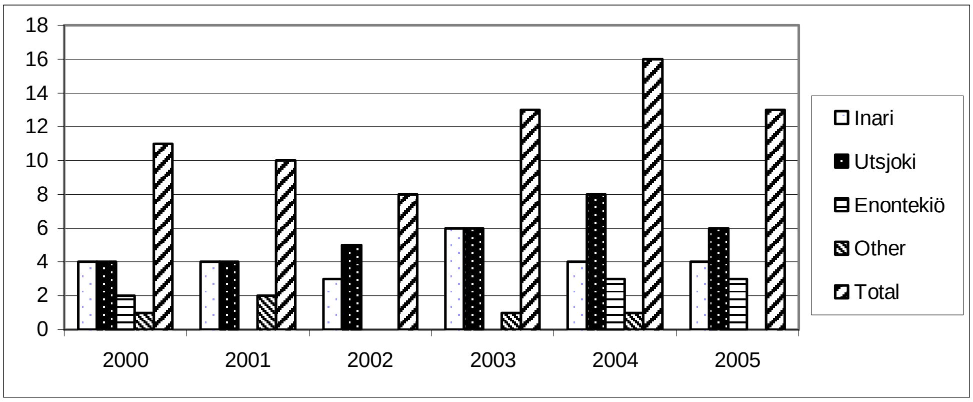

Figure 2. The number of successful Gyrfalcon pairs in municipalities of Finnish Lapland from the year 2000 to 2005.

The natural variation of the number of breeding pairs is quite notable, reflecting, above all, population fluctuations of the Willow Grouse *Lagopus lagopus*, the main prey. Our monitoring system will enable us to monitor changes in the pair numbers and the nesting success of the Gyrfalcon effectively in the long run, too, independent of these natural fluctuations. It provides us enough information on reproductive output even in years with unfavourable breeding conditions.

RESULTS AND DISCUSSION

There are some special features of the nest-sites of the Finnish Gyrfalcons. As the bedrock is – with the exception of the northwestern part of Enontekiö (Kilpisjärvi region) – very old and worn, cliffs are quite low, and the rocky areas are not as abundant as in northern Norway and Sweden, for example. This increases somewhat the risk of nest robbery and other disturbance, although, on the other hand, controlling and wardening of the nesting areas is easier in such a flat country like Finland.

Many of our high cliffs, as uncommon in the landscape, have become popular objects by late-winter skiing excursions, snowmobiling, rock-climbing and camping. These kind of outdoor activities cause unintentional disturbance for several Gyrfalcon pairs annually. Metsähallitus can steer those kinds of people who need a permit for a certain tourism or other activity in the wilderness, but it is more difficult to guide and oversee those who ski or wander in nature on the basis of the public right of access. Metsähallitus uses data on the Gyrfalcon to guide hiking, building of cottages and other disturbing activities to areas further away from nest-sites.

The Gyrfalcon has also been observed to breed in twig-nests in trees because there are so few cliffs in their home range – if any. However, we have found only 0–3 occupied tree nests each year, but, as nests in trees are much more difficult to detect, and their localities vary from year to year, tree-nesting falcons must be more numerous than documented.

For effective conservation of the Finnish Gyrfalcon population, we consider it important to have international cooperation especially with the agencies which are responsible for monitoring in the neighbouring countries. We stress also the importance of continuous contact with police, frontier guard, customs, and other respective authorities who work to prevent possible falcon and egg trade, which is most probably of international scale.

In the future years, our monitoring effort will be increased to find the last Gyrfalcon´s nest-sites, which have so far remained unnoticed, many of them probably in trees. We can also improve the cooperation between researchers of the Gyrfalcon in northern Fennoscandia. Metsähallitus is able, for example, to assist researchers with collecting round-the-year observations from laymen, and with providing help in various studies which give necessary data for more effective conservation of the Gyrfalcon and its habitat. Nest-specific monitoring will be intensified by an increasing use of automatic cameras in the next few years.

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RAPTORS IN THE GORKOVSKY RESERVOIR AREA

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The fauna and population of diurnal raptors (*Falconiformes*) in the Gorkovsky impoundment reservoir area was studied over a multiannual period in 6 permanent sample plots. Registrations include 19 species, of which 13 definitely breed in the area, another 6 are alleged to breed, 1 species is a passage migrant; 6 species are red-listed in the Russian Federation. The population of raptors around the reservoir differs notably from those in flat areas and valleys of small and medium-size rivers of the region.

Key words: diurnal raptors, *Falconiformes*, fauna, population, impoundment reservoir, Upper Volga area.

ХИЩНЫЕ ПТИЦЫ ПОБЕРЕЖИЙ ГОРЬКОВСКОГО ВОДОХРАНИЛИЩА. В. Н. Мельников. *Ивановский государственный университет, Иваново, Россия.*

На основе многолетних стационарных исследований на 6 учетных площадях изучена фауна и население дневных хищных птиц (Falconiformes) побережий Горьковского водохранилища. Отмечено 19 видов, 13 из них достоверно гнездятся, предполагается гнездование еще 6 видов, 1 вид встречается только на пролете; 6 видов занесены в Красную книгу РФ. Население хищных птиц побережий водохранилища в значительной степени отличается от таковых плакорных участков и долин малых и средних рек региона.

Ключевые слова: дневные хищные птицы, соколообразные, Falconiformes, фауна, население, водохранилище, Верхневолжье, Ивановская область.

INTRODUCTION

The Gorkovsky impoundment reservoir was formed in 1955 by building an earthen dam across the Volga River upstream of the town of Gorodets. Three parts differing in the hydrological and ecological conditions are now distinguished within the reservoir: Kostroma pools, mainstem and Yurievets pools or the Yurievets Sea. Lower reaches of rivers Zhelvata and Nodoga, Unzha, Nemda, Mocha and others formed branches of the reservoir, and the mouths of numerous small streams turned into its bays. The fauna and population of raptors in the Kostroma lowland, most of which is now under the Kostroma pools, was studied by A. Kuznetsov (1992). Rare species of raptors along the Unzha branch were studied by S. Bakka and N. Kiseleva (2001). Our studies were done in the reservoir mainstem part, along Yurievets pools, as well as at the Zhelvata–Nodoga and Nemda branches of the reservoir.

MATERIAL AND METHODS

Bird population along the Gorkovsky reservoir mainstem was studied in the 1950s by M. Bubnov (1958, 1968), and in the 1980s by Yu. Gerasimov and S. Buslaev (Gerasimov et al. 2005). Long-term permanent plot studies of raptors in the Krasnogorsky research station in the Zhelvata–Nodoga branch area were started in 1983 by S. Buslaev under the supervision of Prof. S. Helevina. Later on (1986–1988), G. Shatilo and since 1988 the author of the present paper joined the work (Helevina et al. 1992, Buslaev et al. 1991, Mel'nikov 1998).

Abundance was estimated by mapping territories in a sample plot. A total of 6 permanent plots were established: Pljos and Novlyanskoye in the mainstem part, Krasnogorsky along the Zhelvata–Nodoga branch, Yelnat' and Nemda along respective branches, and Obzherikha – on the shore of the reservoir lacustrine part, including a shallow bay and a water-logged area between villages Andronikha and Obzherikha (Andronikha floodplain) (fig. 1). Counts at each area were made during the breeding period for a number of seasons, the only station where the count was made just once (in 1997) being the Nemda branch shore. The combined area of the study plots was 610 km^2, and taking surveys in all study areas into account, counts covered over 2500 km^2.

The population density of common and uncommon species was calculated from the interannual mean number of pairs nesting in the plot rounded off to a whole number, that of rare species from the number of territories detected in several latest years of study. The aim of estimating the density of rare species was not extrapolation, but determination of total values of the population density of all raptors nesting in each plot, correct assessment of dominance, etc. For some raptor species, the abundance, population density and dominance (ratio) are shown in table 1.

Table 1. Raptor population in the research stations surveyed (n – mean interannual abundance rounded-off to whole numbers, pairs; Ni – population density, pairs/100 km^2, Pi – dominance, %).

Research station	Pljos			Novlyanskoye			Krasnogorie			Yelnat'			Nemda			Obzherikha		
Area	80 km^2			100 km^2			250 km^2			70 km^2			40 km^2			70 km^2		
No of seasons	2			7			7			2			1			4		
	n	Ni	Pi	n	Ni	Pi	n	Ni	Pi	n	Ni	Pi	n	Ni	Pi	n	Ni	Pi
Osprey	+			+			2	0.8	2.9	+			2	5.0	14.3	2	2.9	7.4
Honey Buzzard	2	2.5	7.4	1	1.0	3.6	4	1.6	5.8	1	1.4	4.2	-			1	1.4	3.7
Black Kite	5	6.3	18.5	8	8.0	28.6	7	2.8	10.1	5	7.1	20.8	3	7.5	21.4	4	5.7	14.8
Hen Harrier	1	1.3	3.7	2	2.0	7.1	2	0.8	2.9	-			-			-		
Montagu's Harrier	2	2.5	7.4	1	1.0	3.6	3	1.2	4.3	4	5.7	16.7	-			2	2.9	7.4
Marsh Harrier	-			-			-	-		-			-			8	11.4	29.6
Goshawk	3	3.8	11.1	2	2.0	7.1	4	1.6	5.8	1	1.4	4.2	1	2.5	7.1	1	1.4	3.7
Sparrowhawk	4	5.0	14.8	3	3.0	10.7	6	2.4	8.7	3	4.3	12.5	2	5.0	14.3	1	1.4	3.7
Common Buzzard	7	8.8	25.9	9	9.0	32.1	31	12.4	44.9	6	8.6	25.0	5	12.5	35.7	5	7.1	18.5
Short-toed Eagle	-			-			2	0.8	2.9	-			-			-		
Booted Eagle	-			-			-			-			-			+		
Golden Eagle	-			-			-			+			-			-		
Spotted Eagle	-			-			-			-			-			+		
White-tailed Sea Eagle	-			-			1	0.4	1.4	+			1	2.5	7.1	-		
Peregrine Falcon	-			-			-			-			-			+		
Hobby	1	1.3	3.7	-			2	0.8	2.9	1	1.4	4.2	-			1	1.4	3.7
Merlin	-			-			1	0.4	1.4	-			-			-		
Kestrel	2	2.5	7.4	2	2.0	7.1	4	1.6	5.8	3	4.3	12.5	-			2	2.9	7.4
Total	27	33.8	100.0	28	28.0	100.0	69	27.6	100.0	24	34.3	100.0	14	35.0	100.0	27	38.6	100.0

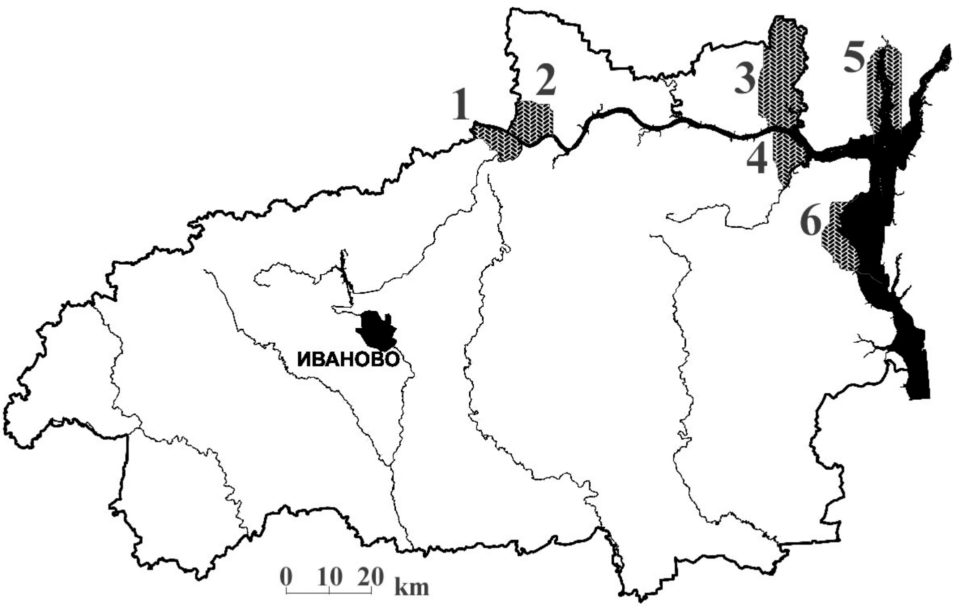

Figure 1. Research plots surveyed: 1 – Pljos, 2 – Novlyanskoye, 3 – Krasnogorie, 4 – Yelnat', 5 – Nemda, 6 – Obzherikha.

RESULTS

Osprey (Pandion haliaetus)*. Very rare breeder (asterisk = red-listed).

M. Bubnov (1957) observed transient Ospreys only. In 1991, S. Buslaev detected an occupied Osprey nest in the downstream of River Unzha, proving the species to breed in the area (Gerasimov et al. 2000). At present, 2–3 Osprey pairs nest on the Unzha branch shore annually (Bakka & Kiseleva 2001).

We observed Osprey during the breeding period in all 6 plots, and found nest areas in three plots. Regular Osprey records were reported from the downstream of River Nodoga in 1991–1993. In 1997, 2 territorial Osprey pairs were registered from the area, with a brood of 2 nestlings known for one of them. Survey of the Nemda branch shore in May 1997 revealed 2 territorial pairs. In 2003–2005, two pairs of Ospreys were regularly seen hunting over the lacustrine part of the reservoir. The birds carried their prey to the mixed forest on the primary shore over 4 km away from the water edge, and ate prey themselves on the top of circular concrete power line posts.

Honey Buzzard (Pernis apivorus). Uncommon breeder.

Registered in our studies from all plots except for River Nemda area. Counts there, however, were made in the first half of May – before the birds arrived. The population density in different plots is relatively even (1–2.5 pairs/100 km^2), and corresponds to the regional average of 1.5 pairs/100 km^2 (Mel'nikov 1999). High Honey Buzzard abundance was sometimes observed locally. E.g., during 2003 surveys of the wider stretch at the mouth of River Nodoga, 4 territories of the Honey Buzzards were observed from one point.

Black Kite (Milvus migrans). Common breeder.

Occupies quite densely forested sections of the shore and branches of the reservoir. Black Kite nests in such areas are 1–2 km apart, arranged in "chains" along the shore. All territories were situated right on the shore, and known nests were 20 to 100 metres away from the water edge. The species clearly avoids nesting further away from the shore. In all plots surveyed, the Black Kite is subdominant among raptors, displacing the more common Common Buzzard from the littoral shore to the primary shore. Variations in the population density estimates – from 3 to 8 pairs/100 km^2 for different plots – are due to differences in the proportion of shoreline areas in the sampling plots. The density of the Black Kite population along Gorkovsky reservoir is notably lower than in the Klyazma river floodplain (Mel'nikov 1999).

Hen Harrier (Circus cyaneus). Rare breeder.

All known Hen Harrier nest areas are situated in cut-over sites regenerated to different degrees in forests on primary shore rather than immediately along the reservoir.

Montagu's Harrier (Circus pygarus). Uncommon breeder.

In the early years of studies the species was rarer than the Hen Harrier. By present time, it has grown adapted to living in vast ruderal vegetation stands in abandoned farms, mineral fertilizer storehouses, etc. It is the number and area of such anthropogenic habitats where colony-type settlements can form that predetermined the present-day distribution. Individual pairs occupy moist areas with high swards, as observed in the Andronikha floodplain.

Marsh Harrier (Circus aeruginosus). Uncommon breeder.

A Marsh Harrier settlement was observed only from an extensive (over 3 km^2) reed and shrub stand in a floating bog in a shallow-water bay in the Andronikha floodplain. At least 8 Marsh Harrier pairs were observed nesting there simultaneously.

Goshawk (Accipiter gentilis). Uncommon breeder.

The Goshawk population is distributed quite evenly throughout the region, densities never being high. Its density did not increase along the reservoir shore either.

Sparrowhawk (Accipiter nisus). Uncommon breeder.

Slightly more abundant than the Goshawk. Settles eagerly in tree-grown gullies and gorges, which are numerous along the mainstem part of the reservoir. In some plots, the abundance may be underestimated due to the species' secretive lifestyle.

Common Buzzard (Buteo buteo). Common breeder.

The most abundant raptor species in the region, dominating in all plots surveyed along Gorkovsky reservoir shores. The density of the Buzzard population along the reservoir, however, is somewhat lower than in the Ivanovo region on average, and significantly lower than in other agricultural districts (Mel'nikov 1999). This fact can be explained by competition for territory with the Black Kite, which is relatively common on the reservoir shore and forces the Buzzard out to dry flatlands. We have observed that the Buzzard pairs nesting closest to the shoreline regularly conflict with the Black Kites entering their breeding territory.

Rough-legged Buzzard (Buteo lagopus). Common passage migrant.

Short-toed Eagle (Circaetus gallicus)*. Very rare presumed breeder.

S. Buslaev reported a Short-toed Eagle in the Krasnogorie plot on 12 June 1982. We observed a Shot-toed Eagle there on 5 August 1999. During observations from watch-sites through a spotting scope in July 2003 and August 2004 we regularly saw Short-toed Eagles in two permanent plots.

Booted Eagle (Hieraaetus pennatus). Very rare presumed breeder.

A light-morph Booted Eagle was sighted in the Andronikha floodplain in the mid-1980s by Alexei

Mishustin (personal communication). In June and July 2003 and 2004, we made a few records of a dark-morph Booted Eagle there.

Golden Eagle (Aquila chrysaetos)*. Very rare presumed breeder.

M. Toropov observed (personal communication) a brood of eagles with two young west of the town of Yurievets in late July – early August 2005. He thought the birds were Spotted Eagles, but owing to a detailed description of the young, with a characteristic white transverse strip on the tail and white spots on the wings, they were identified as Golden Eagles. The birds had probably arrived from the left hand bank of Volga, where a large forest area is situated starting 3–5 km away from the reservoir.

Spotted Eagle (Aquila clanga)*. Very rare breeder.

In the 2003–2005 breeding season, the species was a few times detected in the Andronikha floodplain. In June 2004, an old nest was found on a black alder tree.

White-tailed Sea Eagle (Haliaeetus albicilla)*. Very rare presumed breeder.

Breeding of 2–3 Sea Eagle pairs is known from the Unzha branch of the Gorkovsky reservoir (Bakka & Kiseleva 2001). We regularly registered the White-tailed Sea Eagle on the downstream of River Nodoga. In May 1997, an adult White-tailed Sea Eagle was a few times seen on the Nemda branch shore. A. Kuznetsov (1990) observed White-tailed Sea Eagle nesting near the mouth of River Nemda.

Peregrine Falcon (Falco peregrinus)*. Very rare presumed breeder.

The Peregrine was twice registered in the Obzherikha plot – on 19 June 2003 over a bay of the reservoir and on 11 July 2004 in a transitional mire in the central part of the Andronikha floodplain.

Hobby (Falco subbuteo). Rare breeder.

The density of the Hobby population along the Gorkovsky reservoir is notably lower than along medium-size rivers Klyazma, Lukh, and Teza, and corresponds to the Ivanovo region average (Mel'nikov 1999). Breeding took place in old Raven Corvus corax and Hooded Crow *C. corone* nests, namely those in the Krasnogorsky village outskirts.

Merlin (Falco columbarius). Very rare presumed breeder.

Registered on 1 July 1992 from downstream of River Zhelvata.

Kestrel (Falco tinnunculus). Uncommon breeder.

Late in the 20th century a significant overall decline in Kestrel abundance was recorded in the region. The species registrations in the study area became much fewer in this period. Lately, the number of contacts and known breeding occasions has increased somewhat.

DISCUSSION

Studies have shown that the fauna of diurnal raptors along Gorkovsky reservoir includes 19 species, of which 13 definitely breed in the area, another 6 are alleged to breed, 1 species is a passage migrant. Six species are red-listed in the Russian Federation (marked with an asterisk in the text). All plots surveyed are important bird areas. The fauna and population of raptors in the reserve shore area differ notably from those in drainage divide areas and valleys of small and medium-size rivers (Mel'nikov 1999, Mel'nikov et al. 2002). All three parts of the Gorkovsky reservoir (Kostroma pools, mainstem and Yurievets sea) and its branches are of special value for the conservation of rare species of raptors, including those listed in the Red Data Book of Russia.

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HUNTING HABITATS OF HARRIERS IN AGRICULTURAL LANDSCAPES OF THE LENINGRAD REGION

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The present paper considers hunting habitat preferences of the Hen Harrier (*C. cyaneus*), Marsh Harrier (*C. aeruginosus*) and Montagu's Harrier (*C. pygargus*), as well as differences between species and sexes in the choice of feeding habitats. The study was carried out in 2003–2005 in a 160 km^2 model area 30 km SW of St. Petersburg. In the study area harriers tended to choose farmland as major feeding habitats during the breeding season. We distinguished 5 types of hunting habitats for harriers: 1) "natural" biotopes (cut-overs, reed-overgrown waters, corridors cut for transmission lines), 2) cereal fields, 3) hayfields, 4) pastures and 5) abandoned farmland (abandoned hayfields and idle fields). During the breeding period, the Hen and Marsh Harriers preferred hunting in hayfields because there were optimal quantities of readily available prey. Montagu's Harrier started visiting hayfields to hunt not earlier than the middle of the breeding period, when the young reached an age of 7–10 days. Broods leaving nest areas always moved to mown hayfields. The Marsh and Montagu's Harriers preferred to take prey from taller grasses than the Hen Harrier. An attempt was made also to evaluate the hunting success of the three species in different habitats.

Key words: hunting behaviour, feeding habitat, habitat choice, hunting success.

ОХОТНИЧЬИ БИОТОПЫ ЛУНЕЙ В УСЛОВИЯХ АГРОЛАНДШАФТА В ЛЕНИНГРАДСКОЙ ОБЛАСТИ.
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В настоящей работе мы рассматриваем биотопические предпочтения в кормодобывании полевого (*C. cyaneus*), болотного (*C. aeruginosus*) и лугового (*C. pygargus*) луней, а также межвидовые и межполовые различия в выборе кормового биотопа.

Работа проводилась в 2003–2005 гг. на модельной территории площадью около 160 км^2, расположенной в 30 км к юго-западу от С.-Петербурга.

В наших ландшафтных условиях в качестве кормовых биотопов в сезон размножения луни использовали в основном сельскохозяйственные поля. Мы выделяли 5 типов охотничьих биотопов луней: 1) "естественные" биотопы (вырубки, заросшие тростником водоемы, просека ЛЭП), 2) поля, засеваемые зерновыми культурами, 3) сенокосные поля, 4) пастбища и 5) брошенные поля (брошенные сенокосы и залежи).

Полевой и болотный луни в гнездовой период предпочитали охотиться на сенокосных полях из-за оптимальных количества и доступности жертвы на них. Луговой лунь начинал летать на сенокосы за кормом лишь в середине гнездового периода, когда птенцы достигали возраста 7–10 дней. Выводки, покидая гнездовые территории, обязательно выходили на скошенные сенокосные поля. Болотный и луговой луни предпочитали охотиться на более высокой траве, чем полевой. В работе также была сделана попытка оценить успешность охоты всех трех видов в различных биотопах.

Ключевые слова: охотничье поведение, кормовой биотоп, выбор биотопов, успешность охоты.

INTRODUCTION

In studies dealing with the hunting behaviour of harriers (Schipper 1973, 1977, 1978, Simmons 2000), differences between species and sexes in the choice of the feeding habitat are mostly considered from the point of view of the species and sex food specialization. In our study area, small rodents were the main food for all the three harrier species during the breeding season. Checking the composition of cast pellets collected from nests and from the field (when their identity was certain) as well as remains of harrier meals in the field, we chiefly (90%) found hair and bones of *Microtus* voles. Watching actual hunts, we also saw that when a hunt ended in capturing prey it normally was a vole (visible through binoculars). Hence, habitat preferences of hunting birds depended on other reasons, and we tried to identify them.

Harriers in the study area hunt mainly in farmland. The farmland includes fields of different categories as regards both the use by people (hayfields, pastures, cereal crops and vegetable crops) and the use by birds. We made an attempt to assess the role of different habitats in the foraging of harriers using an area intensively utilized by people as the example.

MATERIAL AND METHODS

The study was carried out in 2003–2005 in a 160 km^2 model area 30 km SW of St. Petersburg. The area was chosen due to the presence of all habitats harriers needed – breeding (water-logged or littered cut-overs, overgrown water-bodies) and feeding (farmland) grounds. The area of the fields controlled was ca. 130 km^2 (fig. 1). Three harrier species breed in the study area: the Hen and the Marsh Harriers regularly, Montagu's Harrier, not every year. In 2003, there nested 5 Hen Harrier pairs, 3 Marsh Harrier pairs, and 2 Montagu's Harrier pairs; non-breeding birds of both sexes occurred throughout the season. In 2004, there nested 5 Hen Harrier pairs, 5 Marsh Harrier pairs and 3 Montagu's Harrier pairs. No non-breeding birds were present in the study area that year. In 2005, there nested 5 Hen Harrier pairs and 2 Marsh Harrier pairs. Montagu's Harriers did not breed in the area in 2005. Non-breeding birds of all three species were present throughout the season. Thus, 25–30 adult harriers were constantly present in the study area every breeding season.

Observations in different biotopes totalled 680 hours in two seasons.

In the study area, the main feeding habitats for harriers during the breeding season were fields. We distinguished 5 types of harrier hunting habitats: 1) "natural" biotopes (cut-overs, reed-overgrown waters, corridors cut for transmission lines, i.e. habitats with a natural vegetation succession), 2) cereal fields, 3) hayfields, 4) pastures, 5) abandoned farmland (abandoned hayfields and idle fields).

Sowing in cereal fields sometimes lasted from late May to early July. Hay mowing began in late June and lasted until early September. Abandoned fields were not treated – grass grew there uncontrolled throughout the season.

The index of abundance of potential prey and its availability was determined for each habitat category (Simmons 2000). Rodent counts were made from May to September by trapping, following the technique by Kucheruk et al. (1963). An indirect indicator of the abundance of small rodents was the number of breeding Short-eared Owls. There were 2 successfully breeding Owl pairs in the study area in 2004, and 5 pairs in 2005.

The parameters selected to estimate prey availability were grass height and thickness (Simmons 2000). Grass height was measured in fields of a certain type with a field tape measure in 15 points ca. 20 m apart arranged along a straight line. Thickness was determined in the same points by estimating the percent cover by eye. Three fields of each type were chosen to this end. Measurements were made twice a month in all model fields on the same days. Fields of different types were compared by mean values of the parameters.

Figure 1. Study area map.

In total, we made 472 registrations of Hen Harriers, 341 of Marsh Harriers and 98 of Montagu's Harriers hunting in different habitats.

To find out the role of a certain habitat in harrier foraging, the frequency of visits to each of the habitats distinguished and the hunting success there were determined. Since fields in the area form a mosaic – a barley field may lie between hayfields, an abandoned hayfield may adjoin a utilized one, a cut-over may neighbour hayfields – the hunting process was subdivided into time intervals within which the bird flew over a certain habitat. During the observations we recorded the duration of such time intervals of a hunting flight over a field of one type. When the type changed, a new stage in the hunt, i.e. a new time interval, began. If a hunt halted and was then resumed in the same field, the next stage of the hunt was considered as a separate hunting flight with its own temporal and other characteristics. When there were boundaries of plots within a habitat – roads, stone ridges, drainage ditches – and the bird just crossed them to continue hunting in the same habitat, it was considered the same time interval. Flights over drainage ditches overgrown with reeds or shrubs were classified as hunting in a natural habitat.

The number of attacks was also recorded. Schipper (1977) described the hunting technique of harriers as follows. A hunting bird would sometimes hover and then choose one of the three options: pouncing (onto prey), carefully inspecting a small (several m^2) area, or chasing prey. It was the first scenario – pouncing onto prey (plummeting into grass) – that was classified as an attack.

The height and speed of the hunting flights were taken into account. Two categories were distinguished for the flight height: low – within 2 m above the ground or water, high – higher than 2 m; and for the speed: slow and fast flight. Both height and speed were determined by eye. Detailed records are available for 148 hunts by Marsh Harriers, 74 by Hen Harriers and 45 by Montagu's Harriers.

As regards hunting success, we distinguished 3 categories of hunts in the habitat:

"successful hunt" – time interval of a hunting flight over a habitat ending in prey capture,

"unsuccessful hunt" – time interval of a hunting flight over a habitat within which ineffective attacks were observed,

"cruising" – time interval of a hunting flight over a habitat when no attacks were made.

The hunting success was defined as the proportion of successful hunts in the total number of hunts in the habitat.

The hunting efficiency (capture success) of harriers in a habitat was defined as the ratio of the number of successful attacks (ending in prey capture) to the total number of attacks undertaken during all hunts in the habitat (Temeles 1986).

Sex differences in the choice of hunting habitats were analysed specifically in hunting grounds (not breeding grounds).

Reliability of differences in the frequency distribution of hunting birds among habitats was determined using the "chi-square" method. Statistical processing of the material was done using "Statistica-6" software.

RESULTS

After arrival in spring, the Hen and Marsh Harriers spent most of the time in natural habitats. As soon as in May, however, they moved to dry low-grass habitats to stay there until departure. Utilization of high-grass habitats in hunting grew notably in September–October – in the migration period. Among the species in our study the Hen Harrier was most closely connected to hayfields, but it also inspected more actively all habitats in its breeding area (fig. 2). The Marsh Harrier also preferred hayfields, but spent more time hunting in high-grass habitats (more often in dry abandoned fields than in moist "natural" habitats) than the Hen Harrier (fig. 3). Montagu's Harrier also hunted in natural habitats early in the season. By the middle of the season it moved to dry high-grass habitats (fig. 4).

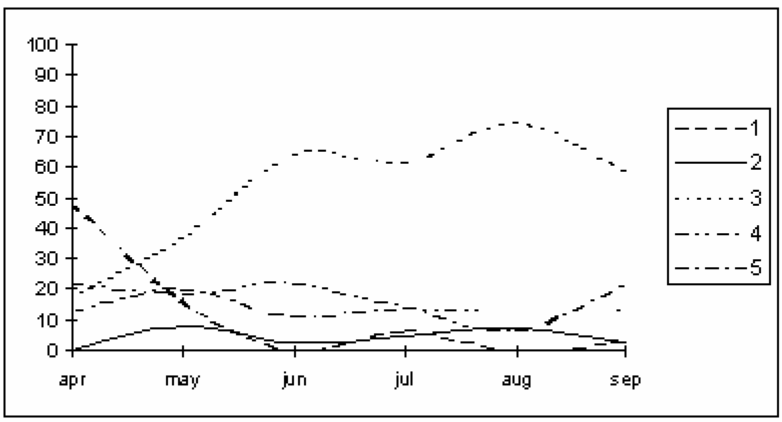

Figure 2. Hunting habitats of *C.cyaneus*. 1 – – wetlands, 2 – sowings, 3 – hayfields, 4 – pastures, 5 – abandoned fields.

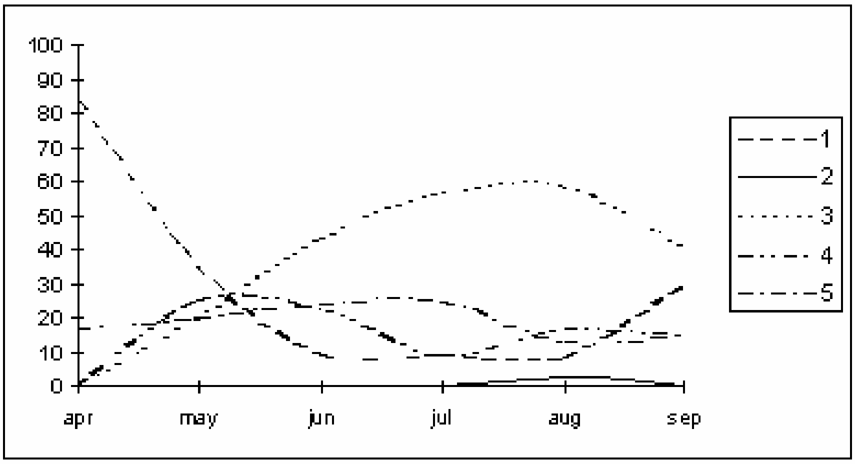

Figure 3. Hunting habitats of *C. aeruginosus*. Legend as in fig. 2.

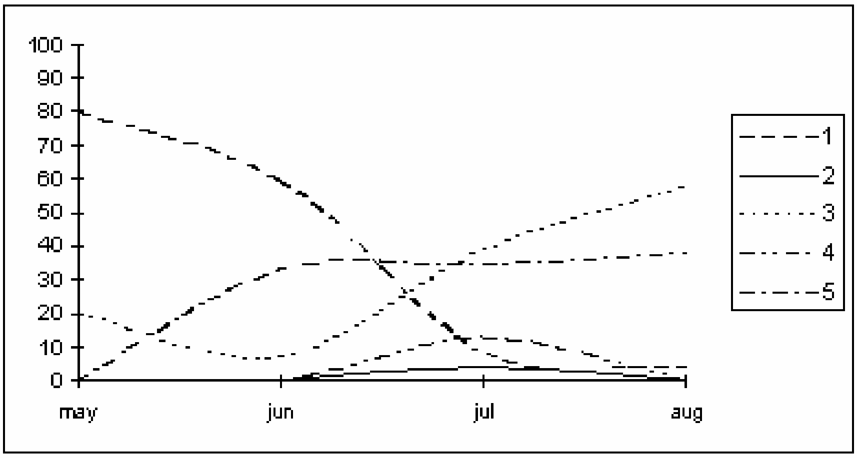

Figure 4. Hunting habitats of *C. pygargus*. Legend as in fig. 2.

Breeding and feeding grounds of breeding males may be quite far apart – a male may travel 1–4 km away from its nest for food. As soon as Hen and Marsh Harrier females started incubating eggs, males left for farmland; not a single male (n=12) hunted within the territory. Montagu's Harrier males hunted in nest areas during courtship, nest construction and egg laying (n=3). During the incubation period they started visiting farmland occasionally, but fields became the main hunting location only when chicks reached an age of 8–10 days.

For the Hen and Marsh Harriers sex differences in the choice of habitats were obvious at the onset of the breeding season. In May, females hunted in abandoned fields more than males. In June, both males and females equally preferred low-grass habitats, but the proportion of pastures in the foraging activities by females was significantly (2–3 times) higher than byr males (fig. 5 and 6). Montagu's Harrier females never hunted in pastures and sown fields (fig. 7). In August, females of all three species hunted nearly solely in hayfields.

After leaving their nest areas, fledglings of all species moved to stubble fields. 10–14 days after leaving the nest area, fledglings hunted almost exclusively in stubble fields, and it was only afterwards that they began inspecting adjacent higher-grass habitats. Thus, the proportion of high-grass fields in their hunting activities increased by the departure time (fig. 8–10). Connection to stubble fields was stronger for Hen Harriers and weaker for Montagu's Harriers.

The abundance of rodents increased in the course of a season in all habitats (fig. 11), but their numbers were the highest in hayfields (both mown and abandoned). Rodent abundance was quite high in natural habitats, too. Prey abundance, however, increased simultaneously with grass height (fig. 12), and it was only in hayfields that its increase ceased at some point (no rodent trapping was made in pastures). When hay mowing began, one could easily see that among hayfields, adult Hen Harriers chose stubble fields, whereas Marsh and Montagu's Harriers preferred hunting along the stubble/tall grass edge.

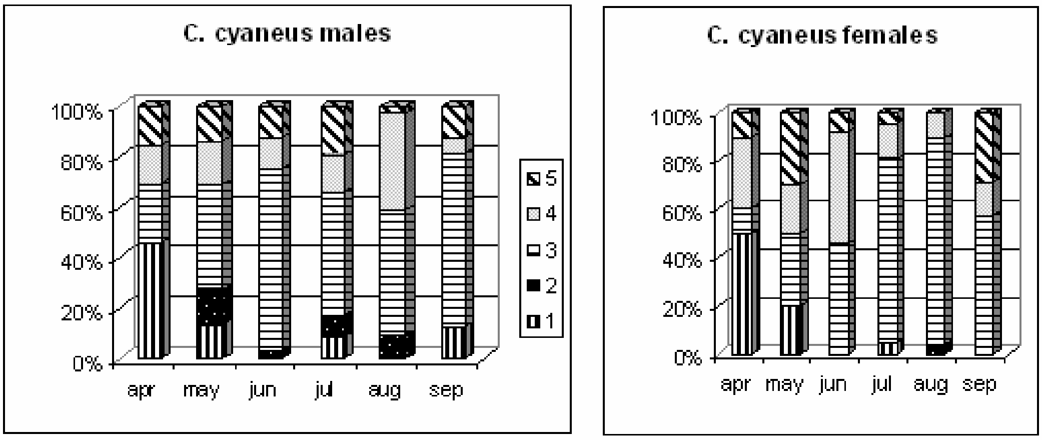

Figure 5. Sex differences in *C. cyaneus* hunting habitat choice. Legend as in fig. 2.

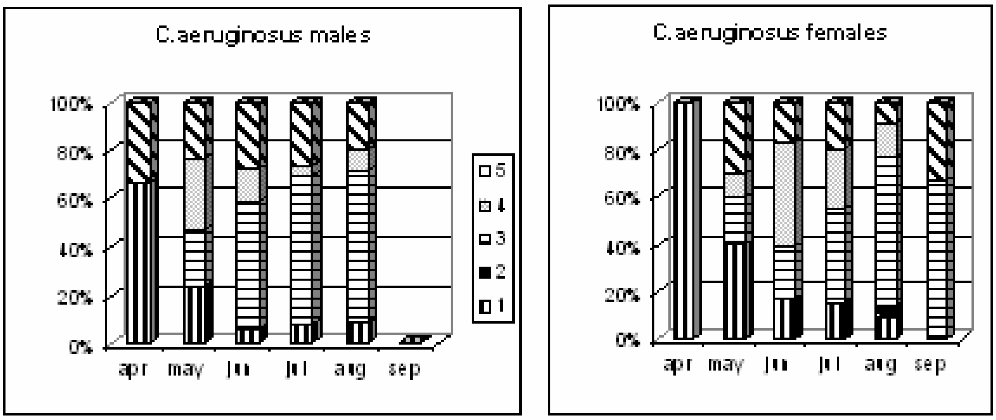

Figure 6. Sex differences in *C. aeruginosus* hunting habitat choice. Legend as in fig. 2.

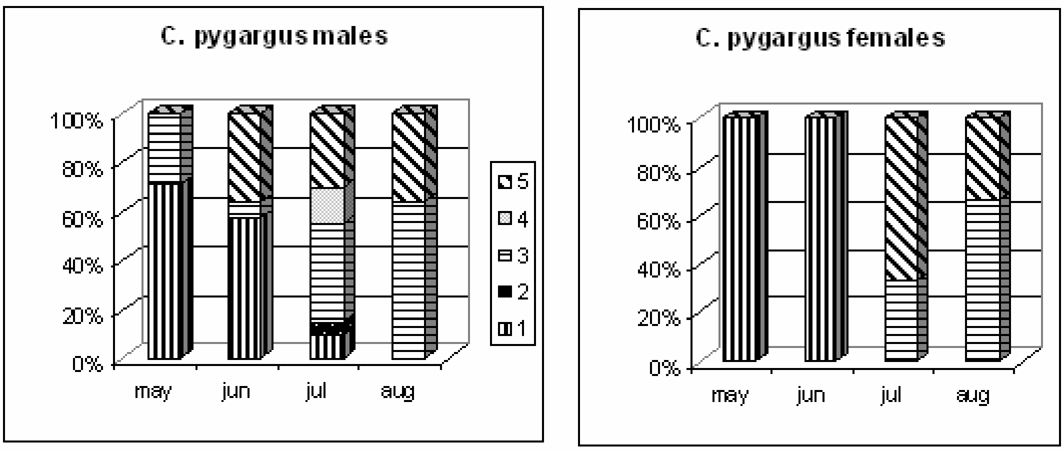

Figure 7. Sex differences in *C. pygargus* hunting habitat choice. Legend as in fig. 2.

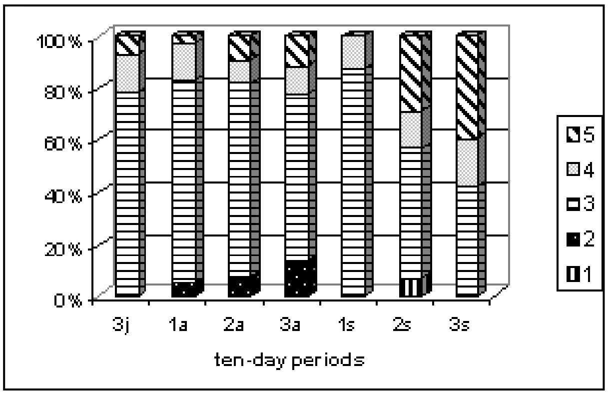

Figure 8. Hunting habitats of young Hen Harriers. Legend as in fig. 2.

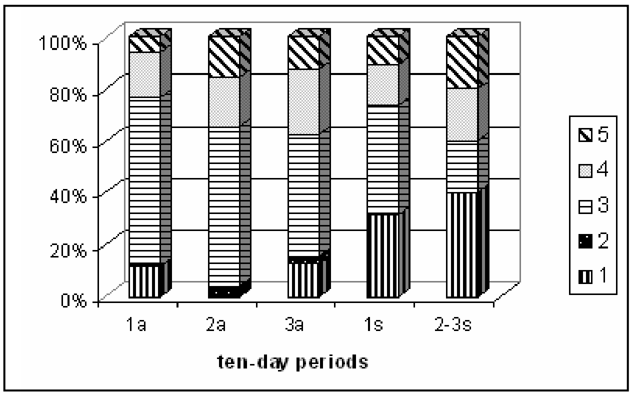

Figure 9. Hunting habitats of young Marsh Harriers. Legend as in fig. 2.

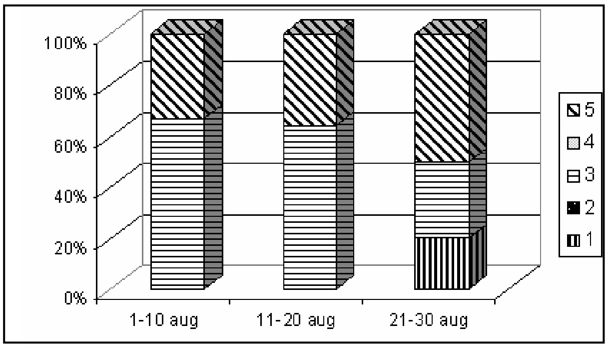

Figure 10. Hunting habitats of young Montagu's Harriers. Legend as in fig. 2.

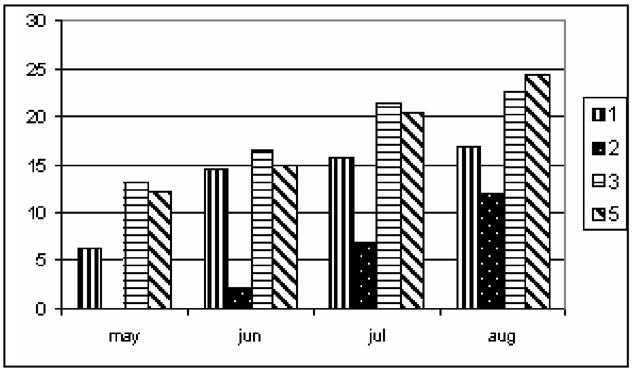

Figure 11. Comparative abundance of rodents in different habitats. Legend as in fig. 2.

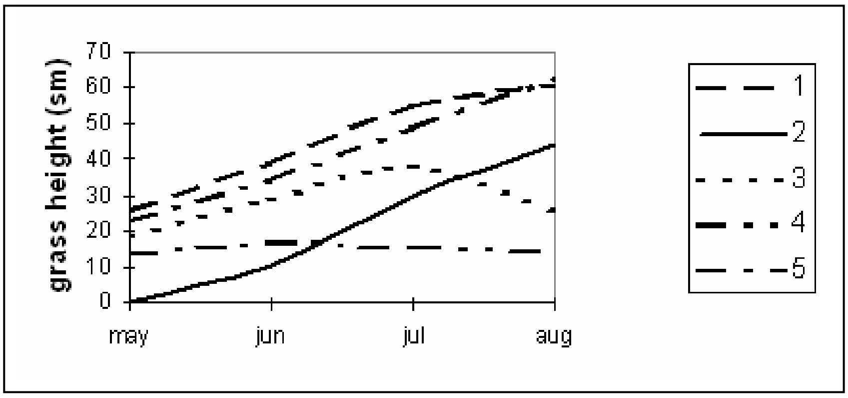

Figure 12. Seasonal changes in average grass height in different habitats. Legend as in fig. 2.

Generally speaking, hunting success was the highest in the Montagu's Harrier, and the lowest in the Hen Harrier. The proportion of "cruising" was the highest in the Hen Harrier.

In natural habitats, the most successful hunters were Montagu's Harriers, the least successful, strange as it is, Marsh Harriers. Marsh Harriers were more successful than others in hayfields and pastures, Montagu's Harriers in abandoned fields (fig. 13).

The hunting efficiency ratio was the same (fig. 14): Montagu's Harriers were the most efficient hunters in natural habitats and abandoned fields, Marsh Harriers in hayfields. In pastures, Hen Harriers hunted less successfully but more efficiently than Marsh Harriers (the former capturing prey at a first or second attempt and the latter at a second to fourth attempt). The duration of hunts in pastures was also somewhat longer in Marsh than in Hen Harriers (fig. 15).

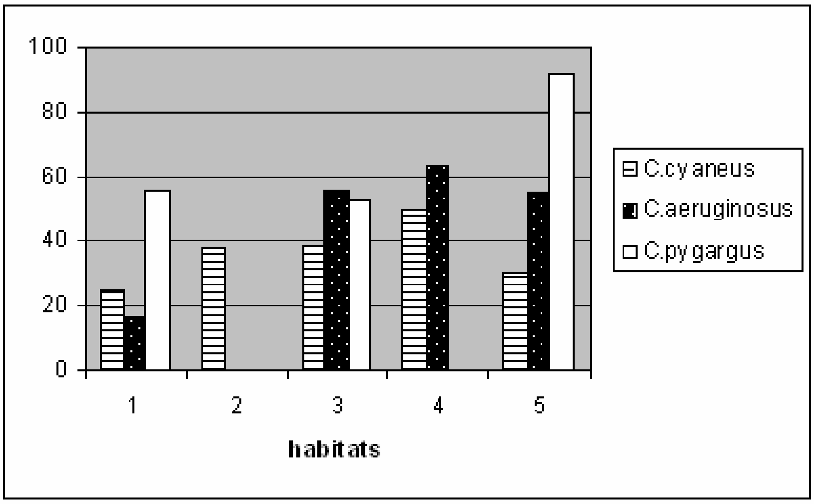

Figure 13. Hunting success in different habitats. Legend as in fig. 2.

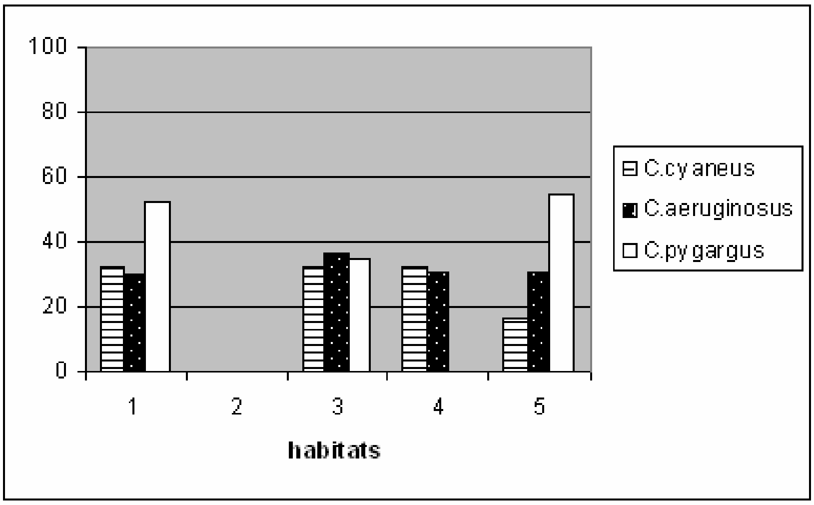

Figure 14. Capture success in different habitats. Legend as in fig. 2.

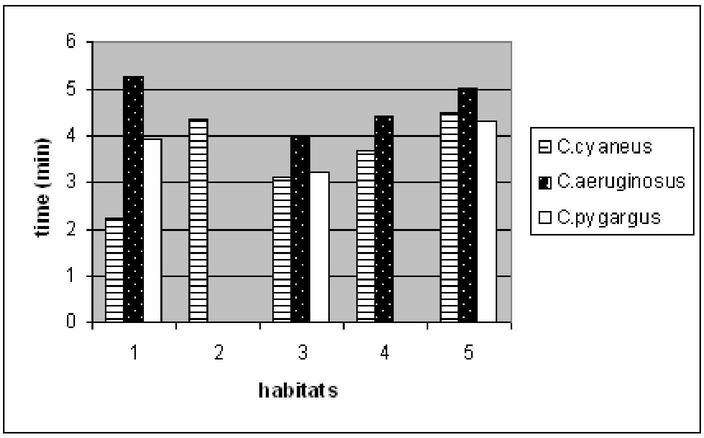

Figure 15. Average hunting duration in different habitats. Legend as in fig. 2.

The average duration of Marsh Harrier hunts was the longest in natural habitats and the shortest in hayfields. Its hunting flights were the longest of all the harrier species in all habitats in general. Hen Harrier hunts in natural habitats were the shortest, as well as more efficient and successful than those of Marsh Harriers. Abandoned fields turned out to be the optimal hunting habitat for Montagu's Harriers. An average hunt in this habitat took them a little longer than in other habitats, but the success and efficiency of their hunting there were the highest compared to other habitats and other harrier species (fig. 13, 14).

Statistically reliable selectivity was found in the distribution of hunting birds among habitats. The Hen Harrier chose hayfields and pastures, avoiding other habitats. The Marsh Harrier also showed reliable preference for hayfields and pastures. Montagu's Harrier ignored sown fields and pastures giving preference to high-grass habitats (tab. 1).

Statistical processing of the data revealed no reliable differences in the height and speed of flight in different habitats. Montagu's Harriers appear to fly higher and faster, but quantitative data to support this statement are insufficient. The hunting flight of Hen and Marsh Harriers was most often low and slow in any habitat. However, the Hen and Marsh Harriers hunted more successfully from low and slow flight, whereas Montagu's Harrier from high and slow flight.

Table 1. Distribution of hunting harriers among biotopes in the breeding season.

	Natural habitats	Cereal fields	Hayfields	Pastures	Abandoned farmland	No
No of biotopes of the type	9 (5.8%)	23 (14.7%)	63 (40.4%)	18 (11.5%)	43 (27.5%)	156
Area of biotopes of the type (km^2)	8	18.5	50.5	16	35	
C. cyaneus	27 (5.7%)	24 (5.1%)	289 (61.2%)	71 (15%)	61 (12.9%)	472
C. aeruginosus	46 (13.5%)	3 (0.9%)	171 (50.1%)	55 (16.1%)	66 (19.4%)	341
C. pygargus	21 (21.4%)	1 (1%)	41 (41.8%)	3 (3%)	32 (32.6%)	98

DISCUSSION

Many of the studies into species and sex differences in habitat preferences of harriers approached the problem from the point of view of food specialization (Temeles 1986, 1987, Schipper 1973, 1977, Simmons 2000). In our study area, no clear food specialization was revealed for harriers during the breeding season (see Introduction). The Marsh Harrier in Europe is the most "reeds-related" bird. It hunts predominantly in moist high-grass habitats. Its food range is, however, quite wide there, whereas the choice of habitats is not so rich. The same is true for the Hen Harrier. The Marsh Harrier preys on larger and less mobile quarry in reed stands. Montagu's Harrier takes the smallest and most mobile prey in dry natural habitats (Schipper 1973, 1975, 1977, Simmons 2000). Judging by the descriptions provided, neither of the study areas of these authors had fields analogous to our hayfields. In addition to wetlands, harriers in Europe hunt in cereal fields. In our conditions they obviously prefer hayfields to both cereal fields and habitats with a natural vegetation succession. Only Montagu's Harrier, although spending much time in hayfields, still prefers high-grass habitats like abandoned fields and reed beds. The proportion of hayfields in our study area is far greater than that of any other type of farmland. Besides, hayfields, both mown and abandoned ones, have a feature essential for *Microtus voles* – the sod layer. Shepel' (1992) also reported of the Hen Harrier in the Perm region hunting in farmland and moving to stubble fields as they became available. Montagu's Harrier in the Perm region hunts in the same type of habitats as in the Leningrad region, but it uses also spring crop fields – a situation observed in our area only once in all three study seasons. The reason may be that hayfields (both mown and abandoned ones) are much more numerous in the study area than cereal fields. Prey abundance, too, is far higher in the former than in sown fields.

The Hen Harrier hunting success was the highest in pastures. It was quite high also in hayfields and abandoned fields. For the Marsh Harrier it was the highest in abandoned fields; then follow hayfields and pastures, where it is only slightly lower. Montagu's Harrier hunted most successfully and efficiently in abandoned fields, preferring this habitat to all others. All the three habitats essentially represent permanent swards with a thick sod layer, which is a crucial precondition for *Microtus voles,* harriers' main food during the breeding season.

Why do Hen and Marsh Harrier females in June spend more time hunting in pastures than males? This is the month of active grass growth. Hay mowing begins not until in the second half of July, and the only low-grass habitat in June is pastures. Schipper's (1973, 1977) studies in northern Europe have shown that females at the beginning of the breeding season prefer high-grass habitats. Since these studies deal with breeding birds, and females during the breeding season are limited to the nest area, their hunting activities are also confined to the area, which is normally a high vegetation habitat. In our study, females hunting in the fields were non-breeding ones. They were thus not limited in the use of the territory and had a freedom of choice. As females of the species are larger than males, heavier and less manoeuvrable, it must be easier for them to hunt in low-grass habitats. Both males and females of Montagu's Harrier equally prefer tall-grass habitats in this period.

Sex differences in habitat choice in August are probably due to stronger connection of females to the brood. For this reason, they hunt in hayfields where their young are. Males can fly over a wider area and really do so.

After leaving the natal nest areas, fledglings move readily to stubble fields. Young Montagu's Harriers begin exploring tall-grass habitats somewhat earlier, and wetland habitats slightly later than other habitat types; young Hen Harriers are altogether unwilling to do that, staying linked to low-grass fields until departure. Migrating juvenile Hen Harriers are, however, more often seen in tall-grass and scrub habitats: in reeds along water-bodies and overgrown drainage ditches.

CONCLUSION

During the breeding season, all the three harrier species in our model area preyed on *Microtus* voles.

The preferred habitats of Hen and Marsh Harriers during the breeding season were hayfields, those of Montagu's Harriers abandoned fields.

After leaving their natal nest areas, broods of all three species always moved to stubble fields.

When hunting outside their territories, females of the Hen and Marsh Harriers chose lower-grass habitats than males.

The hunting success in the Hen Harrier was the highest in pastures. It was, however, quite high also in hayfields and abandoned fields. In the Marsh Harrier, the hunting success was the highest in abandoned fields; then followed hayfields and pastures, where it was only slightly lower. Montagu's Harrier hunted most successfully and efficiently in abandoned fields, preferring this habitat from all others.

The hunting efficiency in the Hen Harrier was the highest in hayfields and pastures, in the Marsh Harrier in hayfields, in Montagu's Harrier in natural habitats and abandoned fields, respectively.

Generally, the most successful hunter was Montagu's Harrier. The Marsh Harrier hunted more successfully than the Hen Harrier. The hunting success of the Hen and Marsh Harriers was higher at low and slow flight. Montagu's and Marsh Harriers preferred hunting over taller grass than the Hen Harrier.

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THE MONITORING PROJECT OF THE GOLDEN EAGLE *AQUILA CHRYSAETOS* IN FINLAND

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All territories and nest-sites of the Golden Eagle have been controlled in Finland since the 1990s. There are comparable data from part of them also since the mid-1900s. In total, 416 territories are known, and 370 of them have been occupied by Golden Eagles during the last five years. Four fifths of the pairs breed in Lapland. The number of pairs has increased slightly thanks mostly to lessened persecution. The average number of "old" (over 50 days) young per occupied territory was 0.57 in 1980–2005, and the number per successful nest 1.20, respectively

Key words: Golden Eagle, monitoring, methods, Finland, distribution, breeding success.

ПРОЕКТ ПО МОНИТОРИНГУ БЕРКУТА (*AQUILA CHRYSAETOS*) В ФИНЛЯНДИИ. Т. Оллила. *Служба лесов и парков Финляндии, Рованиеми, Финляндия.*

Контроль всех гнездовых территорий и участков беркута *Aquila chrysaetos* в Финляндии ведется с 1990-х годов. Начиная с середины прошлого века, по некоторым из них существуют также сравнительные данные. Всего известно 416 территорий, из которых беркут в последние пять лет занимал 370. Пятая часть всех пар гнездится в Лапландии. Число пар несколько выросло благодаря, прежде всего, снижению преследования. В период с 1980 по 2005 г. на одну занятую территорию в среднем приходилось 0,57 «подросших» (старше 50 дней) птенцов, а на одну успешно гнездящуюся пару – 1,20.

Ключевые слова: беркут, монитринг, методы, Финляндия, распространение, успешность размножения.

INTRODUCTION

Information on the distribution, numbers and breeding productivity of the Finnish Golden Eagle *Aquila chrysaetos* population has been collected in a systematic way since the 1950s by the Finnish Nature Conservation Society (e.g. Linkola 1962, Sulkava 1968). The coverage of the field work, and the quality of data, has increased during decades. Since the 1990s all known nests have been controlled annually.

In this report I describe shortly the survey methods of our monitoring project, as well as the present breeding range, population size and productivity of the Golden Eagle population in Finland. The Golden Eagle has been classified as vulnerable (VU) in the national Red Data Book (Rassi et al. 2001). The species is also listed in the Annex I (species in need of special protection) of the EU birds directive.

The reason for these classifications is the marked decrease in numbers of the Golden Eagle in Finland in the first half of the 20th century, due to persecution and fragmentation of large forest areas in southern and central parts of the country. At present persecution is illegal, and the very few cases of shooting of a bird or destroying its nest have practically no effect on the level of population. Actually, the population has increased during the last decades due to various conservation measures.

Environmental administratives started a more comprehensive monitoring project of the Golden Eagle population in the year 1980, and nowadays Metsähallitus takes care of the field work and analysis of results, as well as practical conservation. In addition to the monitoring of the Golden Eagle, Metsähallitus is responsible also for monitoring the populations of the Peregrine *Falco peregrinus* and the Gyrfalcon *F. rusticolus*.

MATERIAL AND METHODS

Voluntary ringers and other bird-watchers have collected the majority of the Golden Eagle material in the field during recent decades. Nowadays about 40 volunteers participate in the monitoring project. The Golden Eagles kill and eat reindeers, and especially calves. Compensatory system for these losses to the reindeer husbandry by the state of Finland is based on the annual number of territories and young raised, and that is why every nest must be controlled annually.

All known territories are visited at least once a year during the breeding season, normally from 15 June to 15 July. Some territories are visited also in April to check whether the pair has started to nest or not.

The continuous mapping of new and previously unknown territories and nests is a prerequisite for successful monitoring of the Golden Eagle. The efficiency of this task has varied between years. At present both new and alternative nests as well as new territories are sought after with a stable and high efficiency. I estimate that we know now about 90% of all the territories in Finland.

Nests have been checked usually by climbing to assess traces of occupancy and the number of young, as well as to ring them. Since the year 1995 Finland has participated in the Nordic colour-ringing programme for the Golden Eagle. From 70 to 80% of all known young are ringed yearly.

A territory has been classified as occupied if successful breeding or breeding attempt was observed, or if recently built, repaired or decorated nest was found. A young older than 50 days is classified as "old". The terms used follow Postupalsky (1974) and Steenhof (1986), and they are specified in more detail by Ekenstedt et al. (2006).

RESULTS AND DISCUSSION

Numbers and distribution

The total number of territories known to the project is 416, of which about 80% lie in Lapland (fig. 1). The southernmost territories have been found in Ostrobothnia and Central Finland, with a lone marginal one in Southwest Finland. The range has remained the same since the 1960s. In the first half of the 20th century many pairs were found further south especially in the east. During the last five years, in total 370 territories have been occupied by Golden Eagles.

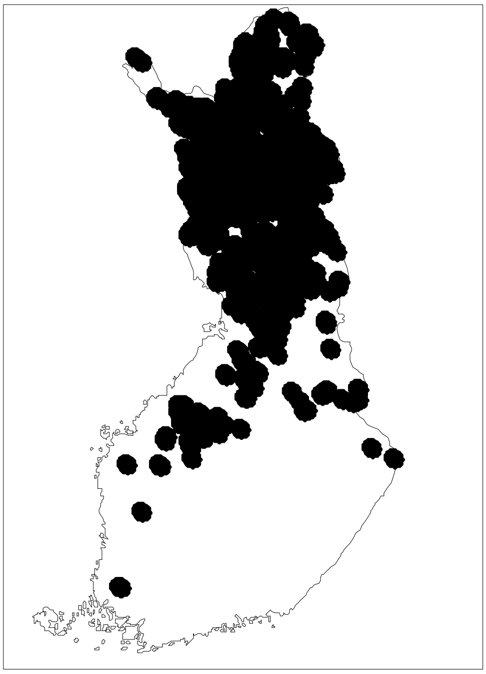

Figure 1. Breeding range of the Golden Eagle in Finland in 2005.

The number of known territories has increased considerably during the last ten years. Although the number of pairs has slightly increased in reality, the main reason for the increase of annual numbers is the more efficient search for previously unknown nest-sites, and improved knowledge on the species and its territories.

The Golden Eagle prefers remote and undisturbed forest and fjell areas, long away from main roads, villages and other human activity. More than 90% of all nests have been built in large pine trees (*Pinus sylvestris*), occasionally in aspen *Populus tremula*, or in Norway spruce *Picea abies*. In northern Lapland some nests have been built on abrupt cliffs.

The distance between nearest neighbours varies considerably. In East Lapland it is, on average, 14.1 kilometres, with a minimum of 5.9 kilometres. The mean area of territories has been estimated at 151 km^2 in East Lapland (Petri Piisilä, unpublished). These figures seem to be representative for the whole of Lapland.

Reproduction

On average, 73% of the territories have been occupied by Golden Eagles (65–83% annually, fig. 2). The proportion was higher in the beginning of the 1980s than later on; most probably field work in those early years was not as representative for the whole population as at present, with ringers concentrating their activity to nests with young in previous years.

Availability of food and weather conditions, especially during the early breeding period, have a marked influence on the reproductive output of the Golden Eagle, explaining a great part of the annual variation in breeding success. The most important prey species in Finland are the mountain hare *Lepus timidus*, Black Grouse *Tetrao tetrix* and Willow Grouse *Lagopus lagopus*, and calves of domestic reindeer *Rangifer tarandus tarandus*.

The number of "old" young per occupied territory has varied from 0.36 to 0.76 (average 0.57) in the period 1980–2005. The number of young per successful nesting has varied from 1.06 to 1.36 (average 1.20), respectively (fig. 3). The productivity of the population varies more in northern fjell regions than further south, but there are no marked spatial deviations in the mean number of young in different parts of the Finnish range.

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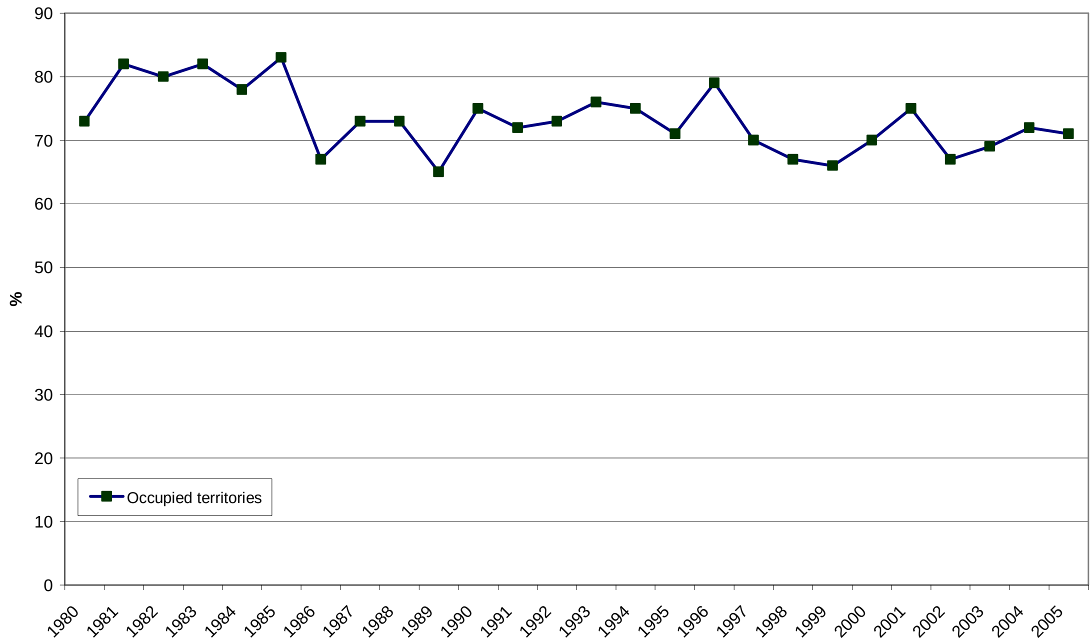

Figure 2. Percentage of occupied territories of the Golden Eagle in Finland in 1980–2005.

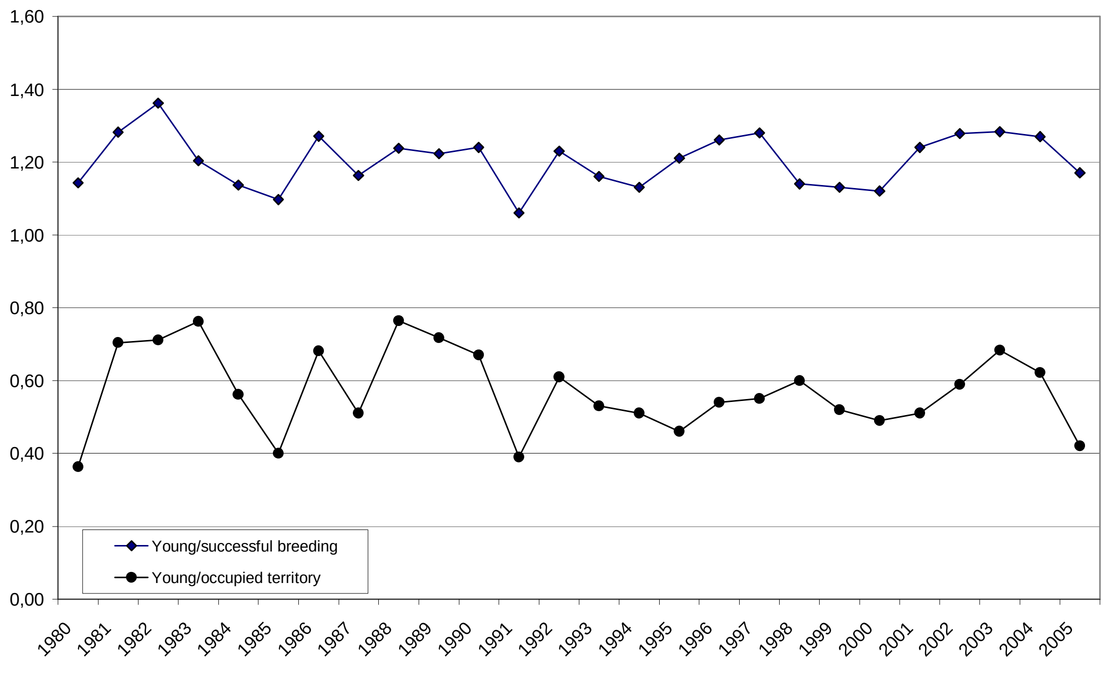

Figure 3. Breeding productivity of the Golden Eagle in Finland in 1980–2005.

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MONITORING OF THE PEREGRINE FALCON *FALCO PEREGRINUS* IN FINLAND

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The number of breeding Peregrine Falcons declined catastrophically in the 1950s and 1960s, reaching a minimum of about 30 pairs in the early 1970s. Since then the species has recovered considerably in the northern half of Finland but not in the south. Since the mid-1990s all previously known nest-site have been controlled at least in July to record nesting success, and new territories have been searched for actively. In total, 213 territories have been occupied at least once during the last five years. Over 90% of the Peregrine Falcons nest on the ground in extensive and wet peatlands. The average number of nestlings (over 30 days of age) per occupied territory has been 1.16 per occupied territory 1993–2005, and the respective figure per successful nest has been 2.33.

Key words: Peregrine Falcon, monitoring, methods, Finland, distribution, breeding success.

МОНИТОРИНГ САПСАНА (*FALCO PEREGRINUS*) В ФИНЛЯНДИИ. Т. Оллила. *Служба лесов и парков Финляндии, Рованиеми, Финляндия.*

Численность гнездящихся сапсанов *Falco peregrinus* в Финляндии катастрофически сократилась в 1950–60–е гг., и к началу 70–х гг. достигла минимального значения примерно в 30 пар. К настоящему времени, вид в значительной степени восстановил свою численность в северной половине Финляндии, но не на юге. Начиная с середины 90–х гг. все ранее известные гнезда проверяются как минимум раз в год – в июле, для регистрации успешности гнездования, а также ведется активный поиск новых гнездовых территорий. В целом, 213 территорий занимались сапсаном хотя бы раз за последние пять лет. Более 90% гнезд сапсана располагаются на земле, среди обширных влажных торфяников. В период с 1993 по 2005 г. на одну занятую территорию в среднем приходилось 1,16 птенцов (старше 30 дней), а на одну успешно гнездящуюся пару – 2,33 птенца.

Ключевые слова: сапсан, монитринг, методы, Финляндия, распространение, успешность размножения.

INTRODUCTION

The breeding population of the Peregrine Falcon *Falco peregrinus* crashed in Finland in the 1950s and 1960s due to pesticides, as a part of the global collapse of this cosmopolitan raptor species. The population, distributed all over Finland, was estimated at 500–1000 pairs before the pesticide era, but in the early 1970s probably no more than 30 pairs were left (Väisänen et al. 1998). The species has been classified as endangered in Finland since 1985 (Rassi et al. 2001). The Peregrine Falcon is listed in Annex I, a species in need of special protection, in the EU Birds Directive.

In this report I present briefly survey methods of the nation-wide monitoring project by Metsähallitus, the governmental organization responsible for monitoring and management of the most threatened raptor species in Finland. I describe also the distribution, size and productivity of the population.

The Peregrine Falcon has recovered considerably in the northern half of Finland during recent decades, mostly because use of the most harmful pesticides was stopped already in the 1970s. However, new types of chemicals, like bromide flame retardants, may pose a threat to top predators like the Peregrine Falcon in the future. In addition, the species has not been able to resettle in the south so far, in spite of range expansion in the north. Drainage of peatlands and other land use has had negative effect on Peregrine Falcons locally, but it cannot explain the total disappearance of the southern subpopulation since the 1960s.

MATERIAL AND METHODS

Nation-wide monitoring of the Peregrine Falcon was started at the beginning of the 1960s by Finnish Nature Conservation Society (Linkola 1959), as a result of the catastrophic population decline. WWF Finland took responsibility for monitoring from 1970 to 1997 (e.g. Wikman 1993), and since then Metsähallitus has organized the project (e.g. Ollila 2000). During all these years voluntary bird ringers and other ornithologists have taken care of the main part of field work, with about 15 active participants at present.

All known territories have been visited at least once during the breeding season, normally between 5[t]–25 July. Due to limited resources, only very few territories have been controlled twice a year, which is a weakness in the monitoring programme – some unsuccessfully breeding pairs, for example, have probably remained unnoticed. The efficiency of searching for unknown territories and new nests in previously known breeding localities has remained fairly high and stable in recent years, but it has varied in earlier times. Continuous looking for new pairs and nest-sites is a necessity for reliable monitoring of an increasing Peregrine Falcon population. I estimate that we know now about 80% of all territories in Finland.

A territory has been classified as occupied if successful breeding or breeding attempt was observed, or a nest with fresh traces of Peregrine Falcons was found, or if a pair was seen during the breeding season. A nestling aged over 30 days has been classified as "old". The terms follow those proposed by Postupalsky (1974) and Steenhof (1986).

About 80% of all found young have been ringed yearly. We have a preliminary plan to start colour ringing of nestlings in the year 2007, integrated with the Swedish programme.

RESULTS AND DISCUSSION

Numbers and distribution

The total number of territories occupied by Peregrine Falcons since the 1970s is 276, and about 80% of them have been found in Lapland (fig. 1.). Of these territories 213 have been occupied during the last five years. The first successful breeding since the year 1970 in Central Ostrobothnia, western Finland, was recorded in 2005, which is one of the first signs of possible recovery of the extinct southern subpopulation.

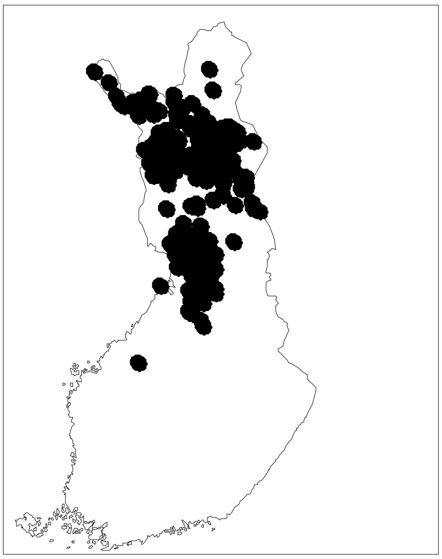

Figure 1. Distribution of the Peregrine Falcon in Finland in 2005.

The number of known territories has increased markedly during the last ten years. In addition to the real increase of the population, a significant reason for this is the improved efficiency of field work; many previously missed territories have been found not until recently. Most of the falcons breed in remote and extensive *aapamires*, very wet peatlands, from northern Ostrobothnia to Central Lapland, the rest in fjell regions further north. Only very few pairs nest near human habitation. The distance between nearest neighbours varies a lot depending on the availability of suitable breeding and hunting habitats.

More than 90% of all nests lie on the ground in peatlands. In fjell regions Peregrine Falcons nest on cliff ledges. Every year some nests (3–5) have been found in trees, in old twig-nests of the Osprey (*Pandion haliaetus*) or the White-Tailed Sea Eagle (*Haliaeetus albicilla*). In the year 2005 the first breeding was found in an old Raven's *Corvus corax* nest.

Reproduction

Peregrine Falcons have been found, on average, in 63% of all territories visited from 1993 to 2005 (annually 59–82%, fig. 2). This percentage was higher in 1993–1994 than later, because in those former years observers concentrated their field effort relatively more often in occupied territories, while after that all previously known territories, whether regularly occupied by falcons or not, have been controlled.

Abundance of prey species and weather conditions have a strong effect on reproductive success of the Peregrine Falcon, especially during incubation period from mid-May to mid-June. These natural variables explain a high proportion of the annual variation in the mean number of old nestlings. The most important prey species in Finland are waders, ducks and gulls.

The average number of old nestlings per occupied territory has varied from 1.10 to 1.85 in the period 1993–2005 (mean 1.61). The data from the years 1995 and 1996 are not comparable with other years due to too low activity in the field work. The number of nestlings per successful breeding has varied from 2.12 to 2.65 (mean 2.33), respectively (fig. 3). Breeding success seems to be higher on cliffs than on the ground, but there is no marked variation between different parts of the Finnish range.

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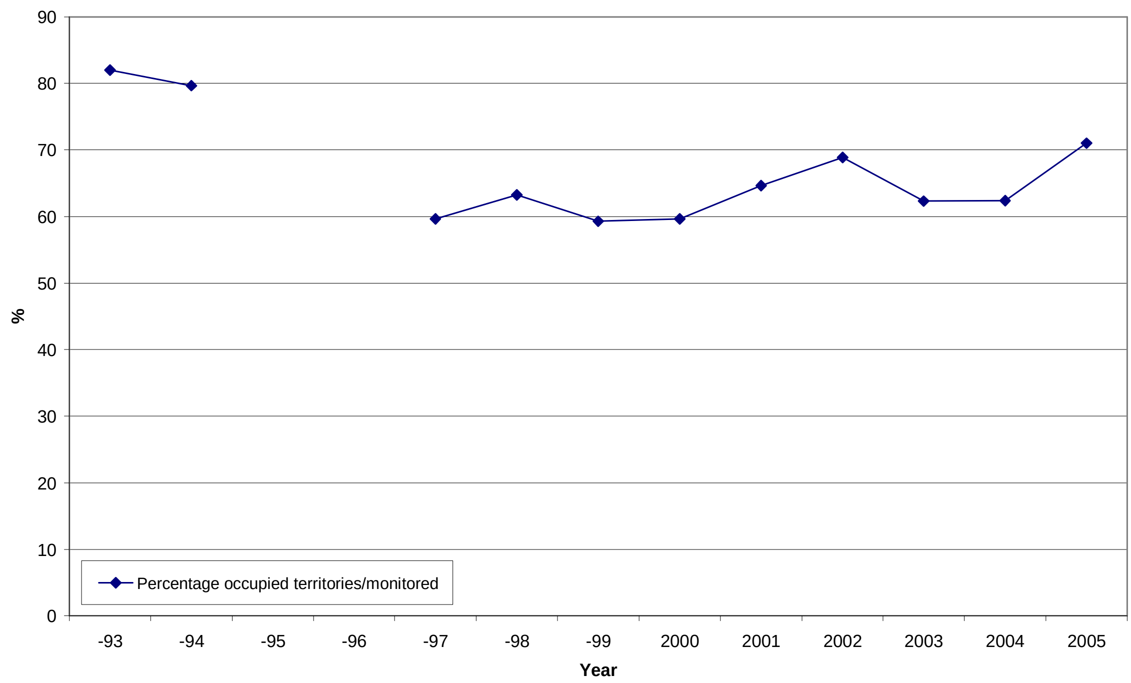

Figure 2. Percentage of occupied territories in Finland in 1993–2005.

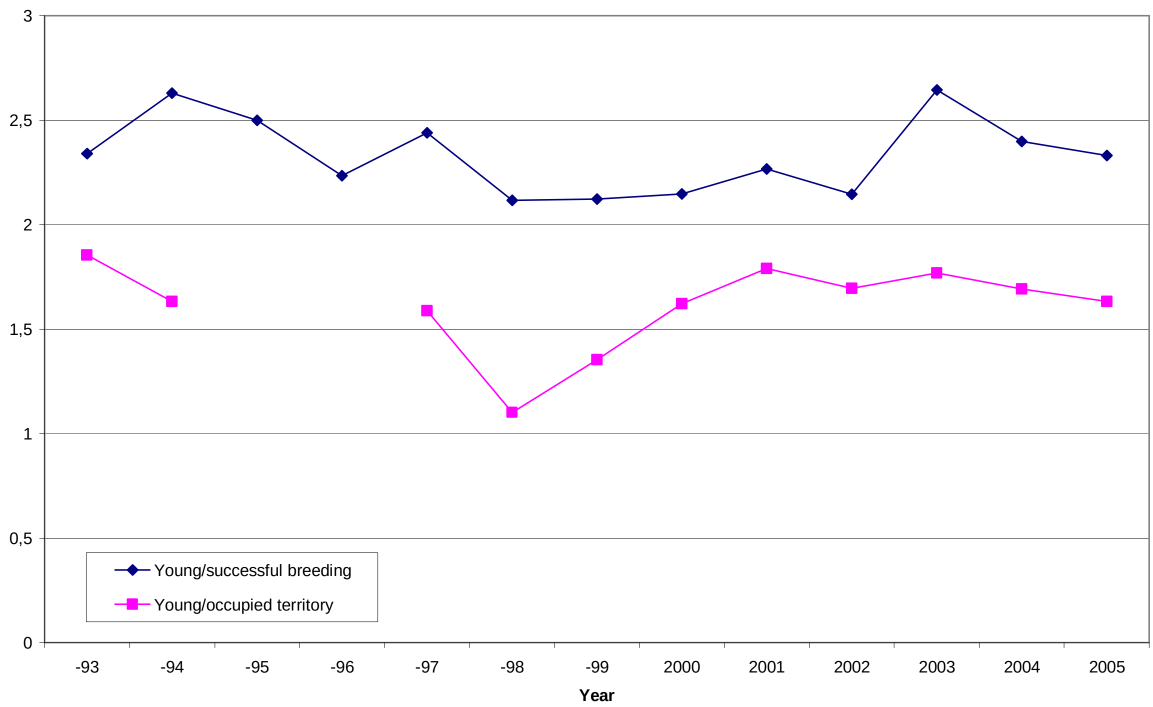

Figure 3. Breeding success of the Peregrine Falcon in Finland in 1993–2005.

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DISTRIBUTION AND ABUNDANCE OF SOME RAPTOR SPECIES IN THE LENINGRAD REGION

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The paper presents data on the abundance of five raptor species breeding in the Leningrad region: the White-tailed Sea Eagle (*Haliaeetus albicilla*), Osprey (*Pandion haliaetus*), Golden Eagle (*Aquila chrysaetos*), Spotted Eagle (*Aquila clanga*) and Lesser Spotted Eagle (*Aquila pomarina*). Information on tendencies in the change of the species abundance over the past 15 years is provided. Maps of nest area distribution in the Leningrad region have been plotted for all the species.

Key words: raptors, distribution, abundance, Leningrad region.

РАСПРОСТРАНЕНИЕ И ЧИСЛЕННОСТЬ НЕКОТОРЫХ ВИДОВ ХИЩНЫХ ПТИЦ ЛЕНИНГРАДСКОЙ ОБЛАСТИ.
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В статье приведены сведения о численности гнездящихся в Ленинградской области пяти видов хищных птиц: орлана-белохвоста (*Haliaeetus albicilla*), скопы (*Pandion haliaetus*), беркута (*Aquila chrysaetos*), большого (*Aquila clanga*) и малого подорликов (*Aquila pomarina*). Приводятся сведения о тенденциях изменения численности этих видов за последние 15 лет. Для всех видов созданы картосхемы размещения гнездовых участков на территории Ленинградской области.

Ключевые слова: хищные птицы, распространение, численность, Ленинградская область.

The fauna of the Leningrad region is quite specific. This is due both to the geographic position and the heterogeneity of landscapes in the area. The region comprises various types of middle and southern taiga forests, mires of various kinds, and numerous water-bodies. The most noteworthy among the latter are Europe's largest freshwater lake, Lake Ladoga, and the brackish eastern Gulf of Finland.

As regards its fauna, the Leningrad region is one of the best investigated regions of Russia. In the early 1980s, generalization and analysis of data on the distribution, biology and behaviour of birds in the region resulted in publication of the monograph by A. Malchevskiy and Yu. Pukinskiy, "Birds of the Leningrad Region and adjacent areas. History, biology, conservation" (1983). After more than 20 years gone since then, new and more accurate data on the distribution and abundance of some bird species in the region have been gathered.

A total of 21 species of diurnal raptors (*Falconiformes*) have been registered in the Leningrad region. Of these, 16 species continue nesting in the territory. Nests of two species, the Peregrine Falcon *Falco peregrinus* and the Short-toed Eagle *Circaetus gallicus*, were not detected in the region in the past decades. The Peregrine is regularly observed during seasonal migrations and even in the breeding period in some parts of the Leningrad region (Noskov et al. 1993, Iovchenko et al. 2001). Short-toed Eagle records are far fewer. The last breeding registration of the species was from the south of the Leningrad region in 1961. There have been no more than a dozen and half observations of the species since then.

Decline in the abundance of the breeding population of large raptors began several decades ago. The decline for some species has been so heavy over this period that they are now at the verge of extinction in the region.

The Red Data Book of the Leningrad region (having, alas, no official status) comprises 13 raptor species. The number includes all eagles (genus Aquila) occurring in the region, the White-tailed Sea Eagle *Haliaeetus albicilla* and Osprey *Pandion haliaetus*. It is for these five species that abundance data are provided in the present paper.

The Osprey *Pandion haliaetus* in the Leningrad region settles on raised bogs within reach of waters rich in fish (fig. 1). The bird builds its large nests on tops of pine trees rising slightly over the rest of the trees in its part of the mire. Although an overwhelming majority of nests are situated in Lake Ladoga and Gulf of Finland shore areas, the Osprey nests also around relatively small but fish-rich lake systems in forests in the eastern part of the region. Researchers have noted a few times that the Osprey tends to settle in colonies. Yu. Pukinskiy (1983) reported of 2–3 pairs of the species nesting in a

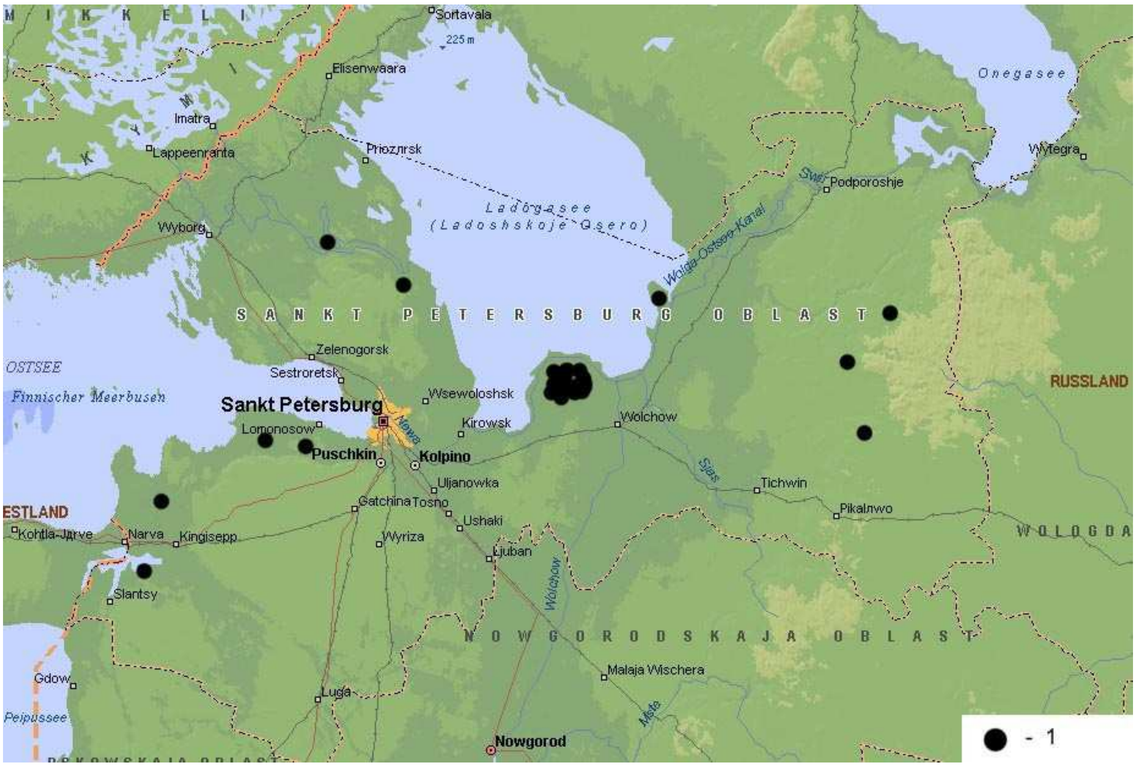

Figure 1. Breeding grounds of the Osprey (*Pandion haliaetus*) in 2000-2005. 1 – occupied nest registrations.

swampy peatmoss larch forest at the Volkhov Bay shore and in the upper reaches of River Svir. A group settlement of ca. 25–27 breeding pairs is known from a mire in southern Lake Ladoga area (Vysotskiy 2000). There are now at least 35–37 pairs of the Osprey breeding in the Leningrad region. The species abundance has shown an upward tendency in the past several decades.

The White-tailed Sea Eagle *Haliaeetus albicilla* settles in a variety of biotopes, but the distribution is always connected to sea coasts and shores of large lakes. Nests are built in the upper part of tree crowns and used repeatedly. Because of annual patching and building up, the nests sometimes reach quite an impressive size. Sea Eagles nest close to the shore of large bodies of water. The nests are 100–3500 m away from the shoreline, the average being 1100 m (n=26). An exception is the distribution of nests around Verkhne-Svirsky (Upper Svir) reservoir, where the White-tailed Sea Eagle places its nests as it does around Rybinsk reservoir (Kuznetsov & Reif 1998) – along the primary shore edge with a temporarily flooded zone. Several nests have been detected on dead trees standing within the flooded area. Apparently, one of the main criteria for the choice of the nest tree is the possibility of free access to the nest. Some territories may contain up to three nests. Birds usually use the same nest for breeding year after year. Only emergencies can make them change it (destruction of the nest, regular disturbance). Sea Eagles are capable of building a new nest within a month. Average breeding success per a breeding pair was 0.72 young (0.46–0.89). One successfully breeding pair produced an average of 1.36 fledglings (1.1–1.9). In 1994, we started an inventory of breeding pairs of the species in Northwest Russia in general and in the Leningrad region in particular. These activities were implemented within the European programme for colour marking of juvenile White-tailed Sea Eagles. Over twenty years of surveys in the territory, breeding grounds of 18 White-tailed Sea Eagle pairs were detected. The main breeding grounds are SW Gulf of Finland coast, southern Lake Ladoga region and the impoundment reservoir on River Svir, in the NE part of the region (fig. 2). The number of breeding pairs has lately remained stable.

The Golden Eagle *Aquila chrysaetos* can be encountered in the Leningrad region throughout the year. This eagle species both occurs during seasonal migrations and overwinters in the region. As indicated by ringed bird recoveries, winter residents are younger individuals breeding in regions further north. At the moment, the status of the Golden Eagle in the Leningrad region is nearly critical, the species being very rare in the region in the breeding period. All Golden Eagle nests found in recent years are located on dry ridges in vast raised bogs. According to some optimistic estimates there now breed no more than 5 pairs of the species in the Leningrad region. At present, we only know of three nests where breeding takes place (fig. 3).

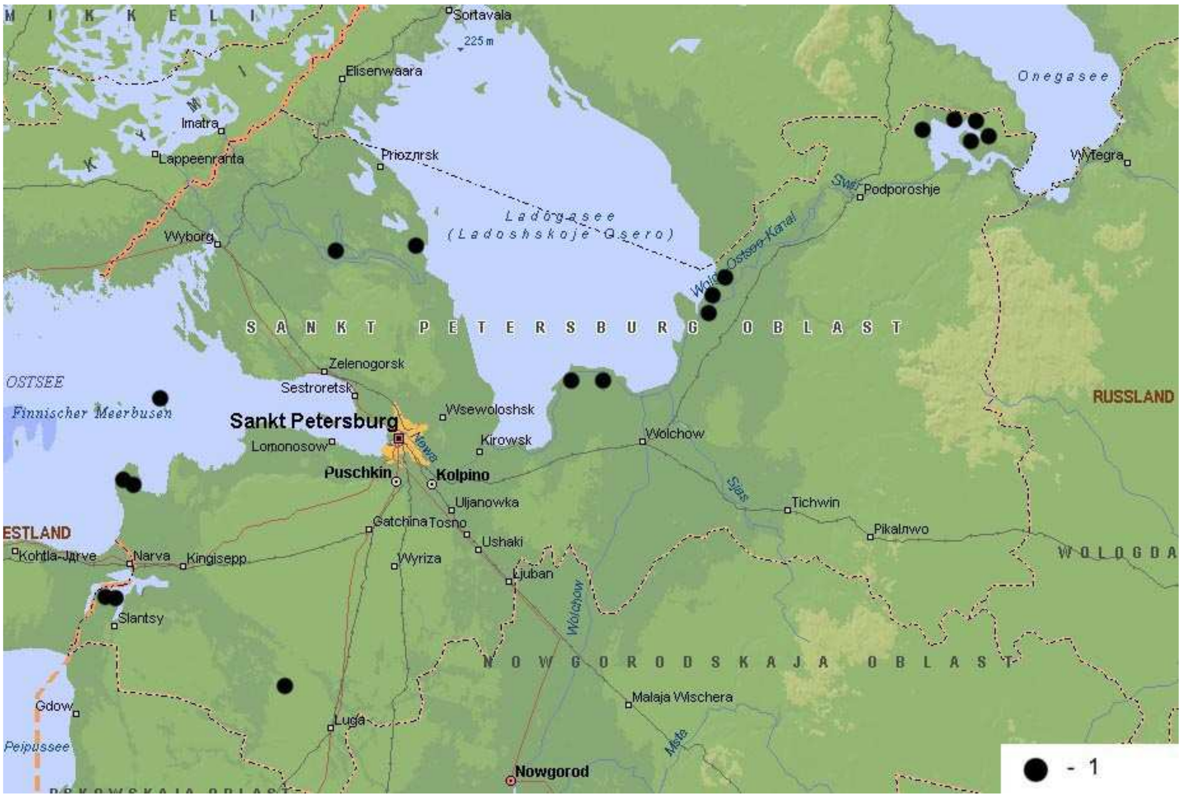

Figure 2. Breeding grounds of the White-tailed Sea Eagle *Haliaeetus albicilla* in 2000–2005. 1 – occupied nest registrations.

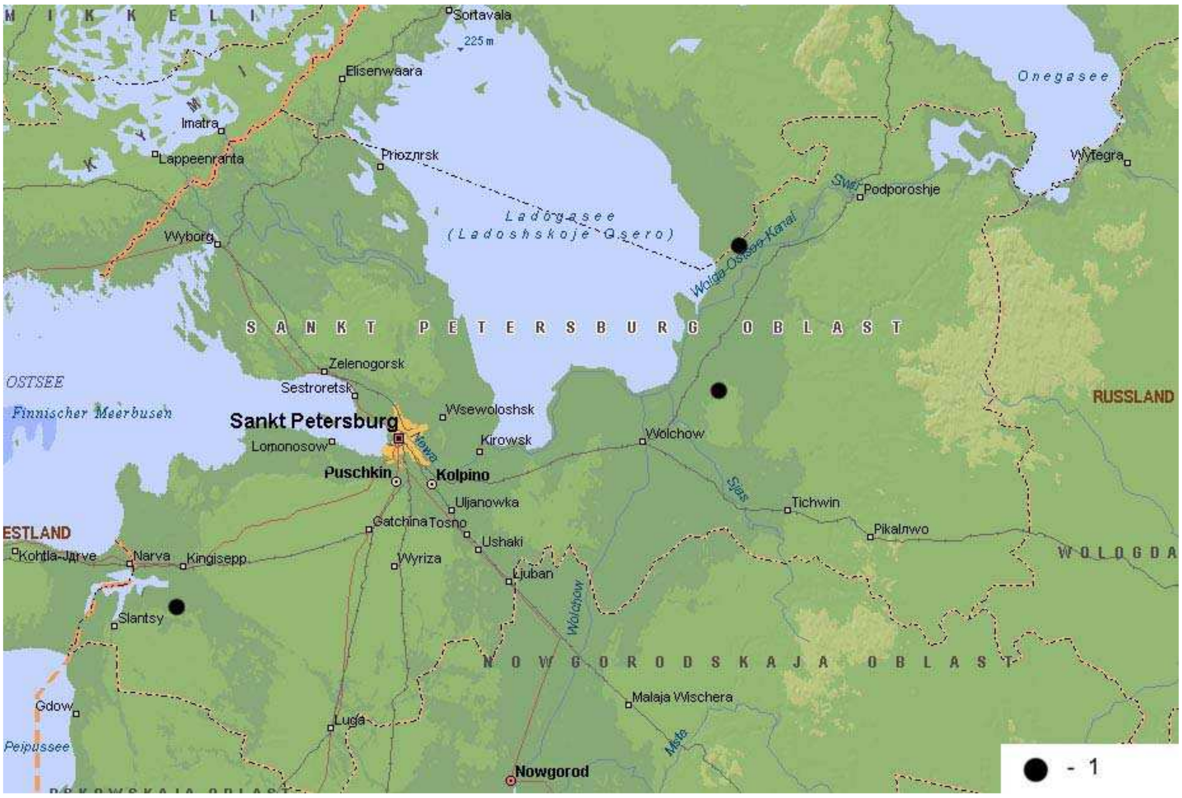

Figure 3. Breeding grounds of the Golden Eagle *Aquila chrysaetos* in 2000–2005. 1 – occupied nest registrations.

One should admit that the main limiting factor for the Golden Eagle is distrbance and intentional persecution of the species. These birds now quite often get shot by poacher taxidermists.

Early in the 1980s, the Spotted Eagle *Aquila clanga* was regarded as the most common species among large raptors in the Leningrad region (Malchevskiy & Pukinskiy 1983). In those years, specialists estimated the population to be 18–20 pairs. The distribution of territories of the Spotted Eagle over the territory was uneven. The species tended to settle in water-logged river valleys, extensive wet cutovers, mires and lake shores becoming overgrown by vegetation. The birds were most frequently sighted in the Lake Ladoga region and around lakes of the Karelian Isthmus. In many locations, Spotted Eagle pairs were known to have bred for decades. Galushin (1980) estimated the Spotted Eagle breeding density in European Russia in those years to be 5 pairs per 1000 km^2.

Judging by our studies, the main requirement to the breeding biotope for the species is availability of open foraging habitats in the vicinity: overgrowing waters, mires, and floodplain meadows. Being a flexible species, the Spotted Eagle easily shifts from one food object to another. However, as meadows and floodplains get overgrown with scrub, foraging opportunities deteriorate. In the past two decades, fewer Spotted Eagle nests have been reported. Experts estimate current Spotted Eagle population in the Leningrad region to be no more than 10 pairs. In addition to the above-mentioned degradation of foraging and breeding habitats, a limiting factor for the species is illegal killing. We are only aware of the nests and breeding grounds of 6 pairs of the species (fig. 4).

It is believed that the northeastern boundary of the distribution range of the Lesser Spotted Eagle *Aquila pomorina* runs across the Leningrad region. The species is quite common in western and southwestern parts of the region, but not observed east of River Volkhov. It settles in small forest patches adjoining barren land or drained fields and avoids extensive forest areas and large raised bogs. The most favourable habitat for the Lesser Spotted Eagle is farmland with low human presence. A very strong limiting factor for the species is the lack of agricultural activities in the farmland. After grasslands have been mown down, members of all pairs nesting in the vicinity come to hunt there. Lesser Spotted Eagles were noted to be unevenly distributed over the territory in the breeding period. They settle in small groups. In such areas, nests may be within 1.5 km apart. We know breeding territories of five pairs of the Lesser Spotted Eagle (fig. 5). There appears to be a total of no more than 10–12 pairs of the species breeding in the Leningrad region.

A heavy impact on raptors in the Leningrad region today is produced by illegal hunting. Birds are taken for taxidermy. The bigger the bird, the more attractive it is to poachers. Overgrowing of fields and cessation of agricultural activities are becoming a weighty limiting factor for raptors hunting in farmland.

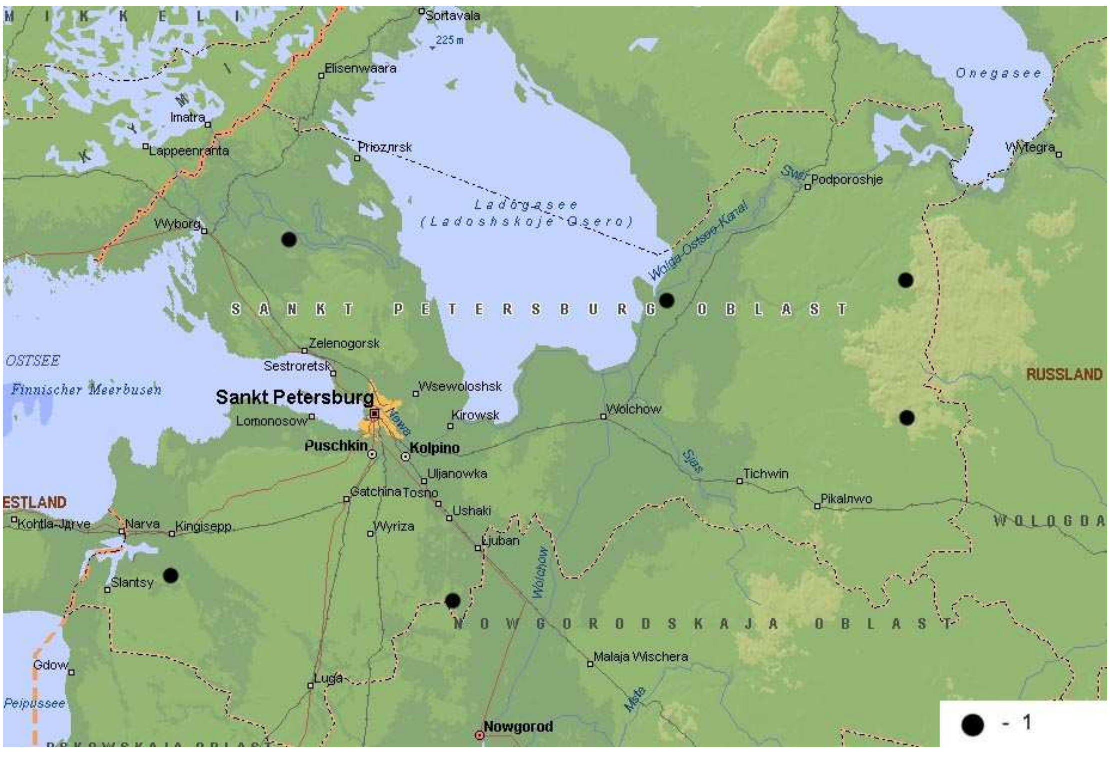

Figure 4. Breeding grounds of the Spotted Eagle *Aquila clanga* in 2000–2005. 1 – occupied nest registrations.

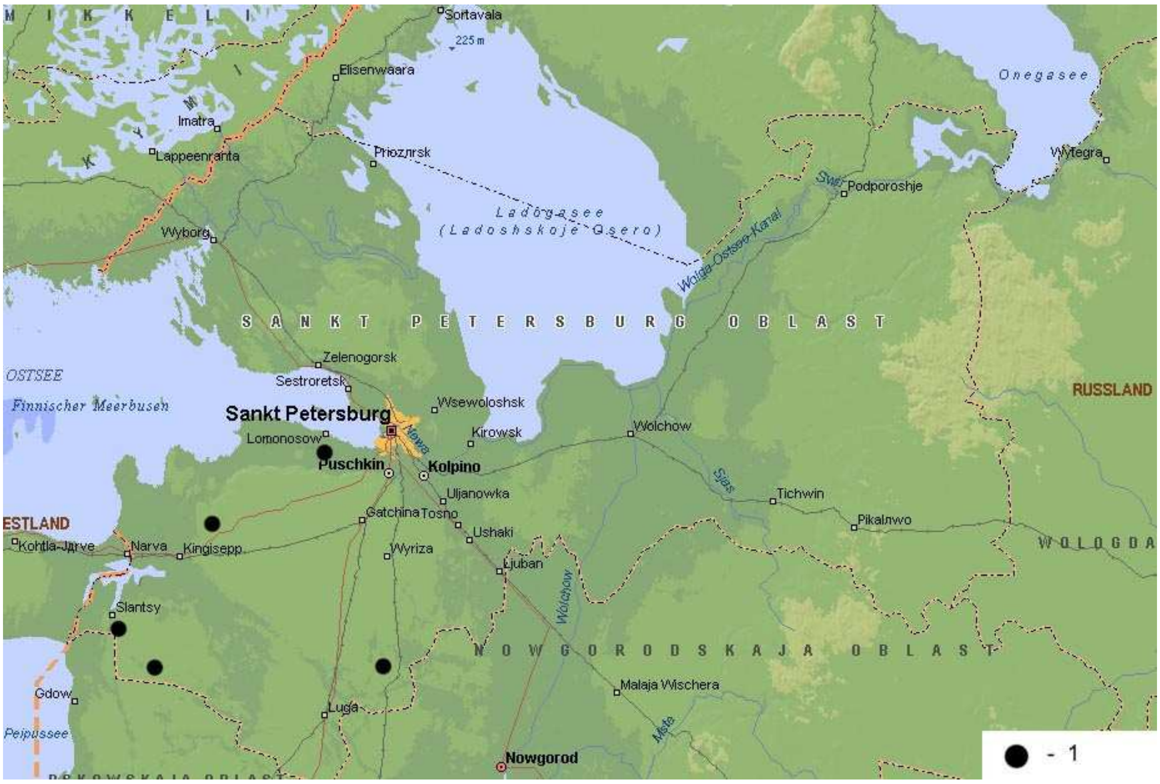

Figure 5. Breeding grounds of the Lesser Spotted Eagle *Aquila pomorina* in 2000–2005. 1 – occupied nest registrations.

The abundance of the White-tailed Sea Eagle and Lesser Spotted Eagle in the past several decades has remained stable (tab. 1). A reduction in the number of breeding pairs in the Leningrad region has been demonstrated by the Golden Eagle and Spotted Eagle. The number of Golden Eagle nests has lately decreased notably. There is only one area where these eagles breed annually. Regular breeding of the pair is due to the location of the nest within the Nizhne-Svirskiy strict nature reserve. Breeding in all other areas is not annual. The number of breeding Osprey pairs has increased lately. In some localities with plentiful food supply and limited human access Osprey pairs group close to each other.

Table 1. The number of raptor pairs and their trends in the Leningrad region over several decades.

Species	1980s (after Malchevskiy & Pukinskiy 1983)	2004–2005, own data	Trend
Osprey	12–15	35–37	Increase
White-tailed Sea Eagle	12–14	16–18	Stable
Golden Eagle	3–4	1–3	Decrease
Spotted Eagle	18–20	8–10	Decrease
Lesser Spotted Eagle	10–12	10–12	Stable

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MONITORING AND CONSERVATION OF FINNISH OSPREYS *PANDION HALIAETUS* IN 1971–2005

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Since 1971, authorized voluntary ringers have checked almost all known Finnish nest sites of the Osprey *Pandion haliaetus* annually. Finnish Osprey population remained on the same level through the seventies, increased from 1982 to 1994 by about 3% per year and, since then, has remained "stable". In 2005, of 1541 potential nest sites checked, 926 were occupied, 753 active and 699 successful. Productivity has improved considerably during the last decades and was in 1996–2005: 1.65 large nestlings per occupied territory, 2.04 per active nest and 2.25 per successful nest. The positive trend of Finnish Osprey population can be attributed (1) to decreased persecution during migration and wintering, (2) to decreased impact of environmental toxicants, and (3) to construction of artificial nests to compensate the losses caused by modern forestry. At present, almost 50% of the Finnish Ospreys breed in artificial nests constructed by voluntary ringers.

Key words: Osprey, *Pandion haliaetus*, population trend, productivity, persecution, environmental toxicants, land use, modern forestry, artificial nests.

МОНИТРИНГ И ОХРАНА СКОПЫ (*PANDION HALIAETUS*) В ФИНЛЯНДИИ В 1971–2005 ГГ. П. Саурола. Музей национальной истории Фнляндии, Университет Хельсинки, Финляндия.

Начиная с 1971 г. кольцеватели-любители ежегодно проверяют практически все известные гнезда скопы *Pandion haliaetus* на территории Финляндии. Популяция скопы в Финляндии оставалась неизменной в 1970-е гг., затем росла примерно на 3% в год с 1982 г. до 1994 г. и с тех пор остается «стабильной». В 2005 г. из 1541 проверенных потенциальных гнездовых участков 926 были заняты, в 753 были сделаны кладки, и в 699 гнездование было успешным. Продуктивность гнезд значительно выросла за последние десятилетия, составив в 1996–2005 гг. 1,65 подросших птенцов на одну занятую территорию, 2,04 – на гнездо с кладкой и 2,25 – на успешно гнездящуюся пару. Положительную динамику популяции скопы в Финляндии можно объяснить: сокращением прямого преследования в период миграций и зимовки, снижением воздействия экологически токсичных веществ и сооружением искусственных гнездовий для компенсации их утраты в связи с текущей лесохозяйственной деятельностью. На сегодня, почти 50% скоп в Финляндии используют для гнездования искусственные сооружения, построенные кольцевателями-любителями.

Ключевые слова: скопа, *Pandion haliaetus*, динамика популяции, продуктивность, преследование, экологически токсичные вещества, землепользование, современное лесное хозяйство, искусственные гнездовья.

INTRODUCTION

The Osprey *Pandion haliaetus* is a cosmopolitan species, which is distributed all over the world and can be encountered in all continents except in the Antarctica. The Osprey has suffered heavily from several human impacts. Persecution, environmental toxicants, fishery practices and land use have been the main factors, which have reduced both survival and productivity in Osprey populations (e.g. Saurola & Koivu 1987, Poole 1989, Saurola 1997).

In Finland, the Osprey breeds all over the country: from the southern archipelago (60° N) to the northernmost Lapland (70° N). Because the Osprey eats almost exclusively live fish, its distribution is primarily determined by the distribution of favourable fishing waters. For a good nest site the Osprey needs a safe, stable and exposed base to support the nest. The breeding densities are highest in areas where these two prerequisites are filled. In Finland, the most suitable Osprey habitats are found along the coasts of Gulf of Finland and Gulf of Bothnia, and in the central lake district in southern Finland (Saurola & Koivu 1987).

On the basis of sporadic observations, the Finnish Osprey population decreased in the beginning of the 20th century due to the heavy persecution. During the World War II, the Osprey population slowly recovered, but decreased again from the 1950s to the early 1970s, this time due to both heavy persecution during migration and wintering, especially in Soviet Union and some Mediterranean and African countries, and to detrimental effects of the DDT and other environmental toxicants (Saurola & Koivu 1987, Saurola 1997).

In this contribution I will (1) introduce the Finnish Osprey monitoring scheme, *Project Pandion*, (2) demonstrate the population trends during the last 35 years, and (3) discuss the threats and conservation of the Finnish Ospreys.

MATERIAL AND METHODS

Project Pandion

In 1971, the Finnish Ringing Centre started a nationwide monitoring programme, *Project Pandion* (Saurola 1980, 1995). As a start, inquiries about the nest sites of Ospreys were addressed through mass media to the general public all over the country. Then all information gathered on potential nest sites was distributed to the ringers, who wanted to participate in the project on the voluntary basis, i.e. without any compensation of travelling or any other kinds of costs. Each nest site was pointed only to one ringer, who was then responsible for checking the site. This way the potential competition between ringers was avoided and the disturbance at the nest sites was minimized.

The normal annual routine carried out by a ringer at an Osprey nest is the following.

(a) To fill in a form which includes: (1) all observations on the breeding success, (2) coordinates of the site with the accuracy of at least 100 meters (Finnish National Grid), (3) description of the nesting habitat (type and amount of human influence), (4) description of the nest site (e.g. species, status, height and diameter at the base and at the top of the tree), (5) information on prey remains found.

(b) To ring the nestlings and to measure their wing length and body mass.

(c) To collect dead nestlings, unhatched eggs, eggshell fragments and feathers for analysis of environmental contaminants.

(d) To put a fibreglass label on new nesting trees. The label indicates (1) that the nest site is protected year round, (2) that all disturbances (including photography) in the neighbourhood of the nest are prohibited during the breeding season, and (3) that the nest site is known to the *Project Pandion*. Thus, after the very first year, general public have been requested to report only the unlabelled Osprey nests to the Ringing Centre.

Since 1972, the authorized voluntary ringers have checked more than 90% of occupied Osprey territories known by the *Project Pandion* every year. E.g. in 2005, 1541 potential nest sites were checked and 926 occupied territories detected. Of these 753 were active (eggs were laid) and 699 successful (young were produced). By 2005, there were altogether 44,977 records in the Osprey computer file (one record = all information in one year from one nest site, including the unoccupied ones).

Ringing and recoveries

In 1913–2005, 38,950 Ospreys have been ringed in Finland, of these 36,360 (93%) during the *Project Pandion*. In the last ten years, the annual ringing total has varied from 1200 to 1400 individuals. In contrast to many other species and due to the nationwide *Project Pandion*, Ospreys have been ringed all over the country, from southern coast to Lapland.

Up to the end of 2005, altogether 2977 recoveries and "interesting" recaptures of 2833 different individuals have been reported. I have classified a recapture as "interesting", if the bird had moved at least 10 km from the location of the previous recapture or if the time elapsed from the previous recapture had been at least three months.

RESULTS

Population trend

According to the "hard" data produced by the *Project Pandion*, the Finnish Osprey population remained more or less on the same level through the 1970s, increased from 1982 to 1994 by about 3% per year, and, since then, has remained more or less "stable" (fig. 1). However, a part of the population "increase", especially in sparsely inhabited northern Finland, may be only a result of increased survey coverage. The present population estimate is 1200 breeding pairs (Saurola 1997).

Productivity

The productivity of Finnish Ospreys has increased considerably during the three last decades (fig. 2). In the 1970s, the average production of young was: 1.37 large nestlings per occupied territory, 1.81 per active nest, and 2.01 per successful nest. During the last ten years (1996–2005), the corresponding averages were: 1.65, 2.04 and 2.21.

Causes of death

Of the "final" encounters of each individual, 58% were of birds reported dead with additional information on the cause of death. Of these 1529 Ospreys, 40% were killed deliberately by man, 31% died because of various fishing operations, and 14% were hit by overhead wires. Finnish Ospreys have been killed in altogether 58 different countries (see fig. 3). Those on the top of the list are: Italy (74 individuals killed), Ukraine (56), Russia (37), Mali (36) and Nigeria (35).

Survival

Both for science and for conservation, estimates of survival rates are as important as the estimates of productivity. However, it is much more difficult to obtain relevant data on survival than on production of young. The most reliable estimates of age- and time-specific survival rates are based on sufficient number of both (a) ring recoveries of birds found dead, and (b) recaptures/resightings of birds encountered alive (see e.g. Francis & Saurola 2004).

In the 1970s and 1980s, several methods to catch adult Ospreys at the nest were developed and more than 200 different adults were caught at least once in a local study area in southern Finland.

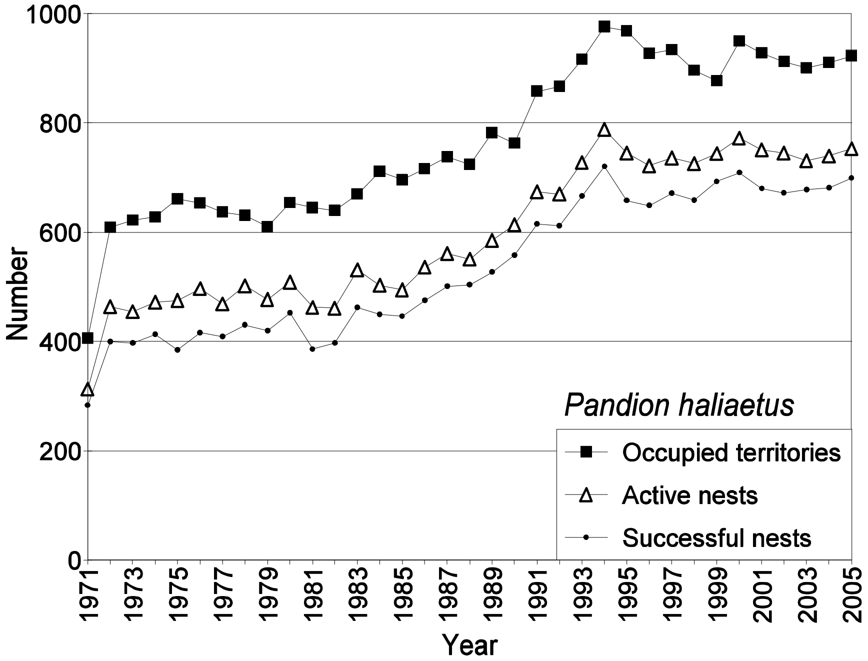

Figure 1. Numbers of occupied, active and successful nests of Finnish Ospreys *Pandion haliaetus* checked in 1971–2005.

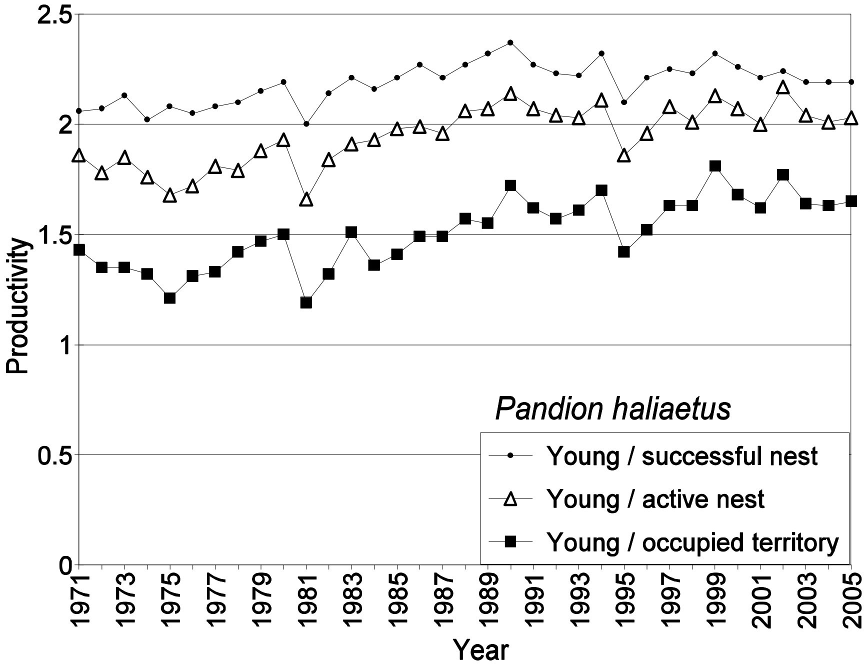

Figure 2. Productivity of the Finnish Ospreys *Pandion haliaetus* in 1971–2005.

However, due to many practical difficulties in trapping adult Ospreys in closed forest habitats and to the low quality of individual colour rings, this activity did not continue effectively enough in the 1990s. Thus, accurate and reliable estimates of survival rates of Finnish Ospreys are not yet available.

The distribution of ring recoveries by age classes indicates, however, as expected, that a remarkable proportion ("40%") of Finnish Ospreys die during the first year of life. The longevity record of the Ospreys ringed in Finland is 26 years, which is, as well, the highest age of the Osprey so far recorded in the world.

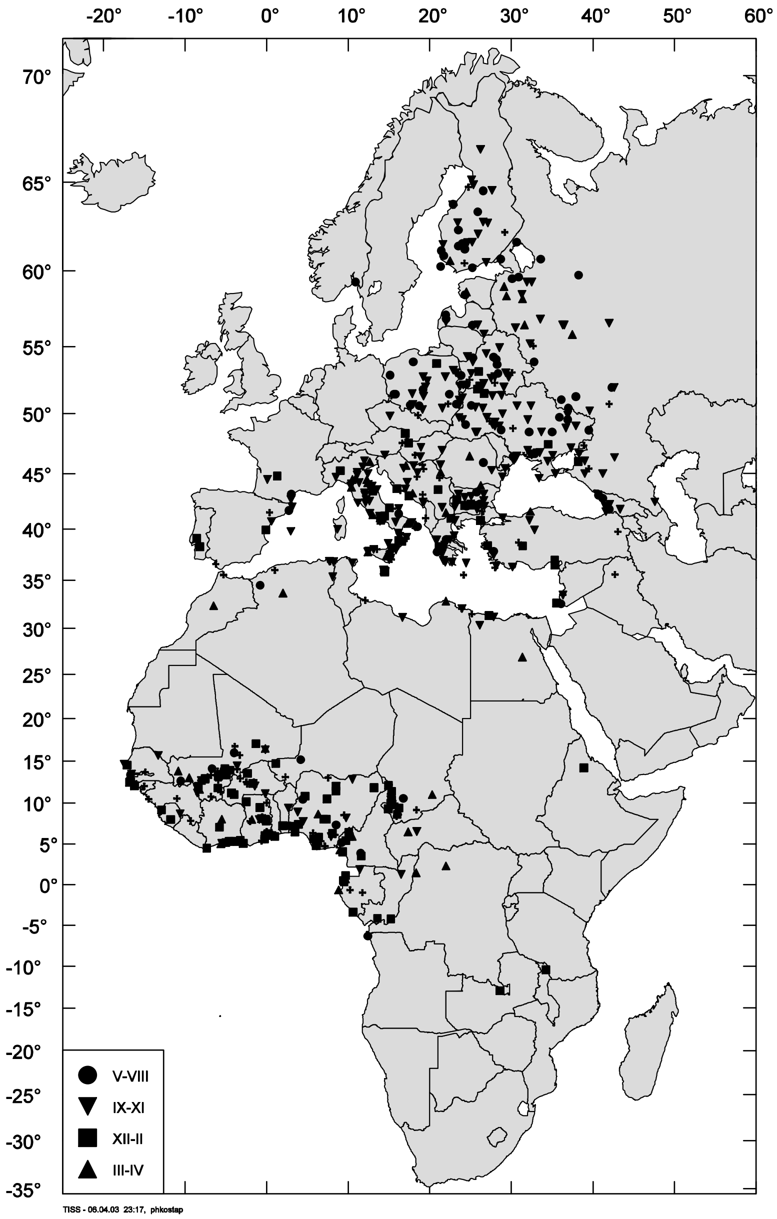

Figure 3. Spatial distribution of encounters of Ospreys *Pandion haliaetus* ringed in Finland and reported as killed by man. Seasons indicated by the following symbols: circle = May–August; triangle, pointing down = September–November; square = December–February: triangle, pointing up = March–April; cross = finding date inaccurate.

Dispersal

Altogether 38 male and 34 female Ospreys ringed as nestlings in Finland have been recaptured as breeders at the nest. According to these data, the *natal dispersal distance*, i.e. distance from fledging site to the first breeding site, was significantly shorter in males (median = 27 km, maximum = 433 km) than in females (median = 133 km, maximum 534 km). In addition, three females and one male ringed as nestlings in Sweden have been recaptured as breeders in Finland, 380–480 km away from their natal sites. When the “random” recoveries of adult birds ringed as nestlings and found dead by the general public during the breeding season were used for estimating natal dispersal, the distances distributed exactly as could be expected from a mixed data set of both sexes (median = 68 km; n = 212).

“Lack of information about dispersal has begun to limit progress on several biological fronts” (Walters 2000). Adequate knowledge of dispersal is of crucial importance in understanding population dynamics, as well as in planning adequate conservation measures, e.g. reintroduction programmes in cases when the local population has become extinct.

Migration and wintering

The very high number of encounters of marked birds gives a good general picture where Finnish Ospreys spend the non-breeding season (figs. 3 and 4). During migration they have been encountered all over Europe from the British Isles to Russia. Further, ring recoveries show that the wintering area of Finnish Ospreys is very wide: from the west coast of West Africa to Arabian Peninsula and from the Mediterranean to the southern coast of South Africa (cf. Saurola 1994). Thus, the changes in the Finnish Osprey population are linked to the environmental and cultural changes in large areas in Europe and Africa.

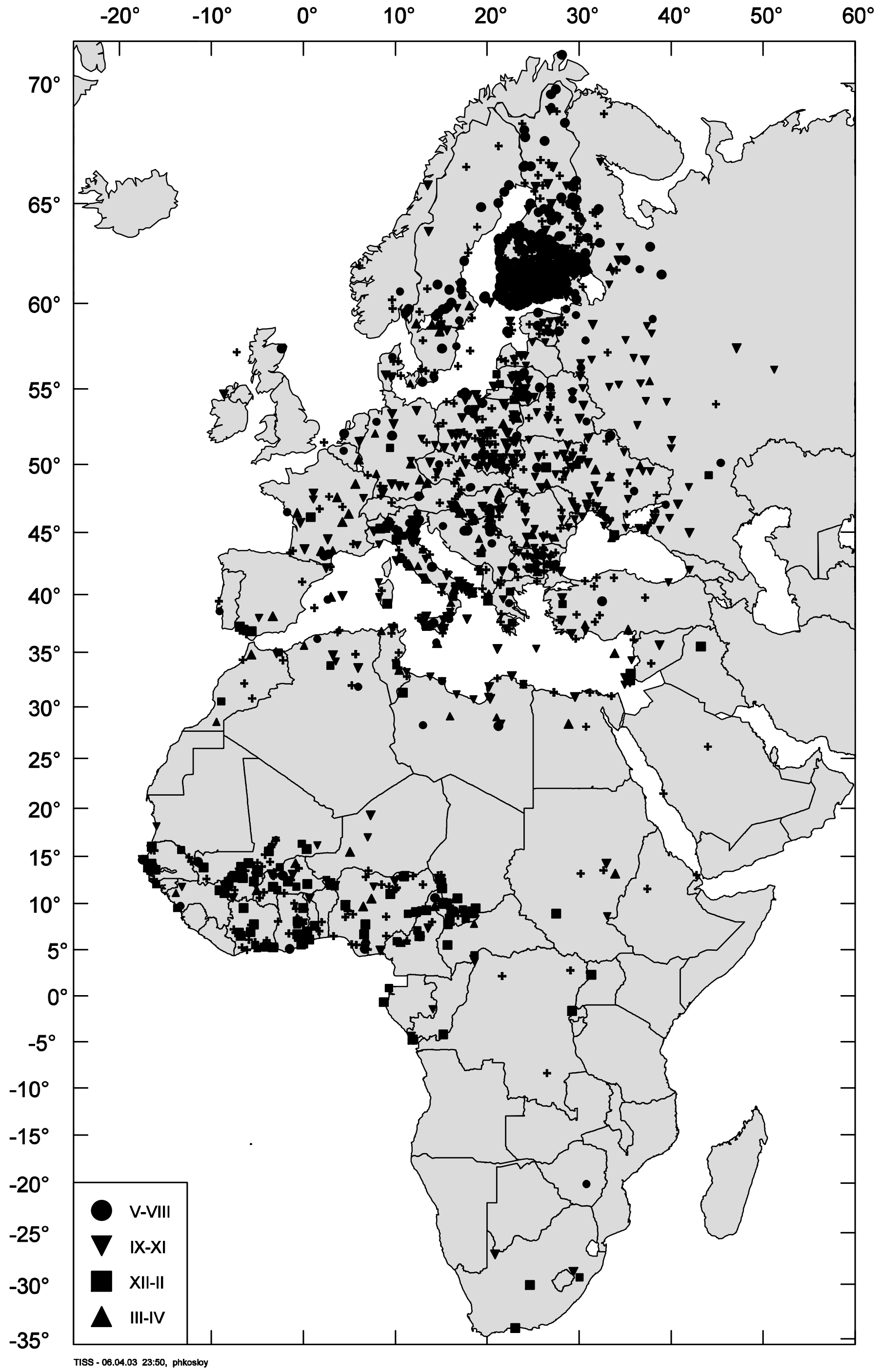

Figure 4. Spatial distribution of encounters of Ospreys *Pandion haliaetus* ringed in Finland. Encounters reported as killed by man excluded (see fig. 3). Seasons indicated by the following symbols: circle = May–August; triangle, pointing down = September–November; square = December–February: triangle, pointing up = March–April; cross = finding date inaccurate.

The picture based on ringing has been recently supplemented with satellite tracking, which has produced, in addition to purely scientific data, important information for conservation as well (see http://www.fmnh.helsinki.fi/satelliteospreys/).

Satellite tracking has demonstrated that, in addition to breeding and wintering sites, conservation of good stopover areas along the migration routes seems to be important for the Ospreys as well as for many other migrating species of birds (e.g. Saurola 2005).

DISCUSSION

At present, Finnish, as most of the other European Osprey populations which have been monitored carefully, have been either increasing or have remained on the same general level during the last two decades (Saurola 1997). E.g. in Germany (Schmidt 2001 and Daniel Schmidt pers. comm.) and Scotland (Dennis and Dixon 2001 and Roy Dennis pers. comm.) the growth rate has been about 8% per year. The most encouraging example has been recorded in a state-owned forest area of 25,000 hectares in central France, where the population increased from one pair in 1990 to 18 pairs in 2003, or in other words 27% per year (Thiollay & Wahl 1998, Wahl & Barbraud 2005)! In 1997, Schmidt and Wahl (2001) recaptured in this area one breeding male and two females, which were ringed as nestlings in Germany, more than 900 km from their breeding sites. This indicates that at least part of the rapid increase was due to long distance natal dispersal.

The favourable trends of the European Osprey populations are due to several causes, which will be shortly discussed below.

Persecution

In the beginning of the 19th century, Ospreys were breeding throughout Europe. Due to heavy persecution, which started as early as the 17th century and peaked during the 19th century, local populations decreased rapidly and, in many countries, the species became extinct during the first decades of the 20th century. During the World Wars I and II, killing of birds of prey decreased, but continued again after the wars (see Bijleveld 1974).

In Finland and Sweden, the Osprey has been fully protected since the late 1920s. However, the legal protection was given to the Osprey less than 50 years ago in many other European countries along the migration route of the Finnish Ospreys: e.g. in the former USSR in 1964 and enforced in 1974, and in Italy in 1971 (Saurola 1980).

Because legal protection does not always mean that killing ceases, I have tried to estimate the changes in persecution in Europe and Africa by calculating persecution indices from ring recoveries (Saurola 1980, 1994). This analysis suggested that hunting pressure on the Ospreys really decreased significantly in the 1970s all over Europe, but it has remained on the same level in Africa during the last decades.

Environmental toxicants

In the late 1940s and 1950s, DDT and other environmental contaminants appeared as a new threat to the future of Ospreys all over the world (e.g. Poole 1989). DDT metabolites caused disturbances in calcium metabolism of females; the eggshell thickness decreased, eggs broke during incubation, and breeding success decreased. After the ban of the use of DDT in developed countries, concentrations of DDT metabolites in the Osprey eggs have decreased, as indicated e.g. by studies in Sweden (Odsjö & Sondell 2001).

In Finland, since the start of *Project Pandion*, bird ringers have collected addled Osprey eggs for further analysis of contaminants. The results of the analysis made so far have shown a highly significant decrease in the sDDT (= total DDT) concentrations in the Finnish Osprey eggs: the geometric mean of sDDT decreased from 63.6 (in 1971–1975) to 17.4 ppm/lipid weight (in 1991–1992, Saurola unpubl. data). During the same period, there was no significant change in sPCB level, which was quite low already in the early 1970s (overall geometric mean was 32.8 ppm/lipid weight during 1971–1992).

In 2004, a new project was started to analyse the trends in dioxin and toxic PCB congener concentrations in the addled Osprey eggs collected during 1971–2006 in Finland.

Fishing and fish farms

Ring recovery analysis has indicated that fishing and fish farms have caused many Ospreys deaths both intentionally and unintentionally during breeding, migration and wintering. In Finland, the most dangerous time for Ospreys is early spring, when most of the fishing grounds are still covered by ice. At this time many Ospreys have been found drowned in nets in small areas of shallow open water exploited both by Ospreys and by (mainly amateur) fishermen.

At commercial fish farms, Ospreys have been killed both by illegal shooting and by wrongly placed strings or nets set to protect fishes. Nowadays the Finnish fish farms are quite safe for the Ospreys, because the government pays compensation to the owners from damages caused by the Ospreys. E.g. in 2002, according to information from the Ministry of The Environment, altogether 19 fish farms growing mainly Canadian rainbow trout *Onchorynchus mykiss* claimed that the damage caused by the Ospreys was 102,961 euros in total. Of this sum, 39,032 euros were compensated by the Ministry of The Environment (Matti Osara pers. comm.).

The present system seems to work, but it has been criticized as well. Firstly, it is very questionable to subsidise rainbow trout farming at all, because it pollutes both the inland and Baltic waters. Secondly, the estimate of "damage" is based too much on the information from farms. Thirdly, if public money has to be used, then it should be used, instead of annual compensation, to construction of proper protection nets, which will prevent the damages and no compensation is needed in the future.

Land use

At present, land use is one of the main conflicts between the Osprey and man. In many areas Ospreys have been forced to move away from the primary habitats along the shore of the sea or lakes because of tourism, recreation etc. In Finland, only about 15% of occupied nest sites are close to the shoreline. The dream of every Finn is to have a summerhouse and *sauna* by the lake or in the Baltic archipelago. In addition, sailing, canoeing, bathing, angling and other recreational activities concentrate to those areas, which are still free from summerhouses. Hence, there is less and less undisturbed shoreline left for Ospreys. In many cases the historic nest sites have been abandoned, and the Ospreys have been forced to move to the middle of forests, several kilometres from their historic nest sites and fishing grounds.

The Finnish conservation law states clearly that it is forbidden to disturb breeding of any bird species. On the other hand, "every man's right" states that everybody can move freely, without permission from the landowner, everywhere except in the very few areas, such as strict nature reserves and military areas.

Forestry and peat industry

Saurola (1997) has recently discussed the detrimental effects of modern forestry on European Ospreys. Habitat destruction by modern forestry and peat industry is a continuous threat to all birds breeding in forests and peat bogs, although the official guidelines have improved during the last years in many countries. Modern forestry may have four kinds of negative effects on the welfare of the Osprey: (a) cutting of occupied nest trees, (b) cutting of potential alternative nest trees, (c) cutting of trees from the protection zone around the nest, and (d) disturbance from forestry activities in the neighbourhood of the nest during the breeding season.

Because the Osprey is fully protected in all European countries, the occupied nest trees should be protected during the breeding season throughout Europe. In Finland, the nests and nesting trees are fully protected during the non-breeding season as well.

Protection of just the occupied nest tree is not enough, because of the "evolution" of the top of the tree occupied by the Osprey. The Osprey brings every year new sticks to the nest, which grows higher and higher. Finally the nest falls down and most probably breaks some important branches. After this, the quality of the top is lower than it was to serve as a solid base for the nest. Thus, within each territory, a sufficient number of old, flat-topped nest trees should be saved as alternative nest trees for the future.

Even if all trees around the nest tree are removed, the Osprey most probably don't abandon the site, although the probability of breeding failure increases for several reasons: (a) a solitary tree is much more exposed to damage caused by storms, (b) the disturbance zone of many activities (forestry, sports, recreation) is wider in open clear-cuts than in closed forests, and (c) a nest in a solitary tree is more vulnerable to predators, especially to the Eagle Owl *Bubo bubo*.

Inappropriate timing of forestry work in the neighbourhood of the nest has caused several breeding failures in Finland. Construction of logging roads, digging of forest ditches, harvesting, improving of young stands and planting seedlings are all activities which should be forbidden in the neighbourhood of the nest during courtship, incubation and brooding periods.

Guidelines for forestry

Metsähallitus (the former Finnish Forest and Park Service) published in 1994 new guidelines for forestry in state-owned land. According to these guidelines at the nest site of the Osprey

a) the nest tree is protected all year under the Nature Conservation Act,

b) protective tree stand (density 200 stems/ha) must be left around the nest for a radius of 50 metres,

c) bog surrounding the nest tree must be left in natural state,

d) all forestry activities must be avoided close to the nest during 15 April–31 July,

e) old Scotch Pines *Pinus silvestris* and, in addition, saw timber trees must be left in clumps for future development into ideal new nest sites,

f) paths and hiking routes must not be established within 500 metres from the nest.

These guidelines for state-owned and private lands would be sufficient for the protection of Finnish Ospreys. In practice, however, the guidelines are on private lands only recommendations and therefore not necessarily followed by the foresters.

Artificial nests

Construction of artificial nests has been the only direct measure to compensate for the effects of modern commercial forestry. In Finland, the first artificial nests were constructed in 1965. Now, four decades later, in practice a half (47–49%) of the Finnish Ospreys breed in artificial nests constructed by voluntary bird ringers to compensate the high-quality natural nest sites destroyed by one-track forestry. In my own intensive study area in southern Finland, the percentage of artificial nests has been more than 90% already for two decades. I have estimated that the population in that area would be less than 50% of the present level without artificial nests. In such areas the Ospreys are, unfortunately, "prisoners of artificial nests".

Construction of artificial nests has been an effective tool in conservation of Ospreys. However, protection of natural nest trees and their surroundings should always be the primary goal. Construction of artificial nests should be used only as the very last and temporary measure to save or reintroduce local populations, but never as an excuse to destroy natural breeding habitats.

Finnish Osprey Foundation

The Ministry of The Environment and the regional Environment Centres have the official responsibility for all nature conservation in Finland. In addition, a non-governmental organization, *The Finnish Osprey Foundation*, was founded, on the basis of the money produced by a book on the Osprey (Saurola & Koivu 1987), in 1990 to promote especially the conservation of the Osprey by collecting money from private companies and general public. The foundation has constructed an *Osprey Centre*, where ordinary people can get information on the conservation and research on the Osprey and, as well, make personal observations and photographs of fishing Ospreys from a close distance, without disturbing them.

CONCLUDING REMARKS

(1) During the last decade, local Osprey populations in northern and central Europe have been stable or recovering from the effects of persecution and environmental toxicants. These two threats are not anymore major problems in Europe, but they still may be problems for European Ospreys wintering in Africa.

(2) In contrast, habitat destruction caused by modern forestry, peat industry, tourism and recreation is still an important negative factor for the Osprey in many areas. More clear and strict official guidelines and positive recommendations are needed to protect traditional and new nesting habitats of the Osprey all over Europe.

(3) Construction of artificial nests has been an effective tool in conservation of Ospreys. However, it should be used only as the very last measure to save a local population and never as an excuse to destroy natural habitats and nest sites.

(4) All conservation must be based on reliable ecological information. Continuous and systematic population monitoring and ringing are both vital elements in conservation. In Finland, the role of well-trained *amateur* ringers, i.e. lovers of their passion, birds, has been crucial for conservation of Finnish Ospreys.

Acknowledgements. This contribution is mainly based on the *Project Pandion*, a landmark of raptor conservation erected by Finnish bird ringers.

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MONITORING "COMMON" BIRDS OF PREY IN FINLAND IN 1982–2005

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In 1982, the *Raptor Grid,* a nation-wide programme for monitoring both diurnal and nocturnal "common" birds of prey was started by the Finnish Ringing Centre. Voluntary ringers were asked to select a 10 x 10 km study plot and find annually all active nests or at least locate occupied territories of birds of prey from their study plot (annual total has averaged 120). Since 1986, additional information has been collected with the *Raptor Questionnaire*. After that, more than 40,000 potential nest sites of birds of prey have been checked annually. During 1982–2005, most of the Finnish populations of birds of prey remained on the same general level, although the annual fluctuations of vole specialists have been extensive. In the Honey Buzzard *Pernis apivorus*, Goshawk *Accipiter gentilis*, Common Buzzard *Buteo buteo* and Eagle Owl *Bubo bubo* the population trend has been negative during several years. In contrast, the populations of Kestrel *Falco tinnunculus* and Pygmy Owl *Glaucidium passerinum* have increased steeply due to extensive nest box projects. International cooperation is needed to monitor nomadic species.

Key words: Birds of prey, monitoring, population changes, productivity, survival, ringers.

МОНИТРИНГ «ОБЫЧНЫХ» ВИДОВ ХИЩНЫХ ПТИЦ В ФИНЛЯНДИИ В 1982-2005 гг. П. Саурола. Музей национальной истории Фнляндии, Университет Хельсинки, Финляндия.

В 1982 г. Финский центр кольцевания птиц запустил общенациональную программу мониторинга как дневных, так и ночных «обычных» хищных птиц «*Сеть мониторинга пернатых хищников*» (*Raptor Grid*). Кольцевателей-добровольцев попросили выбрать участок 10x10 км и ежегодно выявлять все гнезда с кладками или, по крайней мере, занятые территории хищных птиц на этих участках (общая цифра за год составила, в среднем, 120). Начиная с 1986 г. дополнительная информация собирается при помощи *Анкет по хищным птицам*. С тех пор ежегодно проверяется более 40 тыс. потенциальных гнездовых участков хищных птиц. В 1982–2005 гг. большинство популяций хищных птиц в Финляндии оставались, в целом, на одном и том же уровне, хотя состояние численности видов, специализирующихся в своем питании на полевках, значительно варьировало по годам. Динамика популяций осоеда *Pernis apivorus*, тетеревятника *Accipiter gentilis*, канюка *Buteo buteo* и филина *Bubo bubo* в течение нескольких лет была отрицательной. Популяции пустельги *Falco tinnunculus* и воробьиного сычика *Glaucidium passerinum*, напротив, резко выросли благодаря реализации масштабных проектов по установке искусственных гнездовий. Для мониторинга кочующих видов необходимо развивать международное сотрудничество.

Ключевые слова: хищные птицы, мониторинг, популяционные изменения, продуктивность, выживание, кольцеватели.

INTRODUCTION

Efficient monitoring is a vital part of nature conservation in a rapidly changing world. Reliable information on present population status, including size, productivity, survival and dispersal and their annual fluctuations, is necessary to predict long-term trends and to formulate sound management measures. The Northern Spotted Owl *Strix occidentalis caurina* is an example of a bird of prey species which has been monitored really professionally, thanks to the basis of remarkable funding by the government (see e.g. Forsman *et al*. 1996). Unfortunately, in most countries respective funding is only a dream, and the actual resources are insufficient to conduct the necessary fieldwork.

In Finland, both the Christmas Bird Count and the Breeding Bird Survey programmes (e.g., Koskimies & Väisänen 1991) have produced valuable data for monitoring common land birds. However, these programmes do not produce relevant data for monitoring birds of prey. Up to the early 1980s, the only monitoring programmes for birds of prey were on the White-tailed Sea Eagle *Haliaetus albicilla*, Peregrine *Falco peregrinus*, Golden Eagle *Aquila chrysaetos*, and Osprey *Pandion haliaetus* (Saurola 1985). Separate reports on the status of these species and the Gyrfalcon *Falco rusticolus* in Finland are presented elsewhere in this volume.

The quality of Finnish amateur ornithologists (ca. 10,000) including, especially, the bird ringers (686 licenses in 2005) is very high. During the last 20 years, ringing of both diurnal and nocturnal birds of prey has had, for several reasons, a high priority (Saurola 1987a). Hence, more than a half of the Finnish ringers have been interested in research and conservation of birds of prey.

In 1982, the Finnish Ringing Centre, with some support for administration from the Ministry of The Environment, started a monitoring project called the *Raptor Grid* to monitor diurnal and nocturnal birds of prey (Saurola 1986, 1997). Since 1986, additional information on breeding performance has been collected with the *Raptor Questionnaire* (Saurola 1997).

This contribution will describe these monitoring techniques based on voluntary work and present some examples of the results on selected species.

MATERIAL AND METHODS

Population changes

The *Raptor Grid* programme is completely based on voluntary fieldwork by raptor ringers. When the project started in 1982, ringers were asked (1) to establish a study group consisting of both ringers and other bird-watchers, (2) to select a 10 x 10 km study plot, based on "even-ten-kilometers" of the Finnish National Grid, and (3) to try each year to find all the active nests or at least the occupied territories of the diurnal and nocturnal birds of prey in their study plot (Saurola 1986). The annual routine for each study plot includes: (1) listening for territorial hoots of owls, (2) watching aerial display of buzzards and hawks, (3) searching for nests, (4) listening for fledged broods, and (5) reporting the results in September to the Ringing Centre. In addition, the total number of hours of effort used has to be recorded. For relatively good coverage of all raptor species, about 300–500 person-hours/study plot/breeding season is needed in southern Finland (mixture of boreal forest, agricultural land and lakes). The number of *Raptor Grid* study plots surveyed has averaged 120 per year.

Data from the *Raptor Grid* has been used for estimating changes in population size. While an effort has been made to retain the same set of study plots over time, in practice, some plots have become inactive and new ones have emerged, primarily because of changes in volunteers involved in the fieldwork. Thus, analyses have to control for this potential variation in effort among plots. To do this, for each year, population indices have been calculated through pair wise comparisons of mean numbers in that year to those in a reference year for plots that were active in both years. For this analysis, 1997 was chosen as a reference year because it was a good year with many active plots and large data. Two measures of abundance were examined: all occupied territories and active nests (figs. 1 and 2).

Productivity

In 1982, a Raptor Nest Card was introduced, and ringers were asked to fill a nest card for birds of prey nests found during the breeding season. The relatively poor response prompted the use of a special summary questionnaire. Since 1986, all bird ringers *must* report a summary of all nests and territories of all birds of prey they have detected during each year with a simple *Raptor Questionnaire*. The *Raptor Questionnaire* summarizes the total numbers of (1) potential nest sites checked (cf. table 1), (2) active nests and occupied territories found (cf. table 2), and (3) nests of different clutch and brood sizes (cf. table 2) verified by ringers. All these data have been collected within the "territories" of 25 local ornithological societies in different parts of the country (cf. figs. 3, 4 and 5).

Further, the ringer has to give information on the amount of field work done by comparing the present and previous seasons according to following scale: the amount of field work on the species was (1) much more than, (2) a little more than, (3) the same as, (4) a little less than, and (5) much less than in the previous season.

The main purpose of the *Raptor Questionnaire* is to collect data on the annual productivity. In addition, this data, although it cannot be precisely standardized from year to year, may be used with care to detect fluctuations and trends in population sizes, especially when the *Raptor Grid* data are too scanty (figs 3, 4 and 5).

Feedback articles reporting the results of *Raptor Grid* and *Raptor Questionnaire*-programmes have been published every year after the breeding season (e.g., Honkala & Saurola 2006).

Table 1. The numbers of potential nest sites of birds of prey checked in Finland in 2005.

Natural stick-nests of hawks and buzzards	3 982
Nests built by *Corvidae sp*. or by *Sciurus vulgaris*	1 849
Artificial nests for hawks and buzzards	1 553
Artificial nests for falcons	5 494
Nest boxes for the Ural Owl *Strix uralensis*	4 293
Nest boxes for the Tawny Owl *Strix aluco*	4 133
Nest boxes for Tengmalm's Owl *Aegolius funereus*	8 399
Nest boxes for the Pygmy Owl *Glaucidium passerinum*	5 849
Large natural cavities	2 180
Small natural cavities	2 924

Table 2. Total numbers of active nests (= eggs were laid) of "common" birds of prey reported by Finnish ringers during 1986–2005 and the mean of annual means of productivity (large young per active nest) during the same period.

Species		Number	Productivity
Honey Buzzard	*Pernis apivorus*	1571	1.39
Marsh Harrier	*Circus aeruginosus*	1551	2.90
Hen Harrier	*Circus cyaneus*	276	3.38
Goshawk	*Accipiter gentiles*	14398	2.44
Sparrowhawk	*Accipiter nisus*	5 076	3.68
Common Buzzard	*Buteo buteo*	7192	1.89
Rough-legged Buzzard	*Buteo lagopus*	946	1.59
Kestrel	*Falco tinnunculus*	15091	4.16
Merlin	*Falco columbarius*	439	3.22
Hobby	*Falco subbuteo*	1449	2.20
Eagle Owl	*Bubo bubo*	5383	1.60
Hawk Owl	*Surnia ulula*	235	3.63
Pygmy Owl	*Glaucidium passerinum*	4620	4.98
Tawny Owl	*Strix aluco*	7216	2.73
Ural Owl	*Strix uralensis*	12615	2.14
Great Grey Owl	*Strix nebulosa*	541	1.94
Long-eared Owl	*Asio otus*	1220	2.70
Short-eared Owl	*Asio flammeus*	689	3.41
Tengmalm's Owl	*Aegolius funereus*	13827	3.00

Survival and dispersal

For a ringer, encounters (i.e. both recaptures of live birds and recoveries of birds found dead) are the "prize" for the valuable voluntary work described above. Ringing is also a basis for monitoring survival and dispersal. In principle, it is fairly simple and straightforward to estimate changes in apparent adult survival from representative long-term capture-recapture data sets (see e.g., Forsman et al. 1996, Francis & Saurola 2004). Finnish ringers have been encouraged not only to ring nestlings but also to capture and recapture the adult birds at the nest as well (Saurola 1987a, Saurola & Francis 2004). For four owl species and the Kestrel breeding in nest boxes, the data on adults, especially on females, captured at the nest is fairly extensive, but for open-nesting species almost totally missing (cf. table 3).

RESULTS

Population changes

The average annual number of study plots included in *Raptor Grid* programme has been about 120. For the diurnal species of birds of prey, these data have been quite representative for monitoring the population changes of the Honey Buzzard *Pernis apivorus*, Goshawk *Accipiter gentilis*, Sparrowhawk *Accipiter nisus*, Common Buzzard *Buteo buteo*, Rough-legged Buzzard *Buteo lagopus*, Kestrel *Falco tinnunculus* and Hobby *Falco subbuteo* (fig. 1), and for the nocturnal ones, of the Eagle Owl *Bubo bubo*, Pygmy Owl *Glaucidium passerinum*, Tawny Owl *Strix aluco*, Ural Owl *Strix uralensis*, Long-eared Owl *Asio otus* and Tengmalm's Owl *Aegolius funereus* (fig. 2).

The population indices indicate significant negative trends in the Honey Buzzard ($p<0.001$), Goshawk ($p<0.01$), Common Buzzard ($p<0.001$) and Eagle Owl ($p<0.01$). The cause of the recent negative trend of the Finnish Eagle Owl population is quite evident: the decrease of the number of open refuse dumps with high numbers of rats, from about one thousand to one hundred during the last 15 years (see Valkama & Saurola 2005). In contrast, at the moment the causes of the negative trends of the three other species can only be speculated.

The population indices show significant positive trends in the Kestrel ($p<0.001$) and Pygmy Owl ($p<0.001$). Both of these species have benefited greatly from extensive nest box programmes during the last two decades. Nevertheless, the recovery of the Finnish Kestrel population is real and not an artifact (caused by the fact that a breeding attempt is more probably found and reported from an artificial than from a natural nest).

In contrast, the steep "increase" of the Pygmy Owl population has been until 2003 at least partly due to the fact that a part of population has become more "observable" to ringers, because the owls have moved to breed from natural woodpecker cavities to high-quality nest boxes. In the autumn 2003 a large-scale invasion of Pygmy Owls was observed at the Finnish bird observatories (Ojanen 2004). The indices of 2004 and 2005 (fig. 2) show clearly how the Pygmy Owl population crashed dramatically after the invasion and has not yet recovered.

The populations of the rest of the species mentioned above have remained more or less on the same general level during the study period.

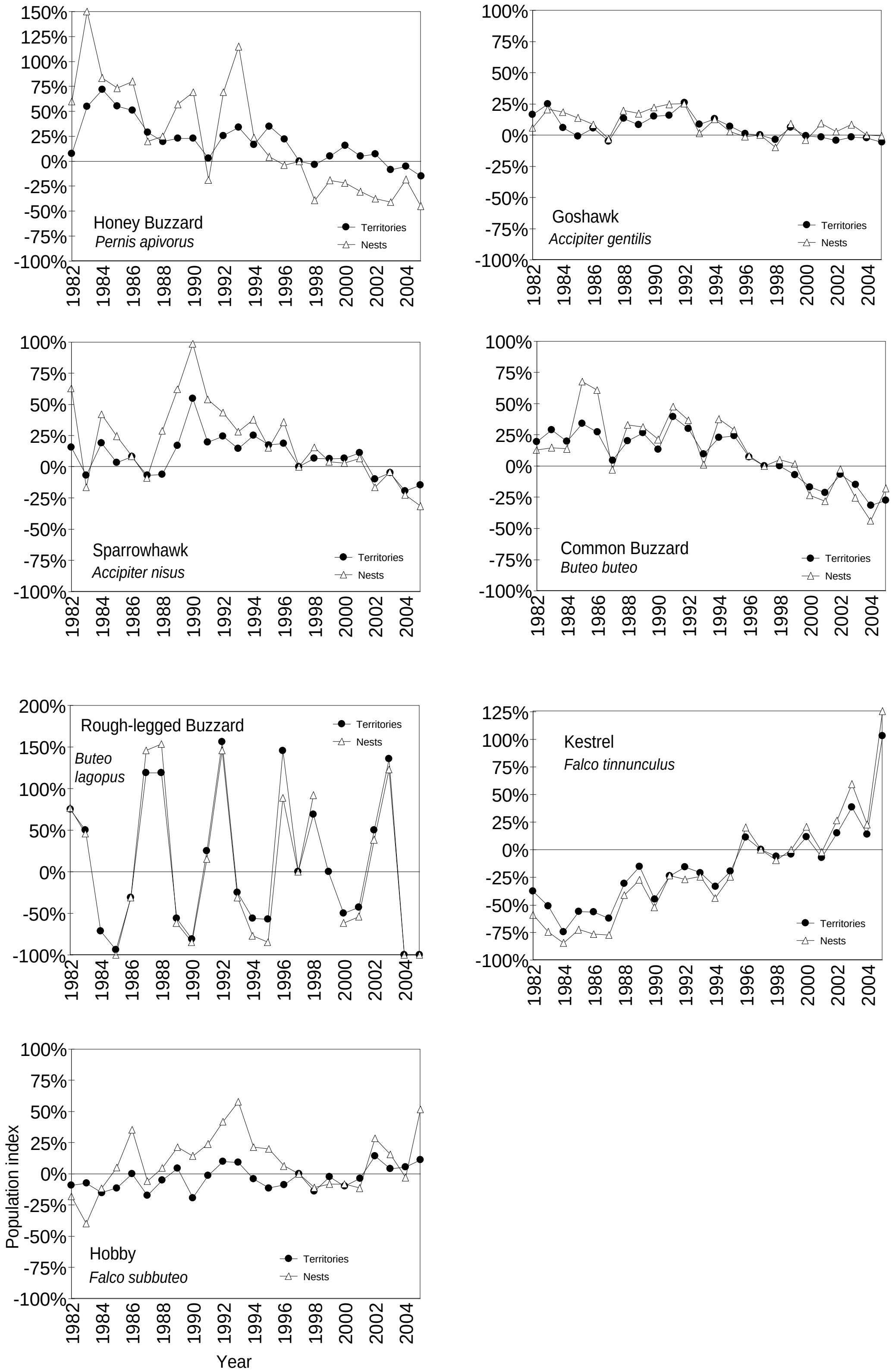

Figure 1. Population indices from 1982 to 2005 of the Honey Buzzard *Pernis apivorus*, Goshawk *Accipiter gentilis*, Sparrowhawk *Accipiter nisus*, Common Buzzard *Buteo buteo*, Rough-legged Buzzard *Buteo lagopus*, Kestrel *Falco tinnunculus* and Hobby *Falco subbuteo* according to the data from *Raptor Grid* 100 km^2 study plots. For each species and year, only the plots in which the species was censused also in the reference year 1997, were included. The numbers of territories (dots) and nests found (triangles) were related to the corresponding numbers in the reference year 1997. The index value of the reference year = 0.

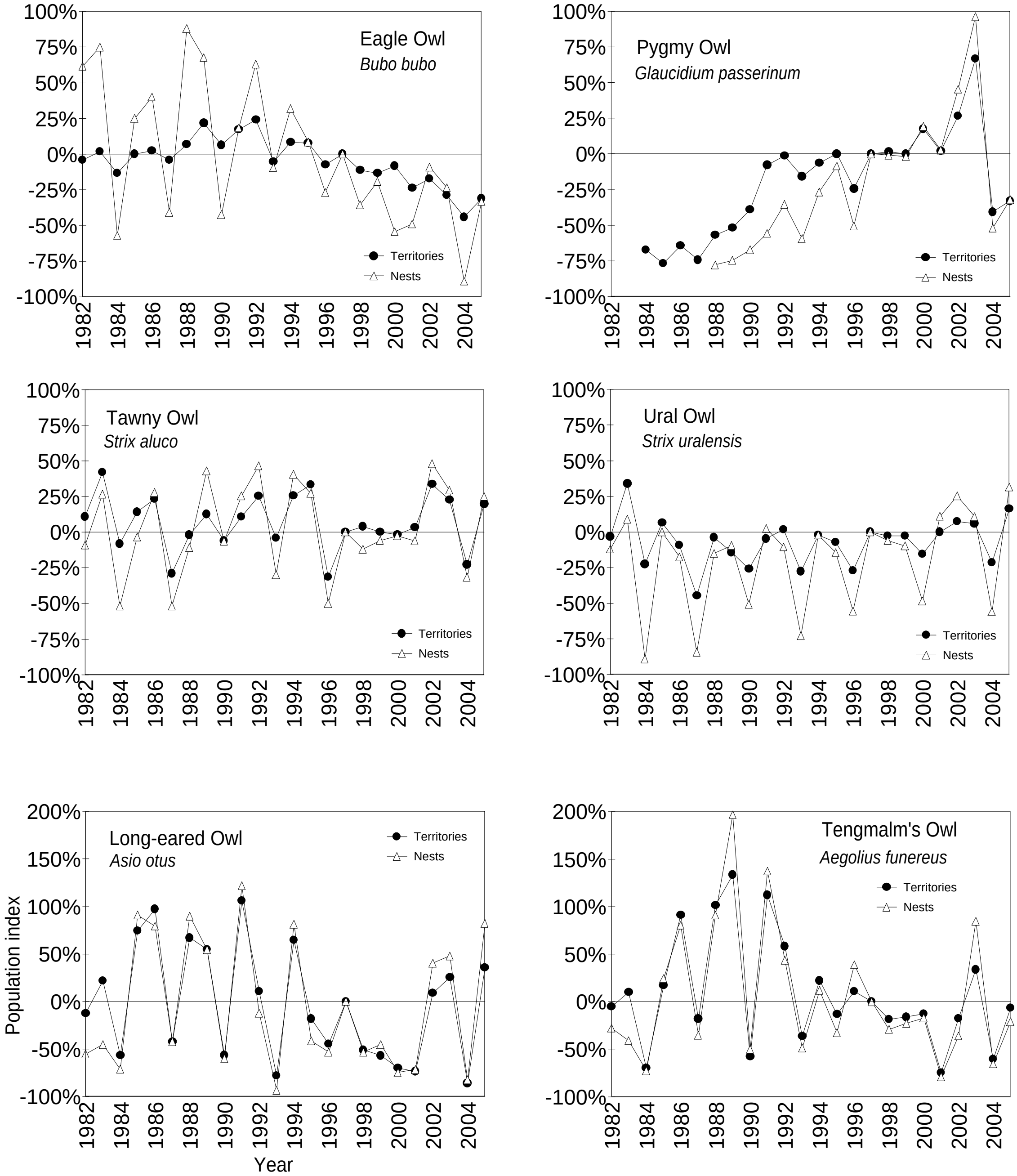

Figure 2. Population indices from 1982 to 2005 of the Eagle Owl *Bubo bubo*, Pygmy Owl *Glaucidium passerinum*, Tawny Owl *Strix aluco*, Ural Owl *Strix uralensis*, Long-eared Owl *Asio otus* and Tengmalm's Owl *Aegolius funereus* according to the data from *Raptor Grid* 100 km² study plots. For each species and year, only the plots in which the species was censused also in the reference year 1997, were included. The numbers of territories (dots) and nests found (triangles) were related to the corresponding numbers in the reference year 1997. The index value of the reference year = 0.

However, the annual fluctuations of the indices of vole specialists, the Rough-legged Buzzard, Tawny Owl, Ural Owl, Long-eared Owl and Tengmalm's Owl, have been, as expected, very large (figs. 1 and 2).

The amount and distribution of the study plots of the *Raptor Grid* are not appropriate for monitoring the Marsh Harrier *Circus aeruginosus*, although it is clearly a southern species. For the same reason, data from the *Raptor Grid* do not tell anything relevant about the population changes of the more northern species like the Hen Harrier *Circus cyaneus*, Merlin *Falco columbarius*, Hawk Owl *Surnia ulula*, Great Grey Owl *Strix nebulosa* and Short-eared Owl *Asio flammeus*. For these species, information from *Raptor Questionnaires* is of great value (figs. 3, 4 and 5).

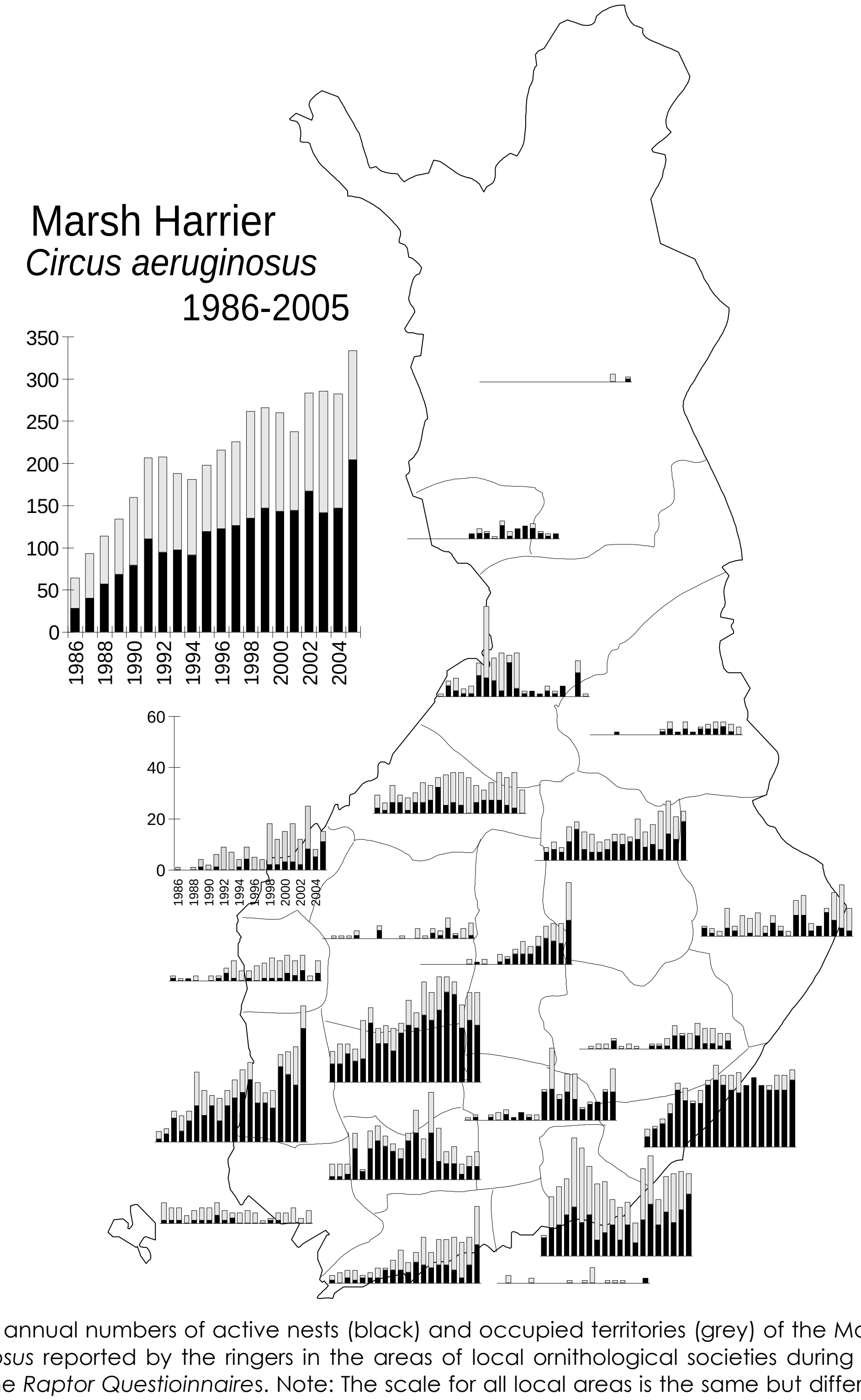

Figure 3. The annual numbers of active nests (black) and occupied territories (grey) of the Marsh Harrier *Circus aeruginosus* reported by the ringers in the areas of local ornithological societies during 1986–2005 according to the *Raptor Questioinnaires*. Note: The scale for all local areas is the same but different for the entire country.

The numbers of occupied territories and active nests of the Marsh Harrier (fig. 3) reported by the ringers have increased during the last two decades. This is due to both the real increase of the population and, in some degree, to the increase in searching effort by the ringers as well.

The Hawk Owl (fig. 4) and Great Grey Owl (fig. 5) are both northern vole specialists, which breed only during the peak years of microtines. Hawk Owls are real nomads, which may change their nesting areas thousands of kilometers as suggested by ring recoveries (Saurola 2002).

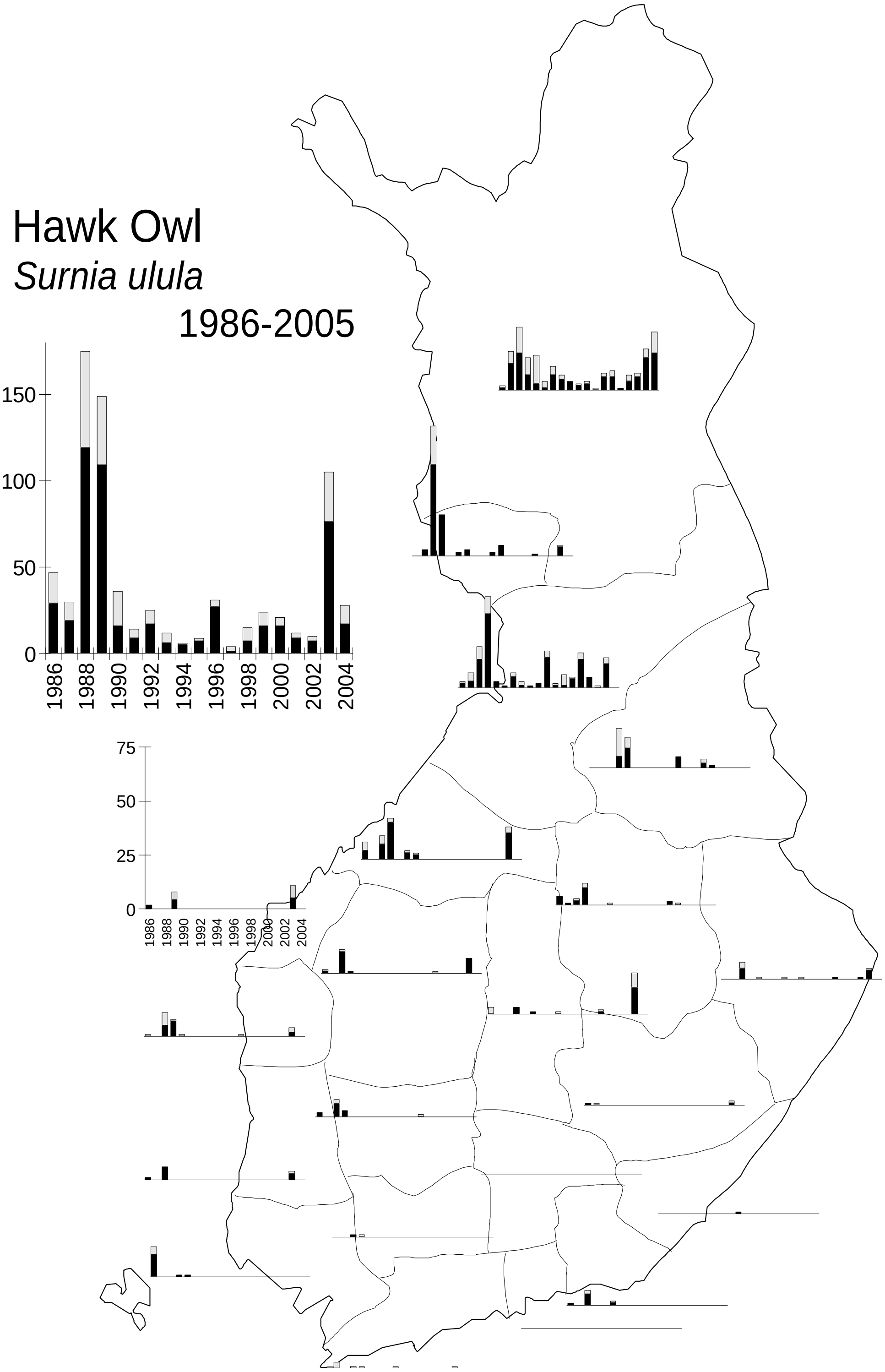

Figure 4. The annual numbers of active nests (black) and occupied territories (grey) of the Hawk Owl *Surnia ulula* reported by the ringers in the areas of local ornithological societies during 1986–2005 according to the *Raptor Questioinnaires*. Note: The scale for all local areas is the same, but different for the entire country.

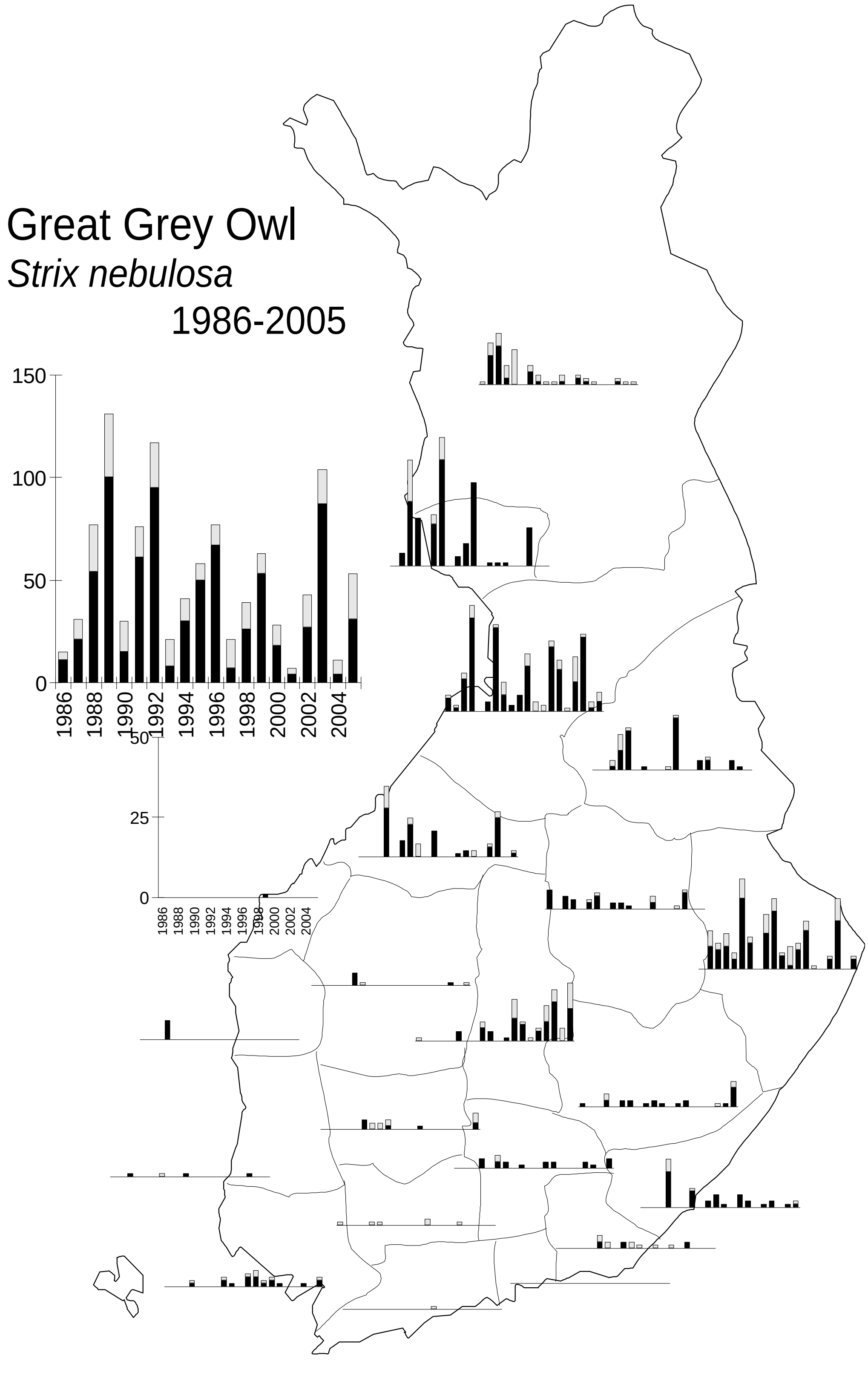

Figure 5. The annual numbers of active nests (black) and occupied territories (grey) of the Great Grey Owl *Strix nebulosa* reported by the ringers in the areas of local ornithological societies during 1986–2005 according to the *Raptor Questioinnaires*. Note: The scale for all local areas is the same, but different for the entire country.

In Fennoscandia, part of the Great Grey Owl population is nomadic, but the other part is resident as shown by Stefansson (1997). Monitoring long-term population trends of such nomadic species must be based on international cooperation.

Productivity

According to the data collected with the *Raptor Questionnaire*, the average productivity of all species has been "normal" (table 3). Annual fluctuations in productivity of the vole specialists, e.g. the Ural Owl (fig. 6), have been large, as expected. In the *Raptor Questionnaire* data on productivity only one significant trend has been detected: the annual mean productivity of the Kestrel has improved significantly (p<0.01) from 1986 to 2005 (fig. 7). During this period, the mean proportion of unsuccessful breeding attempts has dropped from about 13% to 6%. This is most probably due to the fact that more pairs monitored by the ringers breed in nest boxes, which are surely safer against predators than the natural sites.

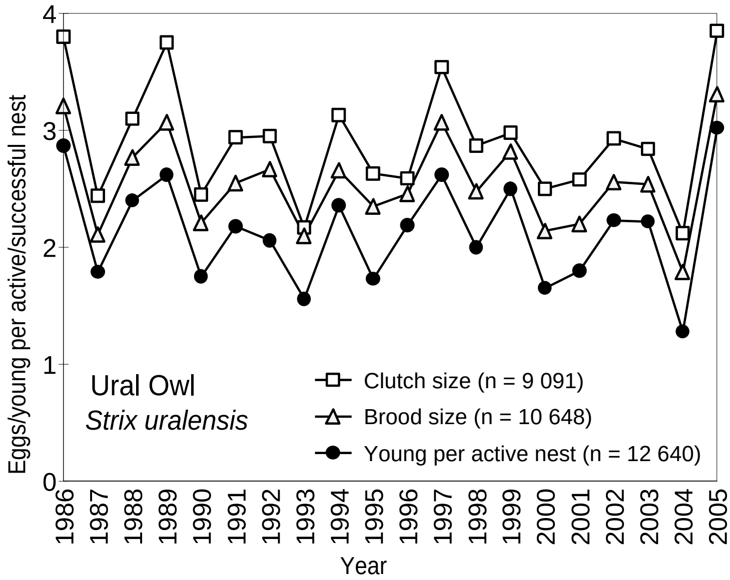

Figure 6. Annual mean clutch size (squares), brood size (= young per successful nest; triangles) and productivity (young per active nest; dots) of the Ural Owl *Strix uralensis* during 1986–2005 according to the *Raptor Questionnaires*. Total amount of data for the entire period given for each category.

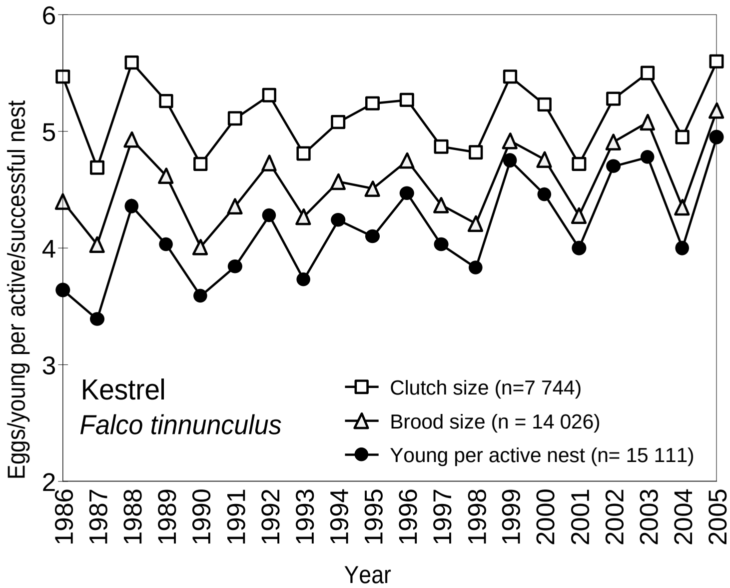

Figure 7. Annual mean clutch size (squares), brood size (= young per successful nest; triangles) and productivity (young per active nest; dots) of the Kestrel *Falco tinnunculus* during 1986–2005 according to the *Raptor Questionnaires*. Total amount of data for the entire period given for each category. The mean productivity (dots) has improved significantly during the study period. $y = 0.048x + 0.013$; $R^2 = 0.41$; $p < 0.01$.

Table 3. Total numbers of all species of birds of prey ringed in Finland during 1913–2005, and total numbers of "interesting" encounters (see text) according to Valkama & Haapala (2006).

Species		Ringed	Encountered
Honey Buzzard	*Pernis apivorus*	3786	171
Black Kite	*Milvus migrans*	56	2
White-tailed Eagle	*Haliaetus albicilla*	2202	5689
Marsh Harrier	*Circus aeruginosus*	6518	225
Hen Harrier	*Circus cyaneus*	1884	75
Pallid Harrier	*Circus macrourus*	3	0
Montagu's Harrier	*Circus pygarcus*	48	0
Goshawk	*Accipiter gentilis*	53723	8616
Sparrowhawk	*Accipiter nisus*	45420	3615
Common Buzzard	*Buteo buteo*	22531	1093
Rough-legged Buzzard	*Buteo lagopus*	3626	153
Lesser Spotted Eagle	*Aquila pomarina*	1	0
Greater Spotted Eagle	*Aquila clanga*	5	1
Golden Eagle	*Aquila chrysaetos*	2379	1048
Osprey	*Pandion haliaetus*	38950	2905
Kestrel	*Falco tinnunculus*	79378	4028
Red-footed Falcon	*Falco vespertinus*	10	2
Merlin	*Falco columbarius*	2613	140
Hobby	*Falco subbuteo*	4305	82
Gyrfalcon	*Falco rusticolus*	298	10
Peregrine	*Falco peregrinus*	3467	250
Barn Owl	*Tyto alba*	1	1
Eagle Owl	*Bubo bubo*	14063	3094
Snowy Owl	*Nyctea scandiaca*	66	8
Hawk Owl	*Surnia ulula*	2864	51
Pygmy Owl	*Glaucidium passerinum*	29284	1937
Little Owl	*Athene noctua*	1	1
Tawny Owl	*Strix aluco*	40781	10876
Ural Owl	*Strix uralensis*	41559	11417
Great Grey Owl	*Strix nebulosa*	2356	139
Long-eared Owl	*Asio otus*	12236	500
Short-eared Owl	*Asio flammeus*	6654	277
Tengmalm's Owl	*Aegolius funereus*	107857	5545

Survival

So far the Tawny Owl is the only species, on which an extensive and technically updated survival analysis (White & Burnham 1999), based on combined data of dead and live encounters (Burnham 1993) from the entire country, has been made (Francis and Saurola 2004). Survival rates averaged 33% in the first year, 64% in the second, and 73% in subsequent years of life. About 50% of the dramatic annual variation in survival rates could be explained by the stage of the vole cycle and severity of winter weather. No long-term trend in survival was detected during 1980–1999.

In addition, an analysis based on local recaptures has shown the similar effect of the three-year vole cycle on the adult survival of breeding males of the Finnish Tengmalm's Owls (Hakkarainen et al. 2002). Similar analysis cannot be made for the females of Tengmalm's Owl because of long breeding dispersal distances of the females (Korpimäki et al. 1987).

DISCUSSION

Raptor grid

Incomplete Coverage. This sampling method is, in principle, very simple, but in practice for some species very laborious, when the study plot is as large as 100 km^2. Hence, the variation in search effort and success is high between the study plots. Because the main aim of this project is to produce annual population indices for detecting long-term trends, variation between study plots is not critical, providing that effort from year to year within each study plot remains the same.

Turnover of Study Plots. In principle, the set of study plots and the search effort in each study plot should be the same from year to year. In practice, because the work is voluntary, some study plots become inactive and new ones emerge. However, the use of an appropriate statistical procedure in the data analysis, may reduce this potential bias.

Here (figs. 1 and 2) all years were compared pairwise with the reference year 1997, which was in general a good year with much data and fairly close to the middle of the study period. This very simple method is relatively unbiased. However, quite a large amount of data from study plots, which were not active in 1997 was not used, and, in the future, more sophisticated analytical methods, e.g. programme TRIM (Pannekoek & v. Strien 2004) will be used.

Semi-random Selection of Study Plots. Because the *Raptor Grid* 10 x 10 km study plots have not been selected randomly, they may be better areas for birds of prey than other potential study plots nearby, and, hence, the changes detected may not represent the changes in the entire population. Although the ringers may freely select their study plots, the boundaries ("even-ten-kilometer" lines) of the plots are randomly pre-determined by the National Grid. For this reason, the quality differences between such large plots and other potential plots nearby are small.

Geographical Distribution of Raptor Grid Study Plots. The number of resident ringers is very low in northern Finland and, consequently, the data from both the *Raptor Grid* and the *Raptor Questionnaire* is not representative for the northern half of the country. This bias is very difficult to avoid without extra funding for travel costs for visiting ringers from southern Finland.

Raptor questionnaire

Population Changes. The total amount of annual fieldwork done by ringers in searching for nests is not constant, although most of the ringers have a traditional ringing "territory" where they check the same nest boxes and territories from year to year. So far, the total effort has been increasing: new permits for raptor ringers have been issued, and some of the veteran ringers have increased their effort, e.g., by putting up more nest boxes within their ringing territory. In principle, the data could be corrected for the change in effort (see Material and methods), but this has not yet been done.

Productivity. Data from the *Raptor Questionnaire* gives a fairly reliable picture of the annual productivity of Finnish birds of prey. However, a potential bias must be noted. First, a successful nest of an open-nesting species is probably found more often than an unsuccessful one. Thus, the productivity estimates for open-nesting species may be too high. Second, the productivity in nest boxes and other artificial nests constructed for birds of prey may be better than in natural nests and, thus, not represent the productivity of the entire population (see below).

Natural vs. artificial nests

Nest box programmes were started as a conservation measure to compensate for the loss of natural cavities by commercial forestry. Later, the use of nest boxes became a research method to find and reach nests much more easily than in natural circumstances. However, some potential biases must be taken into account when analyzing data from nest boxes and other artificial nests.

(1) If only a small part of the total population breeds in artificial nests, and if the number of natural nests becomes an important limiting factor, a decrease of the "natural population" will not be detected if all monitoring data comes from artificial nets.

(2) Properly constructed and placed artificial nests may be better nest sites than natural ones. In virgin forests the number of good natural nest sites is probably large enough that the difference between natural and artificial sites is negligible. In commercial forests, in contrast, nest boxes are, most probably, more productive than the natural sites. Hence, data on productivity from nest box studies do not represent "normal" reproductive success in commercial forests. For example, Ural Owl females may, by scraping the nest bowl deeper and deeper during incubation, push the eggs down through the bottom of a thin stick nest. This cannot happen in a cavity or in a nest box. In addition, young leave a stick nest an an earlier age and are more vulnerable to predators than those in a deep cavity, stump, or nest box.

Survival

Monitoring long-term trends and annual fluctuations in adult and juvenile survival is much more complicated but at least as important as monitoring productivity both for "pure" science and for management and conservation. Survival during the first year of life cannot be estimated with the capture-recapture data on breeding adults. On the other hand, estimates based only on recoveries of birds ringed as nestlings and found dead by the general public are unreliable; although some attempts to overcome this problem has been made (Rinne et al. 1990, 1993.). This means that combined data sets including a large number of both ring recoveries of birds found dead and annual recaptures of birds alive, collected systematically during many years and at the same time of the year, usually at the nest, are needed for reliable and useful survival estimates. As an exception from this "rule" see e.g. Saurola et al. (2003).

In Finland, there are quite large data sets of ringings and encounters of several species of both diurnal and nocturnal birds of prey filed in an easily accessible computer database (table 3). However, for nearly all of the species the encounters are almost exclusively recoveries of birds found dead, in spite of the fact that the Finnish Ringing Centre has encouraged ringers to try to catch breeding adults at the nest (Saurola 1987a). In Finland, the best (and at the moment only) data sets of birds of prey for a "comprehensive" survival analysis are those of the Tawny Owl and Ural Owl. In addition to large data sets of recoveries of birds found dead and recaptures of breeding adults, both natal and breeding dispersal distances of these two owl species are short enough for collecting representative capture-recapture data (Saurola 1987b, 2002, Saurola & Francis 2004). The first analysis on the Tawny Owl survival has been made (Francis & Saurola 2004), and a respective analysis on the Ural Owl is under preparation (Saurola in prep.).

Nomadic species

There are no resident "Finnish breeding populations" of the Snowy Owl *Nyctea scandiaca*, Hawk Owl and Great Grey Owl. These "populations" are only individuals of a large nomadic population from northern Russia through Finland and Sweden to Norway, and they happen to breed now and then in Finland. The Short-eared Owl belongs to the same group, but the common area of its "Western-Palearctic population" extends much further south. Long-eared Owls breeding in Finland are at least partly nomads as well, but probably on a much smaller scale (perhaps mainly within Finland?). These conclusions are based mostly on "common sense" and not on hard data: there are very few breeding season ring recoveries of dead birds and hardly any recaptures at nests showing the real extent of the breeding and natal dispersal of these species.

It is not possible to monitor nomadic species properly without intensive cooperation over large areas in northern Europe and across national boundaries. At least during the peak years for these species, which are easily detected, extra study plots should be established to estimate their densities, nestlings should be ringed, and the adults ringed/recaptured at nests as extensively as possible in all countries sharing the populations. These proposals are of course impossible to realize all over northern Russia. But for the Nordic countries, and perhaps including northwestern Russia, a joint "Nomadic Owls" programme is perhaps not totally unrealistic if the idea is properly "sold" to volunteers.

CONCLUDING REMARKS

1. In Finland, good cooperation between professional-level volunteers (bird ringers) and organizations responsible for monitoring bird populations (Ministry of The Environment and Finnish Museum of Natural History) has produced valuable data for monitoring population changes and productivity of common diurnal and nocturnal birds of prey. In fact, for economical reasons, this has been the only way to get such important information.

2. The data available does not yet suggest really alarming negative trends during the last 15 years for most of the resident species of Finnish birds of prey. However, the trends of the Honey Buzzard and Common Buzzard have been negative during many years. An international project for more extensive monitoring and conservation must soon be taken under consideration

3. In many areas in Finland, commercial forests have been heavily harvested, and cavity-nesting owl species suffer from the lack of natural nest sites, i.e. suitable cavities in hollow trees. In those areas, these owl species are dependent on the continuous voluntary work of owl ringers, who try to compensate the losses with appropriate nest boxes.

4. Reliable survival estimates are crucial for estimating the status and future of the population. Representative data sets for survival estimates are available only for the Tawny Owl and Ural Owl in spite of the efforts to encourage the ringers to ring and recapture the breeding adults at the nest.

5. More fieldwork and international cooperation is needed before reliable conclusions on nomadic species are possible.

Acknowledgements. All data presented here has been collected by enthusiastic and experienced Finnish raptor ringers. Heidi Björklund, Jukka Haapala, Juha Honkala, Jari Korhonen, and Jukka Lehtonen have been responsible for administration needed for storing the data. Heikki Lokki has written the necessary computer programmes.

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PRESENT ABUNDANCE OF DIURNAL RAPTORS AND OWLS IN THE PERM REGION, KAMA AREA

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Data on the abundance and breeding parameters of 26 raptor species gathered over a long-term period (1975–2004) of studies of diurnal raptors and owls in the Kama area of the Perm region are reported. Reasons for changes in their breeding density both in the region at large (160,600 km²) and in the main research plot (100 km²) are analysed. The focus is on rare and endangered species included in the Russian Federation and Perm Region Red Data Books.

Key words: diurnal raptors, owls, abundance, Perm, Kama.

СОВРЕМЕННОЕ СОСТОЯНИЕ ЧИСЛЕННОСТИ ХИЩНЫХ ПТИЦ И СОВ ПЕРМСКОГО ПРИКАМЬЯ. Шепель А.И.
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Исследования хищных птиц и сов проводили в период 1975–2004 гг. на территории Пермского Прикамья (Пермский край), территория которого составляет более 160 тыс. км² и располагается в пределах Западного Предуралья. Сравнивались данные за 1975–1989 гг. и 1990–2004 гг. Стабильная высокая численность характерна для канюка (*Buteo buteo*) – 5500 пар, полевого луня (*Circus cianeus*) – 3000, пустельги (*Falco tinnunculus*) – 3000, черного коршуна – (*Milvus migrans*) 3000, ушастой совы (*Asio otus*) – 2000, перепелятника (*Accipiter nisus*) – 1500, осоеда (*Pernis apivorus*) – 1000, тетеревятника (*Accipiter gentilis*) - 1000, чеглока (*Falco subbuteo*) - 1000, лугового луня (*Circus pygargus*) – 600, длиннохвостой неясыти (*Strix uralensis*) – 600, мохноногого сыча (*Aegolius funereus*) – 900. Стабильная низкая численность отмечена для дербника (*Falco columbarius*) – 200 пар, воробьиного сыча (*Glaucidium passerinum*) – 200, кобчика (*Falco vespertinus*) – 100, бородатой неясыти (*Strix nebulosa*) – 100, болотного луня (*Circus aeruginosus*) – 50, ястребиной совы (*Surnia ulula*) – 40. К видам численность которых повсеместно растет относятся: сапсан (*Falco peregrinus*) – 100 пар, орлан-белохвост (*Haliatetus albicilla*) – 80, скопа (*Pandion haliaetus*) – 60. В последние 10-15 лет в регионе появились степные виды: сплюшка (*Otus scops*) – 80 пар и степной лунь (*Circus macrourus*) – 10. Для болотной (*Asio flammeus*) совы характерен некоторый рост количества птиц в последние годы до 1500 пар. Особую озабоченность вызывают виды, численность которых сокращается: филин (*Bubo bubo*) – 120 пар (в 1980-е годы 330), серая неясыть (*Strix aluco*), – 30 (60), большой подорлик (*Aquila clanga*) – 5 (20), беркут (*Aquila chryisaetos*) – 6 (12). Эти птицы нуждаются в разработке специальных мер по стабилизации и восстановлению численности, в том числе в создании фонда искусственных гнездовий.

Ключевые слова: хищные птицы, совы, состояние численности, Пермский край.

MATERIAL AND METHODS

Systematic studies of diurnal raptors and owls in the Kama area of the Perm region and Komi–Perm autonomous district have been conducted since 1975. The region is situated in the Western Pre-Urals (Middle and Northern Urals) and occupies an area of 160,600 km². The western, larger part of the region is a slightly uplifted, heavily eroded portion of the Russian plain; the eastern part comprises the foothills and western ranges of the Ural mountain belt (Korotaev 1962). It lies in the forest zone and forests cover ca. 50% of the territory, mostly in northern and eastern parts. In the 1950s, Danilova (1958) delineated six natural forest districts, which have changed somewhat by present (Ovesnov 1997). There are numerous rivers in the region – over 550 – and extensive Kama and Votkinsk impoundment reservoirs covering 3000 km². Farmland occupies 2,870,000 ha. (Status and conservation of the Perm Region environment in 2004).

The main research plot with an area of 100 km² is situated in the Kishert and Kungur districts of the region. According to Maksimovich (1950), it is a piece of an ancient strongly uplifted plain cut by the Sylva river valley and numerous ravines. Maximum elevations are 240–250 m a.s.l., minimum ones 110 m a.s.l. There are many calcareous cliffs shaped as pillars, ridges and scallops along the steep banks of River Sylva. Their tops rise 70–80 m above the river level. The research plot is the contact zone of southern taiga, Kungur forest steppe and mixed broadleaved-coniferous forests. According to Ponomarjov (1950) there occur typical spruce-fir taiga, broadleaved lime and elm-maple-lime forests, pine forests of the Siberian and forest-steppe types, as well as birch forests. Timber harvesting early in the 20th century has led to wide distribution of secondary forests: birch forests, aspen forests and mixed stands of spruce, fir, birch and lime. About 50% of the plot is forested, 23 km^2 is the area of the "Preduralie" nature reserve.

Absolute abundance of the birds inhabiting the research plot was determined by continuous registration of all diurnal raptors, including breeding and non-breeding individuals, as well as by detecting nests and territories. Owl counts were made using all applicable methods. Birds were counted by pre-breeding calling in spring and by owlet solicitation in summer, nests were detected by concentration of brood cast pellets, total "combing" was applied to search for *Athene* and *Aegolius* owls. The cliffs and shores suitable for breeding of the Eagle Owl were selectively checked. Results of the counts are shown in table 2.

Counts in the region were made in 40 administrative districts. Activities were planned so that all geobotanical districts are covered every year with regard to seasonal variations. In contrast to Danilova (1958) and Ovesnov (1997), we distinguish five geobotanical districts (tab. 1), since mid-taiga pine forests, which have been nearly totally logged by now, are not considered as a separate group.

Table 1. Characteristics of the Perm region geobotanical districts.

Geobotanical district	District area, km^2	Area suitable for breeding, km^2	Proportion of forest, %
Fir-spruce montane taiga	25600	8300	90
Fir-spruce middle taiga	57900	18800	80
Fir-spruce southern taiga	46100	23200 (33700)*	60
Mixed broadleaved-coniferous forest	19200	13500 (15400)	30
Kungur forest steppe	10800	7600 (8600)	30
Total in the region	160000	71400	60

*Note. Figures in brackets stand for the area suitable for breeding of the most flexible species: Common Buzzard, Kestrel, Hen Harrier, Long-eared and Short-eared Owls, which are more likely to use anthropogenic landscapes than other species.

Table 2. Diurnal raptor and owl abundance in the main research station (registered number of breeding pairs per 100 km^2).

Species		1976–1989	1990–2004
Species with stable abundance (4 species)			
Honey Buzzard	*Pernis apivorus*	1–2	1–2
Hobby	*Falco subbuteo*	1	1
Long-eared Owl	*Asio otus*	2–4	2–4
Tengmalm's Owl	*Aegolius funereus*	2–3	2–3
Species with growing abundance (6 species)			
Common Buzzard	*Buteo buteo*	5–6	8–9
Black Kite	*Milvus migrans*	1–2	4–5
Hen Harrier	*Circus cianeus*	2–3	6–7 (3–4)
Sparrowhawk	*Accipiter nisus*	2–3	3–4
Goshawk	*Accipiter gentiles*	1–2	2–3
Peregrine Falcon	*Falco peregrinus* – 1984*	0–1	2–3
Irregularly breeding species (7 species)			
Montagu's Harrier	*Circus pygargus*	0–1	0–1
Pallid Harrier	*Circus macrourus* – 1992*	0	0–1
Short-eared Owl	*Asio flammeus*	0–2	0–3
Ural Owl	*Strix uralensis*	0–1	0–1
Great Grey Owl	*Strix nebulosa*	0–1	0–1
Pygmy Owl	*Glaucidium passerinum*	0–1	0–1
Red-footed Falcon	*Falco vespertinus*	0–1	0–1
Species with decreasing abundance (1 species)			
Kestrel	*Falco tinnunculus*	6–12	3–4
Locally extinct species (1 species)			
Eagle Owl	*Bubo bubo*	1–2 (1988)*	0

*Note. Years for the Peregrine Falcon and Pallid Harrier are the first breeding registrations from the research plot, for the Eagle Owl the last registration.

Two to four sample plots were established in an administrative district, and a team of 3–4 people worked there for 4–5 days. Each person surveyed a sector, searching for nests and registering all raptors contacted. In addition to breeding pairs we counted also single birds, which normally stay in the territory throughout the breeding period. As it is a common practise in the literature, the results were recalculated per number of pairs, wherefore some tables contain fractional numbers standing for abundance values. Sample plots had a mean size of 120 km^2, with a range of 60 to 200 km^2, depending on geobotanical characteristics, scope of human activities and meteorological conditions.

The area of suitable breeding habitats was determined from 1:100 000 topographic maps and turned out to be 32–70% of the area of individual geobotanical districts and 45% of the region in general, i.e. 71,400 km^2. For the Common Buzzard *Buteo buteo*, Kestrel *Falco tinnunculus*, Hen Harrier *Circus cianeus* and Long-eared Owl *Asio otus*, which are more tolerant of human impact, the area suitable for breeding is larger – it is shown in brackets in table 1. The specific number of pair registrations was summed up for each geobotanical district and then extrapolated to the area suitable for breeding, since counts in sample plots were made exactly in suitable breeding habitats. Attention was given also to the limits of distribution of certain species. Thus, e.g., the Tawny Owl *Strix aluco* does not live throughout mid-taiga, but occurs in an area of 12,600 km^2 only, the area of its suitable breeding habitats being 5100 km^2. Having calculated the number of bird pairs for each district we interpolated the value per 1,000 km^2. The total number of pairs in the region was determined as the sum of those found in individual districts. For rare red-listed species systematic efforts were taken to detect proper nest sites. Basic activities for determination of the density of the raptor population were implemented in the 1980s. Since then, selective control counts have been made annually in sample plots and individual geobotanical districts. Eagle Owl and Peregrine Falcon nests are checked regularly, every year. The results are shown in table 3.

The material is presented following the taxonomic approach of Stepanyan (1990).

Table 3. Diurnal raptor and owl abundance in the Perm region (calculated number of breeding pairs per 160,000 km^2).

Species		1980–1989	1990–2004
Species with stable abundance (13 species)			
Common Buzzard	*Buteo buteo*	5500	5500
Hen Harrier	*Circus cianeus*	3000	3000
Kestrel	*Falco tinnunculus*	3000	3000
Black Kite	*Milvus migrans*	2500	3000
Long-eared Owl	*Asio otus*	2000	2000
Sparrowhawk	*Accipiter nisus*	1100	1500
Honey Buzzard	*Pernis apivorus*	1000	1000
Short-eared Owl	*Asio flammeus*	1200	1500
Goshawk	*Accipiter gentiles*	700	1000
Hobby	*Falco subbuteo*	700	1000
Montagu's Harrier	*Circus pygargus*	600	600
Ural Owl	*Strix uralensis*	600	600
Tengmalm's Owl	*Aegolius funereus*	700	900
Uncommon species with stable abundance (6 species)			
Merlin	*Falco columbarius*	200	200
Pygmy Owl	*Glaucidium passerinum*	200	200
Red-footed Falcon	*Falco vespertinus*	100	100
Great Grey Owl	*Strix nebulosa*	100	100
Marsh Harrier	*Circus aeruginosus*	50	50
Hawk Owl	*Surnia ulula*	Singular contacts	40
Species with abundance growing throughout the region (3 species)			
Peregrine Falcon	*Falco peregrinus*	13	100
Osprey	*Pandion haliaetus*	20	60
White-tailed Sea Eagle	*Haliatetus albicilla*	10	80
Species first registered from the Kama area in the 1990s (2 species)			
Scops Owl	*Otus scops*	0	80
Pallid Harrier	*Circus macrourus*	0	10
Species with abundance decreasing throughout the region (4 species)			
Eagle Owl	*Bubo bubo*	330	120
Tawny Owl	*Strix aluco*	60	30
Spotted Eagle	*Aquila clanga*	20	5
Golden Eagle	*Aquila chryisaetos*	12	6

RESULTS AND DISCUSSION

Judging by the breeding density, nest spacing, tendencies in abundance and species composition, the raptor population is now fluctuating in the Perm region's Kama area under the influence of both natural and anthropogenic factors acting within the Kama area, in adjacent territories and in Europe at large.

The Black Kite *Milvus migrans* and Hobby *Falco subbuteo* will further continue to colonise the northern part of the region, and following a period of increase, their abundance will stabilize in the coming 10–20 years. After the stabilization and saturation of breeding biotopes with birds, however, they may decrease in abundance and recede southwards due to regeneration of harvested areas.

The number of breeding pairs of the Goshawk *Accipiter gentilis* and Sparrowhawk *Accipiter nisus* is likely to increase unless their persecution will recover. They have not fully occupied potential breeding areas yet. The Long-eared Owl *Asio otus* abundance may increase in southern and central parts of the region, in areas with agricultural activities maintained.

The Short-eared Owl (*Asio flammeus*) has lately demonstrated some increase in the number of breeding birds from 1200 to 1500 pairs.

The Pallid Harrier *Circus macrourus* and Scops Owl *Otus scops*, which appeared in the region in the past 10 years (Lapushkin et al. 1995, 2003), are colonising southern districts, and their abundance is likely to increase.

Three species of "grey" harriers: the Hen *Circus cyaneus*, Montagu's *Circus pygargus* and the Pallid *Circus macrourus* harriers, show frontal expansion into taiga forests, where they have colonized a new breeding biotope offered by cut-over sites and forest edges. Given the declining abundance of the species in many parts of Europe, especially southern ones, one can say that the forest zone is a salvation for them. Overgrowing of cut-overs and farmland in the past decade, however, is likely to cause spatial redistribution of their breeding grounds and a decline in abundance in some districts, as indicated by observations in the main research plot.

The abundance of the Osprey *Pandion haliaetus* and White-tailed Sea Eagle *Haliatetus albicilla* will increase, although slowly; that of the Sea Eagle in southern parts of the region, as birds disperse from the Lower Kama reservoirs, that of the Osprey in northern parts, as drift floating of timber on rivers has been terminated. The increase in the Peregrine Falcon *Falco peregrinus* population density in the southern half of the region and the species' northwards expansion will continue.

The abundance of the Common Buzzard *Buteo buteo* and Honey Buzzard *Pernis apivorus* will remain invariably high; that of Tengmalm's Owl *Aegolius funereus*, Pygmy Owl *Glaucidium passerinum*, Ural Owl *Strix uralensis*, Great Gray Owl *Strix nebulosa*, Merlin *Falco columbarius*, Red-footed Falcon *Falco vespertinus*, Marsh Harrier *Circus aeruginosus* and Hawk Owl *Surnia ulula* will retain stability at a low level.

The abundance of the Spotted Eagle *Aquila clanga* will keep declining because of its rarity in Europe and lack of potential sources for replenishment of the Kama area population.

The abundance of the Golden Eagle *Aquila chrysaetos* will fully depend on conservation measures. There is a good chance of stabilization of the species abundance if the salvation programme is implemented.

Another species in need of conservationl measures (organisation of artificial nest sites) is the Tawny Owl *Strix aluco*.

The breeding performance of the Eagle Owl *Bubo bubo* is very low (tab. 4, 5), wherefore its abundance has dropped nearly by two thirds over the past twenty years. Special measures to stabilize and restore the numbers are needed for this species also.

Table 4. Breeding success of diurnal raptors and owls in the Perm region Kama area.

Species		Proportion of fledged young per total clutch size, %
White-tailed Sea Eagle	*Haliatetus albicilla*	80–90
Peregrine Falcon	*Falco peregrinus*	80–90
Hobby	*Falco subbuteo*	70–80
Honey Buzzard	*Pernis apivorus*	60–70
Montagu's Harrier	*Circus pygargus*	60–70
Black Kite	*Milvus migrans*	60–70
Goshawk	*Accipiter gentiles*	60–70
Sparrowhawk	*Accipiter nisus*	60–70
Common Buzzard	*Buteo buteo*	60–70
Hen Harrier	*Circus cianeus*	50–60
Kestrel	*Falco tinnunculus*	50–60
Long-eared Owl	*Asio otus*	50–60
Short-eared Owl	*Asio flammeus*	50–60
Eagle Owl	*Bubo bubo*	< 50 %

Table 5. Breeding success of the Eagle Owl and Peregrine Falcon in the Perm region Kama area in different years.

Years of observations	Mean clutch size	Mean no of hatchlings	Mean no of fledglings	Breeding success (proportion of fledglings per total clutch size) (%)
		Eagle Owl (*Bubo bubo*)		
1977–1989	2.2	1.6	1.3	59.0
1990–2004	1.5	1.1	0.7	47.0
		Peregrine Falcon (*Falco peregrinus*)		
1995–2004	3.0	2.8	2.7	90.0

It appears difficult to forecast the situation for the Kestrel *Falco tinnunculus*, the abundance of which remains more or less stable in the Kama area in general, but halved in the main research plot.

An object of special attention among diurnal raptors and owls are species listed in the national and regional Red Data Books, wherefore we tried to find out why the abundance of some of them declined, and that of others increased.

The presumed reasons for the rise in the abundance of the Peregrine Falcon *Falco peregrinus* in the Perm Kama area are the following: 1) effective conservation at the international, national and local levels; 2) stable and rich food resources constituted mainly by Black-headed *Gulls Larus ridibundus* and *Columbidae*; 3) significant nesting facilities available; 4) adaptation to disturbance factors, nesting in the immediate vicinity of sites regularly visited by people; 5) high breeding success.

The factors for the Osprey *Pandion haliaetus* and White-tailed Sea Eagle *Haliatetus albicilla* are: 1) effective conservation at the international, national and local levels; 2) ban on drift floating of timber along rivers and reservoirs; 3) ban on logging in the waterside protection zone since the early 1990s; 4) stable and rich food resources; 5) high infestation of *Cyprinids* with *Ligula parasites*; 5) adaptation to disturbance factors, nesting in the immediate vicinity of sites regularly visited by people; 6) high breeding success.

Presumed reasons for the decline of the Eagle Owl *Bubo bubo* are: 1) disturbance by local people, fishermen and hunters in the breeding period; 2) unfavourable weather conditions (spring frosts and forest fires caused by dry weather in the period) destructive for clutches and hatchlings; 3) killing of young by predatory mammals; 4) killing of adult birds by poachers; 5) deaths in traps; 6) killing of owls for taxidermy, since stuffed animals have lately become fashionable; 7) transformation of some breeding habitats as the result of mining of silinite and other minerals.

The factors for the Spotted Eagle *Aquila clanga* and Golden Eagle *Aquila chrysaetos* are: 1) no adaptation to the disturbance; 2) deficit of nesting facilities; 3) logging in areas with nests and felling of trees with artificial nest platforms; 4) poaching; 4) death in traps.

CONCLUSIONS

Thus, among the 26 raptors of the Perm region Kama area the breeding density of 12 species is invariably high, that of 6 species invariably low.

Having appeared in the region in the 1990s, steppe-related species, the Scops Owl *Otus scops* and Pallid Harrier *Circus macrourus*, are now colonising the southern half of the Perm region, the territory with mosaic forests.

The abundance of the Peregrine Falcon *Falco peregrinus*, Osprey *Pandion haliaetus* and White-tailed Sea Eagle *Haliatetus albicilla* has been growing steadily in the past 10–15 years owing to high breeding success, adaptation to disturbance factor and rich food resources.

Especially alarming is the decrease in the breeding density of the Eagle Owl *Bubo bubo*, Tawny Owl *Strix aluco*, Spotted Eagle *Aquila clanga* and Golden Eagle *Aquila chrysaetos*. For these species specialised measures need to be developed to stabilize and restore the abundance, one of them being building of artificial nest sites.

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POPULATION TRENDS AND BREEDING SUCCESS OF THE WHITE-TAILED SEA EAGLE *HALIAEETUS ALBICILLA* IN FINLAND, 1970–2005

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The productivity of the Sea Eagle in Finland began to deteriorate in the 1950s, reaching its lowest level during the 1970s. The breeding population diminished, from approximately 55 pairs in 1960 to ca. 40 pairs in 1970, many of them incapable to reproduce. Associated with active protective measures, breeding success improved, and the population increased to about 50 pairs in 1980, 80 pairs in 1990, 200 pairs in 2000 and 300 pairs in 2005. The number of occupied territories increased from 37 in 1980, to 75 in 1990, 167 in 2000, and 255 in 2005, including 4, 14, 21 and 34 fresh water or inland territories in northern Finland, respectively. The total annual number of nestlings in the early 1970s varied between 4 and 10. It was 17 in 1980, 62 in 1990, 172 in 2000, and 256 in 2005. Nestlings per occupied territory was <0.3 in the 1970s, slightly higher in the early 1980s, and increased during the 1980s and 1990s to about 0.94 in 2000–2004. The improvement of the breeding success started some years earlier on the Åland Islands than in other sub-regions. During the period 2000–2004 about 60% of the nesting attempts were successful compared to only about 20% (16–23%) in 1970–1974. The average brood size increased as well, e.g. on the Åland Islands from 1.21 nestlings 1976–1979 to 1.65 in 2000–2004. Considering the high productivity and low mortality among juveniles and sub-adults since the 1990s, the population should continue to increase.

Key words: White-tailed Sea Eagle, population trends, breeding success, brood size.

ТЕНДЕНЦИИ В СОСТОЯНИИ ПОПУЛЯЦИИ И УСПЕХЕ ВОСПРОИЗВОДСТВА ОРЛАНА-БЕЛОХВОСТА (*HALIAEETUS ALBICILLA* L.) В ФИНЛЯНДИИ, 1970–2005 гг. Т. Стернберг, Я. Койвусаари, Я. Хёгмандер, Т. Оллила, Х. Экблом. *Музей национальной истории Финляндии, Университет Хельсинки; Региональный центр окружающей среды Западной Финляндии, Васаа; Служба лесов и парков Финляндии, Турку, Рованиеми.*

Продуктивность орлана-белохвоста *Haliaeetus albicilla* в Финляндии начала снижаться с 1950-х гг. и достигла самого низкого уровня в 70-е годы. Гнездовая популяция сократилась с примерно с 55 в 1960 г. до. 40 пар в 1970 г., многие из которых оказались неспособны к размножению. Активная реализация охранных мер позволила повысить успешность гнездования, и популяция выросла примерно до 50 пар в 1980 г., 80 – в 1990 г., 200 – в 2000 г. и 300 – в 2005 г. Число занятых гнездовых территорий увеличилось с 37 в 1980 г. до 75 в 1990 г., 167 – в 2000 г. и 255 – в 2005 г., из которых соответственно 4, 14, 21 и 34 находились на пресноводных водоемах или во внутренних районах Лапландии. В целом, в начале 1970-х гг. рождалось от 4 до 10 птенцов в год, в 1980 г. – 17, в 1990 г. – 62, в 2000 г. – 172, в 2005 г. – 256. На одну занятую территорию приходилось <0.3 птенца в 70-е гг., чуть больше – в начале 1980-х гг., а к 2000–2004 г. этот показатель вырос до 0.94. На Аландских островах рост успешности гнездования начался несколькими годами раньше, чем в других районах. В 2000–2004 гг. успешными были около 60% попыток гнездования, по сравнению с 20% (16–23%) в 1970–1974 годах. Средний размер выводка увеличился на Аландских островах с 1,21 птенца в 1976–1979 гг. до 1,65 – в 2000–2004 гг. Учитывая высокую продуктивность и низкую смертность молодых птиц, наблюдаемые с 1990-х гг., следует ожидать дальнейшего роста популяции.

Ключевые слова: орлан-белохвост, *Haliaeetus albicilla*, динамика популяции, успешность гнездования, размер выводка.

INTRODUCTION

The White-tailed Sea Eagle population in Finland, as well as in other countries around the Baltic, decreased rapidly in the 1960s and 1970s. Human persecution, poisoned bait, loss of breeding biotopes, disturbance and, especially from the 1950s onwards, toxic chemicals were the main threats for Sea Eagles. Surveys and research started in the 1960s, some already in the 1940s.

These activities were consolidated in December 1972 when WWF Finland appointed a special Sea Eagle working group to work out a rescue and research programme and to implement it. Regional voluntary Sea Eagle working groups have since then been responsible for the monitoring of the population and the nesting success. They have also conducted a comprehensive winter-feeding programme, built artificial nests, and taken other protective measures. This paper aims to elucidate population trends and breeding success for the White-tailed Sea Eagle in Finland 1970–2005. It is an update of two earlier papers (Stjernberg et al. 2003, 2005). The data for 2005 are preliminary.

MATERIAL AND METHODS

The White-tailed Sea Eagle population in Finland is not evenly distributed (fig. 1). Since the map was produced in the late 1990s, the Sea Eagle in Finland has settled in three further grid squares: one in the archipelago east of Helsinki, one in eastern Finland (Pohjois-Karjala), and one on the fringe of the Bothnian Bay at the Oulu latitude. Three of the sub-populations are on the brackish Baltic fringe: (1) the Åland Islands (Ahvenanmaa) between Finland and Sweden, (2) southwestern Finland, comprising the two former counties of Turku and Pori, and Uusimaa, and (3) western Finland, i.e. the Quark (Merenkurkku), comprising the former county of Vaasa. The fresh water population breeds in northern Finland (Lapland and Koillismaa). In recent years a few fresh water pairs have also settled in sub-regions 2 and 3, as well as in eastern Finland.

The regional Sea Eagle working groups have annually checked every known territory and nest, and breeding production has been established by visits to nests in late May or in June to ring nestlings with coloured rings. New territories and nests and "lost" pairs are located, often using information got from the public. Since 1980, aircraft have been used to check nests in western and northern Finland during incubation in April, and occasionally to search for new nests in June. Productivity was calculated as the number of half-grown nestlings/occupied territory/year, brood size as nestlings/successful nesting attempt, and breeding success as successful nesting attempts (%). These calculations were made for the whole population and separately for the different sub-regions.

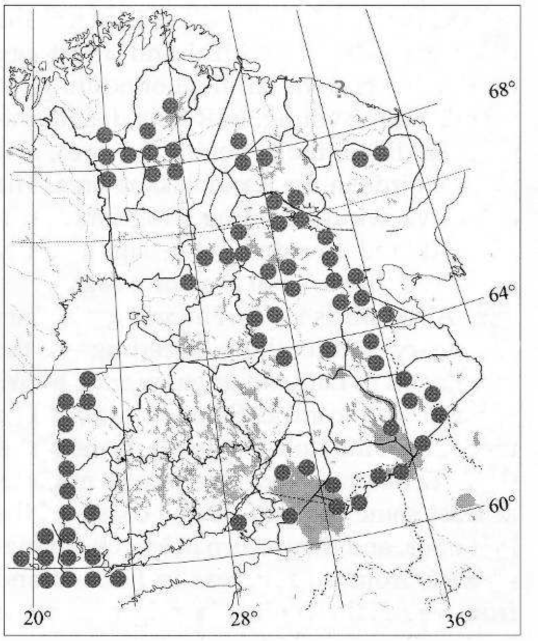


Figure 1. The distribution of the White-tailed Sea Eagle in Finland in the late 1990s (from Stjernberg et al. 1998).

RESULTS AND DISCUSSION

Population trends

The breeding population of the White-tailed Sea Eagle in Finland was estimated to comprise approximately 55 pairs in 1960 and ca. 40 pairs in 1970 (cf. Stjernberg et al. 1990, 2003). The population reached its lowest level during the late 1960s and early 1970s. The number of occupied territories (= at least one decorated nest known) in the early 1970s varied between 11 and 23, in the early 1980s between 37 and 50, in the early 1990s between 75 and 100, and in the early 2000s between 167 and 255 (fig. 2).

The annual increase of occupied territories in 1990–2000 averaged 8.9% – in calculation 1989 was used as starting point – and from 2000 to 2005 7.5%. (The figure for 1990–2000 has been recalculated, cf. Stjernberg et al. (2003), where the presented figure is lower.) The recorded numbers of occupied territories started to increase from the mid-1980s, earliest on the Åland Islands and latest in western Finland ten years later (fig. 2).

Nesting success

The productivity of the White-tailed Sea Eagle in Finland began to deteriorate in the 1950s and reached its lowest in the late 1960s and early 1970s (Stjernberg et al. 1990, 2003). In the early 1970s only 4–10 nestlings were recorded annually. At that time, all but one pair in Lapland nested on the Baltic fringe. In 2005 256 nestlings were recorded, out of which 35 in Northern Finland (fig. 3).

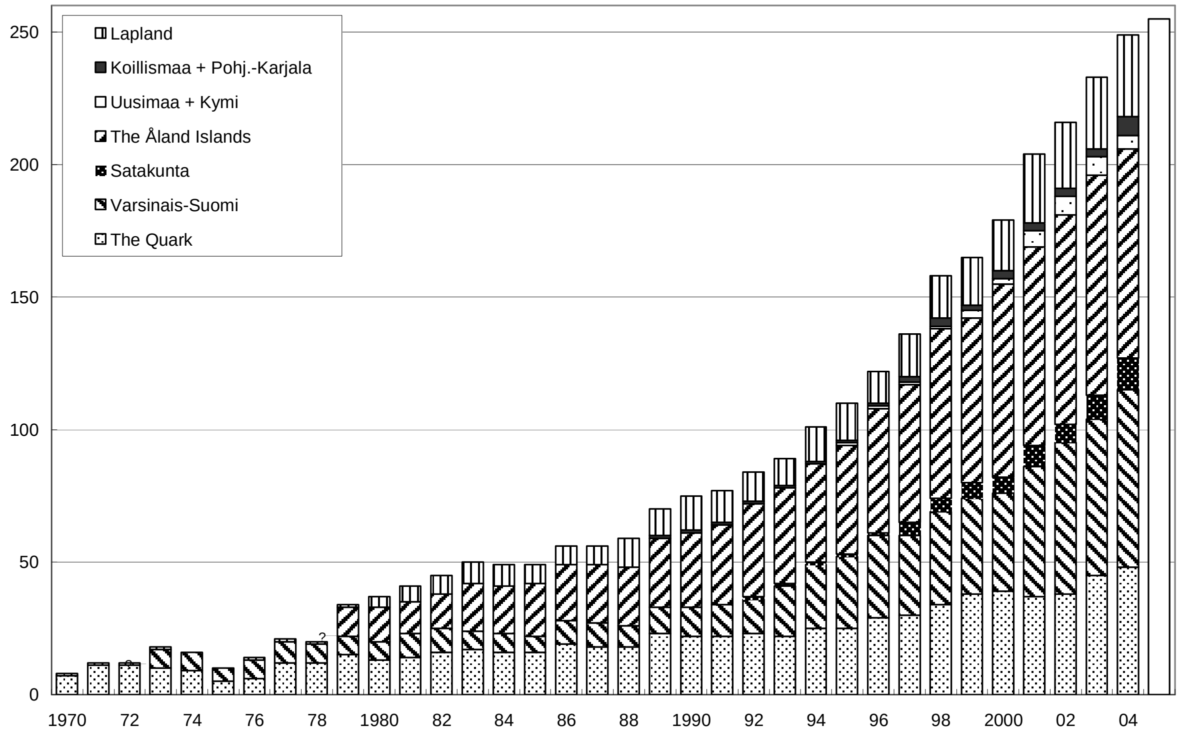


Figure 2. The numbers of occupied territories of the White-tailed Sea Eagle in different regions in Finland in 1970–2005. The numbers for the Åland Islands in 1970–1978 are not as complete as later ones, neither the figures for the other regions in 1970–1972. Koillismaa = the inner (freshwater) parts of the province of Oulu, Pohj.-Karjala = the province of Pohjois-Karjala, Uusimaa = the province of Uusimaa, Kymi = the province of Kymi, Satakunta = the county of Satakunta, Varsinais-Suomi = the county of Varsinais-Suomi (Satakunta and Varsinais-Suomi = the former province of Turku and Pori). The figure for 2005 is preliminary.

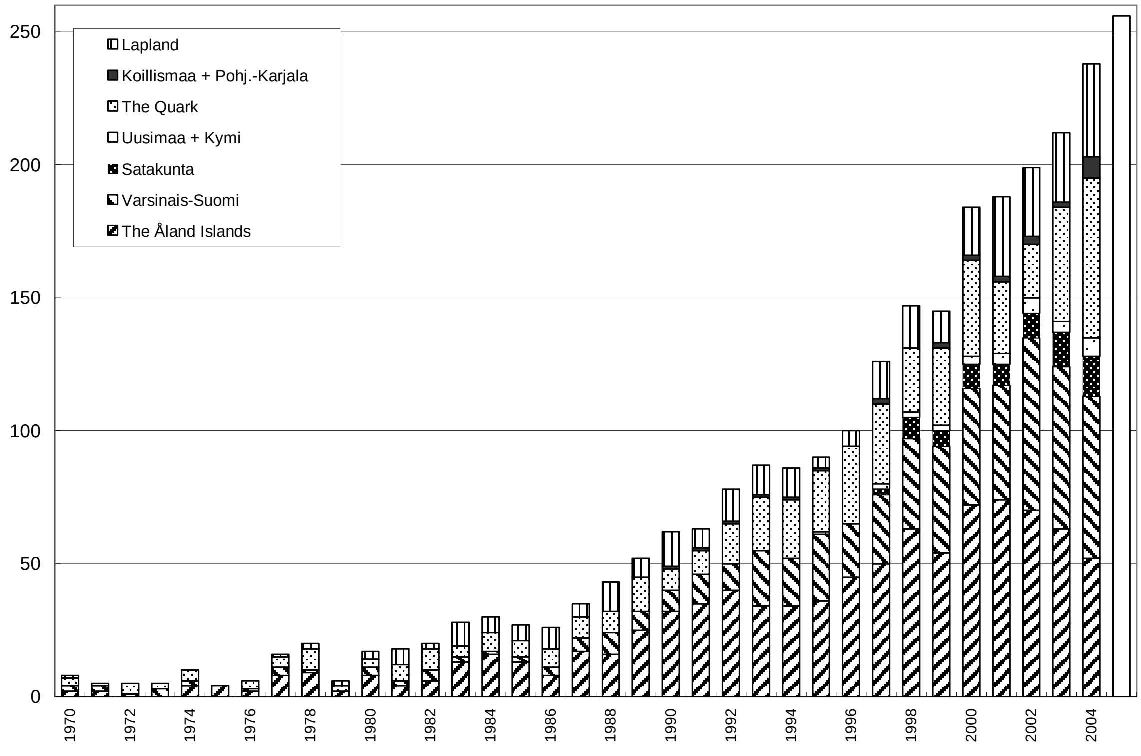


Figure 3. The numbers of half-grown White-tailed Sea Eagle nestlings in different regions in Finland in 1970–2005. For regions, see fig. 2. The figure for 2005 is preliminary.

Nestlings/occupied territory and successful nesting attempts

The productivity of the White-tailed Sea Eagle – measured as nestlings/occupied territory and percent successful nesting attempts – in Finland during the last 36 surveyed years, as well as in other countries around the Baltic, has improved (e.g. Stjernberg et al. 2003). In the early 1970s 16–24% of the nesting attempts were successful (figs. 4, 7) and <0.3 nestlings/occupied territory were recorded (figs. 5, 6, 7). In 2000–2004 ca. 0.94 nestlings /occupied territory were recorded (fig. 7), and ca. 60% of the nesting attempts were successful (fig. 7). In Lapland the average productivity during the whole period 1980–2005 was of the same (good) magnitude as the productivity on the Baltic fringe during the early 2000s, although the annual fluctuations in Lapland were much stronger than further south, especially in the 1980s and 1990s (figs. 4, 5).

The improvement in nesting success started earlier on the Åland Islands than in the neighbouring sub-region southwestern Finland, and even later in western Finland.

Brood size

Not only the breeding success, but also the brood size were depressed in the 1970s and averaged 1.26 in the 1970s in western Finland (tab. 1). Since then the average brood size gradually increased, and it was 1.67 in the latter part of the 1990s and 1.73 in 2000–2004. The recent brood size on the Åland Islands was similar – 1.65 in 2000–2004 (tab. 2). Recent average brood size of the Baltic populations in Finland and Sweden is similar and only slightly below the 1.84 under undisturbed conditions (Helander 1994, 2000, tab 2).

Table 1. Brood size of *Haliaeetus albicilla* in Western Finland (The Quark) in 1965–2004. Only nests inspected by climbing included.

Years	Brood size 1	Brood size 2	Brood size 3	Broods	Mean
1965–1969	2	1	0	3	1.33
1970–1974	6	1	0	7	1.14
1975–1979	8	4	0	12	1.33
1980–1984	8	9	0	17	1.53
1985–1989	15	12	0	27	1.44
1990–1994	24	19	2	45	1.51
1995–1999	27	43	3	73	1.67
2000–2004	36	56	9	101	1.73

Table 2. Brood size of *Haliaeetus albicilla* on the Åland Islands 1976–2004.

Years	Brood size 1	Brood size 2	Brood size 3	Broods	Mean	Notes
1976–1979	(11	3	0	14	1.21)	1)
1980–1984	(24	9	1	34	1.32)	1)
1980–1984	15	7	1	23	1.39	2)
1985–1989	27	24	1	52	1.50	3)
1990–1994	47	55	4	106	1.59	3)
1995–1999	55	79	5	139	1.64	3)
2000–2004	66	105	5	176	1.65	3)
Helander 1994: Brood size <1954 in Sweden, Baltic (undisturbed):						
Pre-1954	24	58	9	91	1.84	

Notes: 1) Numbers of nestlings established from the ground.
2) Nests inspected by climbing the tree (nestlings ringed).
3) Only nests inspected by climbing included.

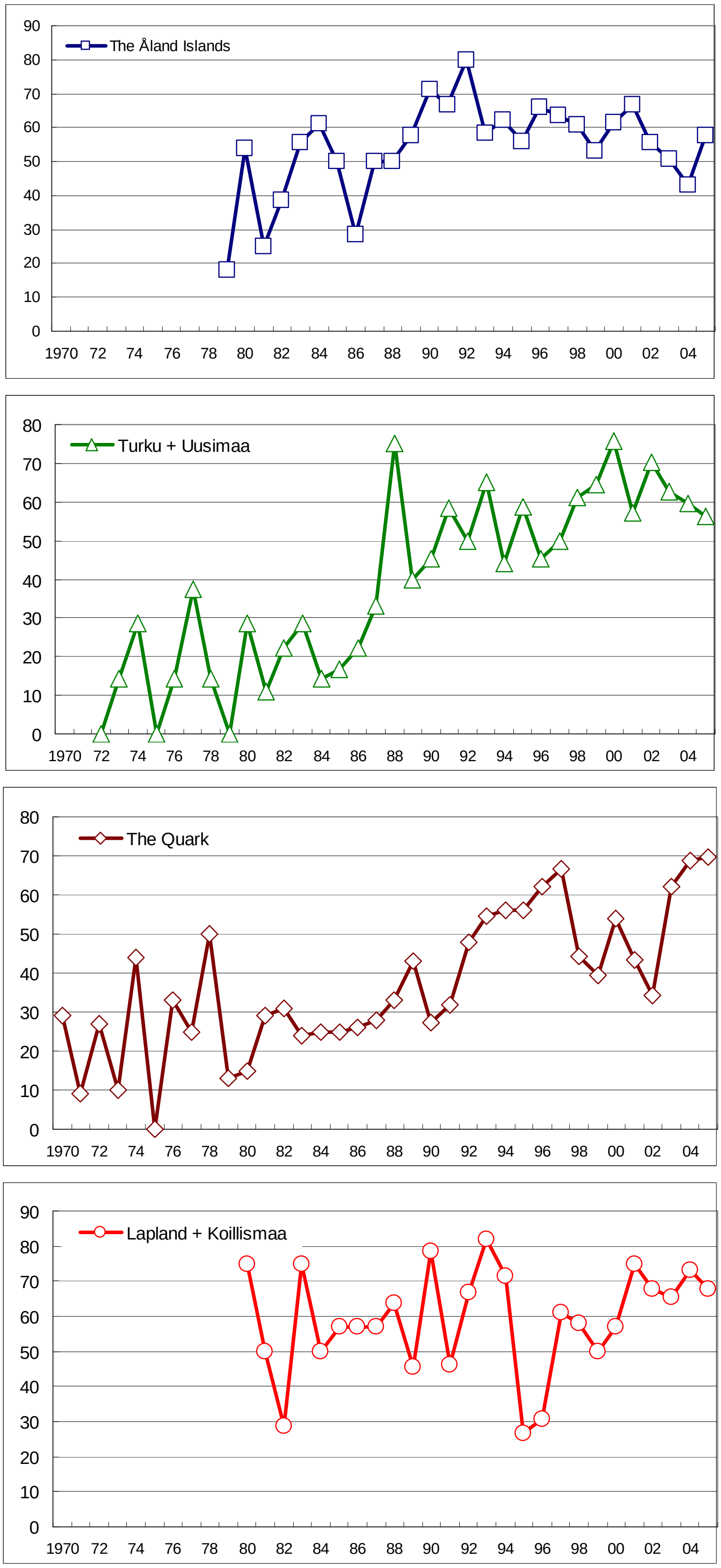


Figure 4. Successful nesting attempts (%) of the White-tailed Sea Eagle in different regions in Finland in 1970–2005. For regions, see fig. 2. Turku = the former province Turku and Pori comprises the county of Varsinais-Suomi and the county of Satakunta; here it also includes data from the provinces of Uusimaa and Kymi. Lappi + Koillismaa also include data from the county of Pohjois-Karjala. The figure for 2005 is preliminary.

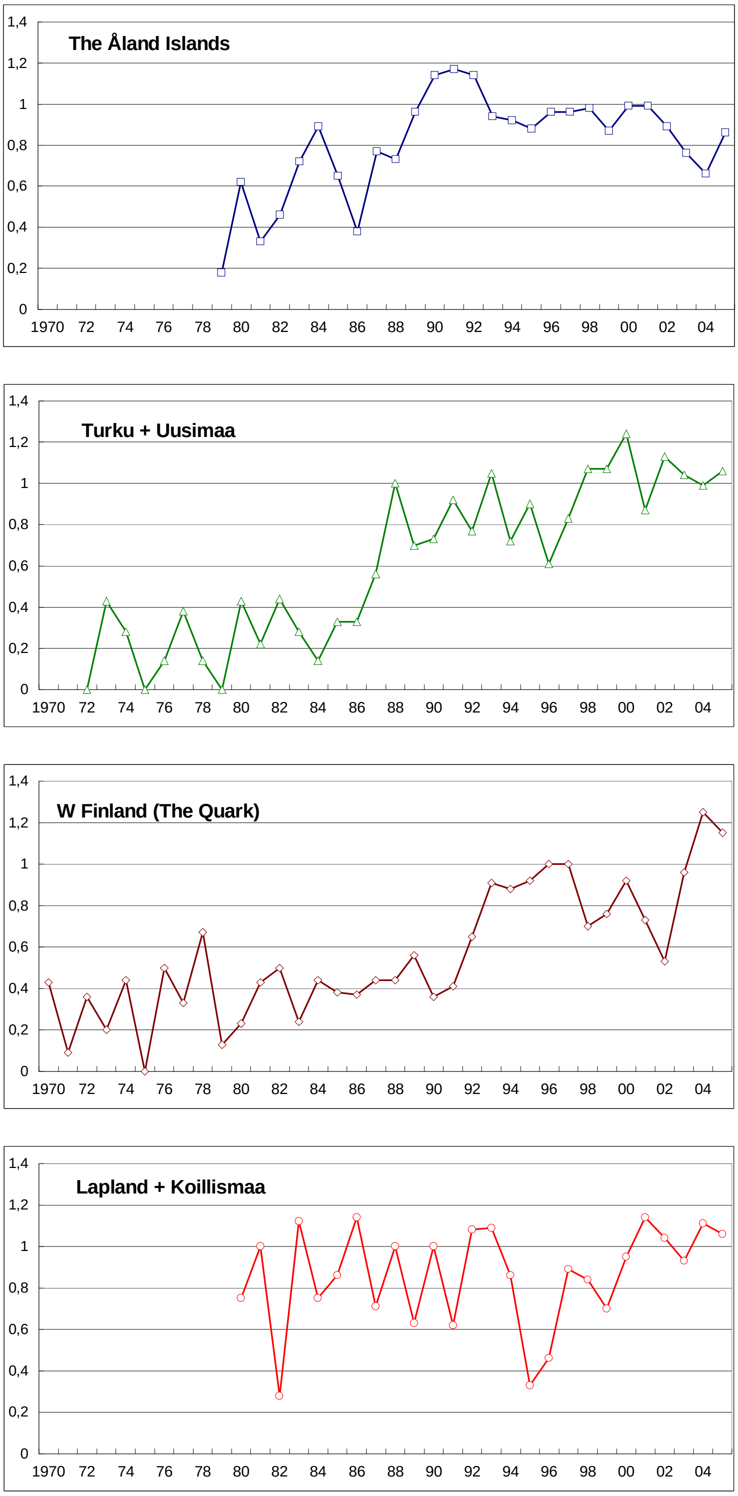


Figure 5. The average number of nestlings/occupied territory/year of the White-tailed Sea Eagle in different regions in Finland in 1970–2005. For regions, see figs. 2 and 4. The figure for 2005 is preliminary.

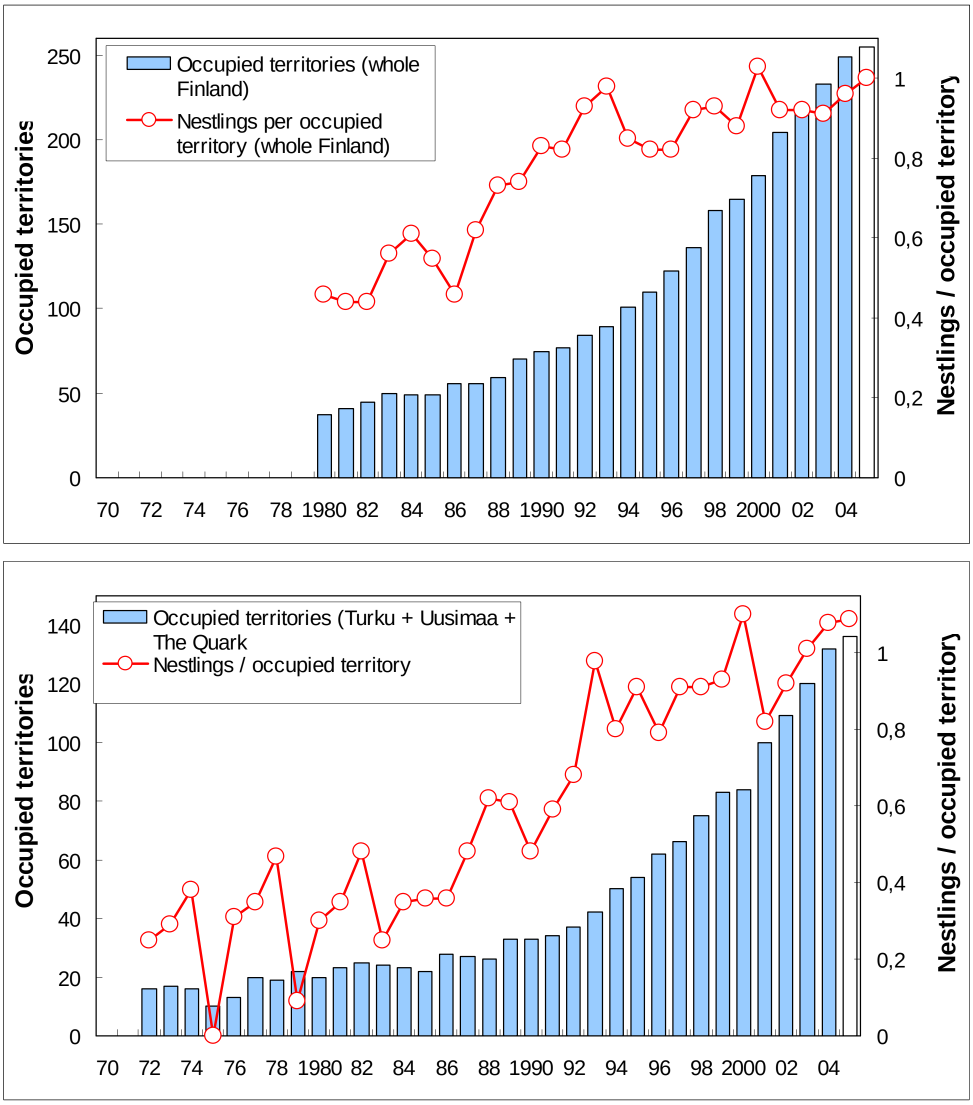


Figure 6. The average numbers of nestlings/occupied territory/year (curve) and the numbers of occupied territories/year of the White-tailed Sea Eagle in Finland in 1980–2005, and for the regions in southwestern Finland and the Quark in 1972–2005. The figure for 2005 is preliminary.

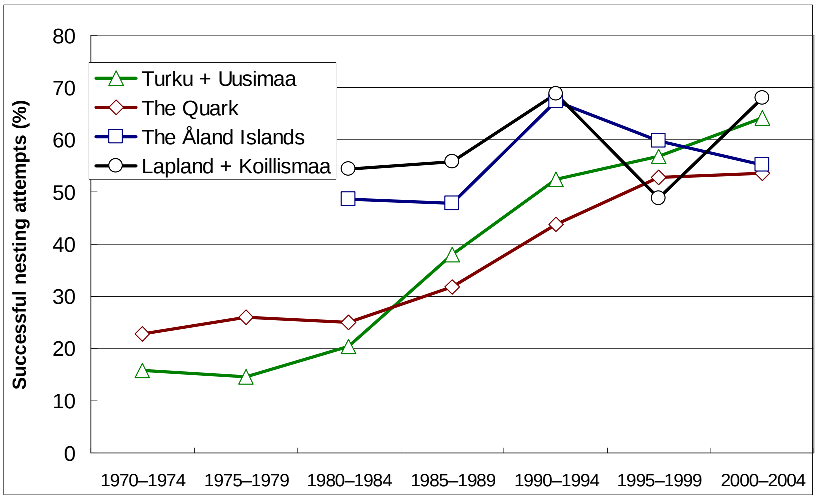
CONCLUDING COMMENTS

Winter-feeding, which was started from the very beginning of the Sea Eagle projects in Sweden and Finland (e.g. Hario 1981, Helander 1985) was perhaps, besides the general ban of use of DDT in the countries around the Baltic, the most important single protective measure for the Baltic populations in the 1970s. Winter-feeding especially lowered the mortality among yearlings and sub-adult birds.

In the 1990s, when the winter-feeding programme in Finland still was in force, the mortality among yearlings and sub-adults was very low. An analysis of comprehensive re-sighting data of White-tailed Sea Eagles ringed as nestlings in Finland 1991–1999 showed that the apparent minimum survival from fledging to the 1st winter, and annually to the 4th winter, was in the range 0.86–0.96 (Saurola et al. 2003). The improved survival of the few eaglets hatched during the 1970s stopped the alarming decrease of the Sea Eagle population, and the ban of use of DDT gradually lowered the contaminant burden of the Baltic environment (e.g. Helander et al. 2002), thus resulting in a recovering population.

The population is increasing although density dependent mortality factors, e.g. fatal territorial fights, seem to be increasing, and also environmental contaminants like lead and mercury still constitute a risk in some areas (cf. Krone et al. 2006).

WWF Finland's Sea Eagle project can be considered as a success story which has surpassed beyond all expectations, at least according to the fieldworkers starting surveys already in the "dark 1960s".



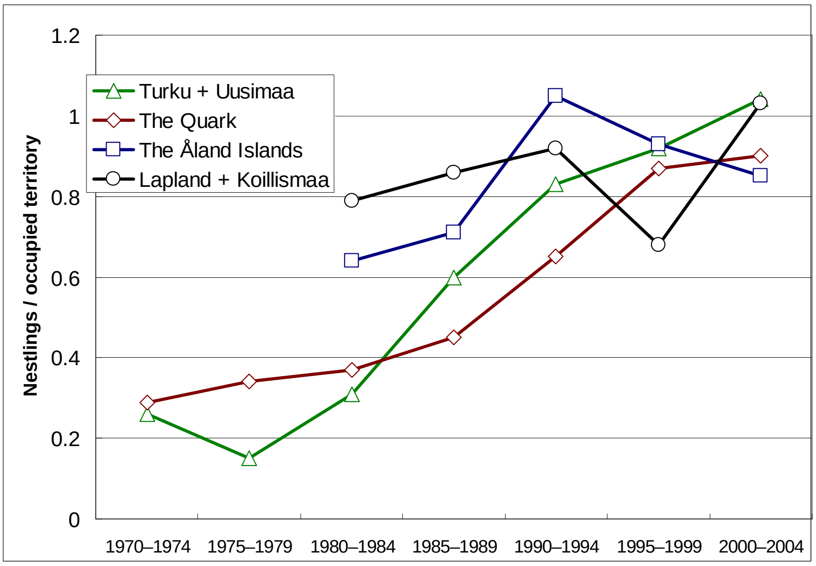


Figure 7. The average number of White-tailed Sea Eagle nestlings/occupied territory (below) and successful nesting attempts (%) in pentads in different regions in Finland in 1970–2004 (above). For regions, see figs. 2 and 4.

However, during the last years some other people, mostly hunters, have expressed as their opinion that there now might be too many White-tailed Sea Eagles in Finland. But, perhaps, also this opinion can be considered as a measure of success?

Acknowledgements. This report would have been impossible without the selfless work of the volunteers engaged in the White-tailed Sea Eagle project within the regime of WWF Finland over the last 35 years. The role of the regional sub-groups and the surveyors has been outstanding, as well as others that have used almost every winter weekend to provide eagles with uncontaminated food despite hard conditions. Pekka Routasuo drew the diagrams. We express our gratitude to all of them.

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THE RESPONSE OF THE GOSHAWK *ACCIPITER GENTILIS* TO CHANGING GROUSE *TETRAONIDAE SP.* POPULATIONS

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Goshawk's diet and breeding success was studied in northern Finland in the vicinity of Oulu during years 1989–2004 in order to evaluate predation impact on four grouse species, the Black Grouse *Tetrao tetrix,* Capercaillie *Tetrao urogallus,* Hazel Grouse *Bonasa bonasia* and Willow Grouse *Lagopus lagopus.* Sporadic food data was also used from years 1965–1988. Number of studied territories raised from 12 to 37 during the study years. Food remains were collected from territories at least three times per year: in spring (around the nesting site, n = 1420), in summer (from the nest after chicks fledged, n = 1782) and late summer (around the nesting site, n = 826). Winter diet was assessed by telemetry and from museum samples (n = 88). Diet composed mainly of grouse species totalling highest in spring, around 50%, and lowest in winter, around 30%, by number. Black Grouse were the most numerous among grouse, but juvenile grouse outnumbered them during late summer. Preference of different grouse species in Goshawk's diet was measured by a simple catch/supply index. Willow Grouse was taken twice more among grouse than their abundance in the field suggested, while Black Grouse and Hazel Grouse were taken at the same ratio as their abundance in the field. Capercaillies (only females) were taken around half compared to their relative abundance. Goshawk's functional response (grouse found/nesting site as a response variable) against grouse density of the previous autumn was typically concave. Occupancy rate and productivity (chicks fledged/occupied territory) of the Goshawk territories declined as the grouse density declined but brood size remained at the same level. Combining functional and numerical responses for total response (kill rate) declined as well with grouse density implying that Goshawk's predation impact on grouse has remained in a stable level. During years 1989–1998 year to year variation of total response tended to lag grouse density by two years, which implies destabilising effect of the Goshawk on grouse population. After 1999 this pattern, however, disappeared when grouse density fell to a very low level. Applied for the whole period, correlation with two year lag was observed but it was far from significant. Predation impact calculated for years 1989–1998 was 31% for the Willow Grouse, 15% for the Black Grouse, 2% for the Capercaillie and 16% for the Hazel Grouse.

Key words: Goshawk, grouse, diet, breeding, predation.

РЕАКЦИЯ ТЕТЕРЕВЯТНИКА (*Accipiter gentilis*) НА ИЗМЕНЕНИЯ В ПОПУЛЯЦИЯХ ТЕТЕРЕВИНЫХ ПТИЦ (TETRAONIDAE Spp.). Р. Торнберг. Университет Оулу, Финляндия.

Питание и успешность гнездования тетеревятника изучались на севере Финляндии, в районе Оулу, в 1989–2004 гг. для оценки воздействия его охоты на четыре вида тетеревиных птиц: тетерева *Tetrao tetrix,* глухаря *Tetrao urogallus,* рябчика *Bonasa bonasia* и белую куропатку *Lagopus lagopus.* Привлекались также разрозненные данные по питанию вида в 1965–1988 гг. За годы исследований число обследуемых территорий выросло с 12 до 37. Остатки пищи с территорий собирались не реже 3 раз в год: весной (вокруг гнезда, n = 1420), летом (из гнезда после вылета птенцов, n = 1782) и поздним летом (вокруг гнезда, n = 826). Питание в зимний период оценивалось по данным телеметрии и по музейным образцам (n = 88). Рацион состоял, в основном, из тетеревиных птиц, чья доля в питании была выше всего весной – около 50% (по числу объектов), и ниже всего зимой – около 30%. Тетерев был наиболее многочисленным среди прочих тетеревиных, но поздним летом птенцы тетеревиных опережали его по количеству объектов в рационе. Пищевые предпочтения тетеревятника по видам тетеревиных оценивались при помощи простого отношения добыча/ресурс. Белых куропаток добывалось вдвое больше, чем предполагала их относительная численность на территории, тетерев и рябчик добывались пропорционально их численности. На глухаря (только на самок) тетеревятник охотился примерно вдвое меньше, чем предполагало его наличие. Функциональная реакция тетеревятника (число тетеревиных на одно гнездо как функция отклика) на плотность населения тетеревиных птиц предыдущей осенью обычно была вогнутой. Индекс занятости территорий тетеревятника и их продуктивность (число слетков на территорию) снижались при сокращении плотности населения тетеревиных, но размер выводков оставался прежним. Объединив функциональный и количественный отклик, мы видим, что общая реакция – частота добыч, также снижалась при сокращении плотности тетеревиных птиц, что говорит о неизменном уровне воздействия на них охоты тетеревятника. В 1989–1998 гг., межгодовые колебания общей реакции отставали на 2 года от изменений плотности населения тетеревиных, указывая на дестабилизирующее воздействие тетеревятника на их популяцию. Однако после 1999 г., когда плотность тетеревиных птиц упала до крайне низкого уровня, эта закономерность исчезла. Анализируя весь период исследований в целом, корреляция с запозданием на 2 года существовала, но была совсем незначительной. Расчетное воздействие хищничества в период 1989–1998 гг. составило 31% для белой куропатки, 15% – для тетерева, 2% – для глухаря и 16% – для рябчика.

Ключевые слова: тетеревятник, тетеревиные птицы, питание, гнездование, хтщничество.

INTRODUCTION

The response of a predator to changes of prey availability can be divided into functional (dietary) and numerical response (Keith et al. 1977, Begon et al. 1996). Further, functional response is usually divided into three main types according to shape of the response curve: linear, concave and sigmoid shaped (Holling 1959). Combining functional and numerical response a total response is obtained (Doyle & Smith 2001, Tornberg 2001). It means a total number of prey specimens killed by predators in a given area. This so called kill rate divided by density of prey yields predation rate, often called predation impact (Lindén & Wikman 1983). Predators can be placed, based on their food habits, on a continuum from specialist to generalist predators. Utmost specialists respond only numerically while utmost generalists only functionally to prey changes (Reif et al. 2004a).

Predator´s response on changes of the availability of prey can have impact on prey population. Some predators, typically the species wandering around like nomads, respond immediately to the changes of prey numbers, while others, mainly small mammalian predators and certain site-tenacious raptorial birds, lag one or several years behind their prey (Galushin 1974, Korpimäki & Norrdahl 1989, Nielsen 1999, Tornberg et al. 2005). Former type of predation tends to stabilize prey population while latter destabilize it. Effect may also be influenced by predator type; i.e. whether it is a specialist or a generalist predator. Specialists can have both effects while generalists mainly stabilize prey populations (Hanski et al. 1991).

Goshawks *Accipiter gentiles* hunt in boreal forests mainly on four grouse species: Black Grouse *Tetrao tetrix,* Capercaillie *Tetrao urogallus*, Hazel Grouse *Bonasa bonasia* and Willow Grouse *Lagopus lagopus* throughout the year. These species account for 30–50% of the diet by number in northern Finland (Tornberg 1997, Tornberg & Colpaert 2001). Goshawk's breeding output is also highly dependent on grouse density (Sulkava et al. 1994, Byholm et al. 2002, Tornberg et al. 2005). Since the beginning of the 1960s, densities of all grouse species have continually declined in Finland (see Ranta et al. 1995, Helle et al. 2002). This has reflected in the diet of the Goshawk (Tornberg & Sulkava 1991). Some recent studies also show that Goshawk populations have declined in many regions in Fennoscandia (Lindén & Wikman 1983, Widen 1997, Selås 1998, Gundersen et al. 2004). In Finland, however, clear evidence of steady decline is still only local. The total population seems to be declining slightly (e.g. Björklund et al. 2002).

Aim of the present study is to document recent changes in the dietary and numerical responses of the Goshawk to varying grouse density, as well as to analyse Goshawk's possible effect on this variation. I am especially interested in how keenly Goshawks react to grouse density in northern Finland. I also present newest data about preference of the Goshawk for different grouse species, and whether there has appeared any change in the course of time.

STUDY AREA, MATERIAL AND METHODS

The study has been carried out in the vicinity of the city of Oulu (25° 30' E, 65° 00' N), mainly from 1989 to 2005, but some scattered data is also available since the year 1965. The landscape in the study area is typical for the region, i.e. lowland with few lakes and many rivers and brooks. The area is characterized by coniferous forests, with pines *Pinus sylvestris* and Norway spruce *Picea abies* mixed with birches *Betula pubescens* and aspens *Populus tremula* covering around 65% of the area. Around 30% of the area comprises of peat bogs, of which 2/3 are drained for forestry. The rest of the area are covered by fields, sandpits and human settlements.

Data on prey

Prey species eaten by Goshawks were monitored by collecting their remains around nesting sites during three phases of the nesting period: (1) nest-building and incubation period (hereafter spring), (2) nestling period (hereafter summer), and (3) during and after fledgling period. Prey remains were identified by using reference material of the Zoological museum, University of Oulu. Prey remains collected after the year 1989 total as follows: 1782 individuals from spring, 1420 from summer, and 826 individuals from fledging period, respectively. Data collected before 1989 sum up to 413 prey specimens from spring, and 395 from summer. Diet outside the breeding season was assessed by radio tracking during 1991–1995 (see Tornberg & Colpaert 2001), and during 2000–2003. Also stomach contents of Goshawks found dead in the study area or near-by, and sent to the Zoological Museum, were included in the data set (in total 88 prey specimens).

Data on Goshawk nesting

Nesting territories were checked in spring to detect whether they were occupied or not. Territory was stated to be occupied if fresh twigs of spruce or pine were brought to the nest. During May occupied nests were checked to see whether eggs were laid or not. Number of eggs was counted, and the eggs were measured whenever possible. Sometimes a new nest was found not until the young were already hatched. In successful nests the nestlings were counted and ringed as well as weighed, and their wing lengths were measured. The annual number of territories checked varied between 14 (1989) and 35 (2004).

Data on grouse populations

Since 1989 density estimates of grouse species were obtained from wildlife triangle censuses organized by Finnish Game Research Institute (Lindén et al. 1989). Census routes are triangles, with four kilometres long sides. A triangle is walked by three observers 20 m apart, and all grouse met in this transect line are counted. The following information is recorded: species, sex (Black Grouse and Capercaillie), number of lone females and those with a brood, and the number of juveniles. Each observation is plotted on a map. In the beginning, there were 10–12 triangles counted in my study area annually, but recently not more than 7–8. Grouse were counted by a similar line transect method also from the year 1963 to 1988, but in that period the transects were walked along the most suitable habitats for broods of grouse (Rajala 1974). Wildlife triangles give more representative densities for the landscape in general, but the older route censuses indicate more optimal habitats. However, there seems to be no abrupt shift in density estimates between route and triangle censuses (see Lindén et al. 1989).

Statistical analysis

For prey data I calculated percentage of each prey species or species group in a sample. I further calculated the mean of all samples from each year to have an annual average estimate of each species. For grouse I also used the number of grouse species found per sample, and calculated annual estimates for them as described above. This parameter measured the functional response.

For Goshawk nest data I defined occupancy rate as the number of territories occupied per number of territories checked. The number of fledglings per occupied territory (Steenhof 1987) indicated breeding productivity. Index for the numerical response of the Goshawk can be defined as 2 x occupancy rate (=number of parents) + productivity (=number of young). I further calculated an index for the total response by multiplying both response types (functional response x numerical response). Preference index for the different grouse species was calculated by dividing the relative proportion of each grouse species in the diet by the relative density of the species in the field. This so called catch per supply ratio results as 1.0 when a prey species is consumed in the same proportion as predicted by its abundance alone.

I used regression analysis to analyse trends in the time series, and cross correlation analysis for making pair-wise tests with different time-lags between the grouse data and the Goshawk parameters. Before running cross correlation analysis I removed trends from time series by residual techniques. For testing whether Goshawks preferred any of the grouse species when hunting, I used one-sample t-test.

RESULTS

Seasonal diet composition

Grouse species account for more than 50% of the diet during spring but drop till about 30% during summer. Their proportion increases again up to ca. 40% during the fledging period (fig. 1). In winter the percentage of grouses tends to be lower than during the breeding season. Proportion of mammals is less than 20% during the breeding season, but it increases up to almost 50% outside the breeding season. In addition to grouse, only ducks and corvids are important during the breeding season. Corvids are especially important prey during the nestling period.

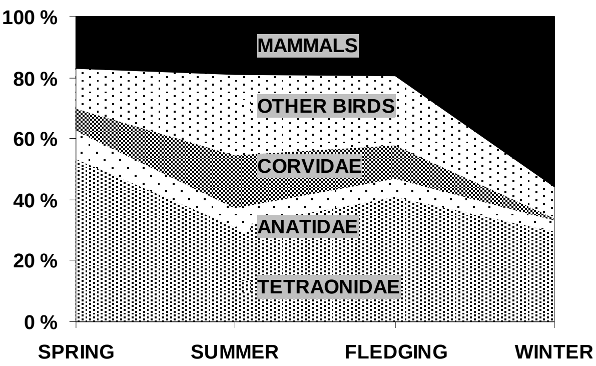

Figure 1. Seasonal change in the diet of the Goshawk near Oulu during 1989–2003.

The Black Grouse is the most important prey, accounting for 15–20% of the Goshawk's diet throughout the year (fig. 2). The Hazel Grouse and the Willow Grouse are numerous during spring, but their proportion tends to decline strongly during the breeding season. In winter, Hazel Grouse are relatively important prey for Goshawks. Capercaillies, of which only females are found in the diet during the breeding season, are rarely taken by the Goshawks. Capercaillie cocks are found in the diet only outside the breeding season. Only female Goshawks kill full-grown Capercaillie cocks.

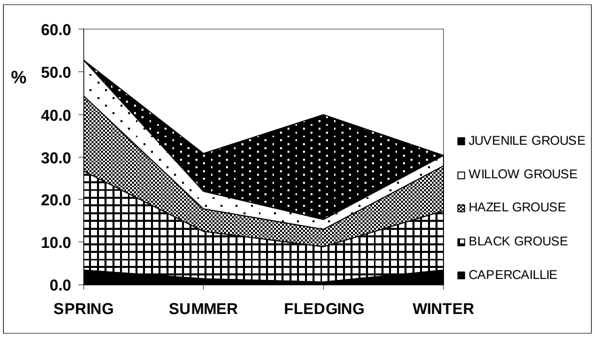

Figure 2. Seasonal change of grouse species in the diet of the Goshawk near Oulu during 1989–2003.

Goshawk's preference for different grouse species

Goshawks clearly prefer Willow Grouse over other grouse species as their prey in spring (t = 3.725, df = 32, p = 0.001, one-sample t-test). The Black Grouse and the Hazel Grouse are consumed roughly at the same ratio as found in the field, but Capercaillie females are taken in considerably lower proportion than available (t = –7.653, p < 0.001) (fig. 3). There was a slight increase in the preference for Black Grouse and Capercaillie females during the study years.

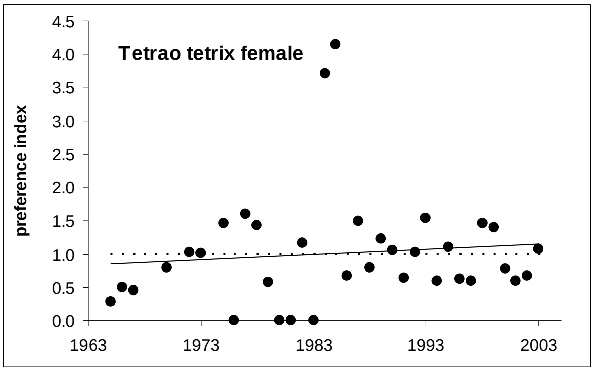

Figure 3. The change of the Goshawk's preference for Black Grouse females during the breeding season near Oulu in 1965–2003. Each dot represents a catch–supply ratio (proportion of prey in the diet per proportion in the field) of one year. Prey is preferred when dot is above the dashed line (ratio =1).

Goshawk's functional response for grouse density

The number of grouse killed by the Goshawk follows fairly well both the annual changes as well as the long-term trends of grouse populations in the field (fig. 4). After removal of the trends, cross-correlation analysis revealed that best correlation was obtained with 1-year lag, i.e. when comparing the number of killed grouse to the grouse density of the previous year (r = 0.410, p < 0.05). When the number of killed grouse is plotted against the density of grouse of the previous autumn, a functional response curve is obtained. Best fit was obtained for logarithmic function (F = 21.62, df = 30, r^2 = 0.429, p < 0.001) (fig. 5).

Goshawk's numerical and total responses related to grouse density

Goshawk's occupancy rate, productivity and combination of these two declined at the same rate as the grouse density (fig. 6). The clutch size declined slightly, but the brood size remained stable. I correlated all these variables with grouse density with different time lags after removal of the trends. Of these variables only the clutch and brood sizes correlated significantly with grouse density with a one year time lag (r = 0.566 and r = 0.526, p < 0.05, respectively). Total response correlated best with 2-year time lag but correlation was not significant (r = 0.376, n.s.). During the 1990's (1990–1999), however, correlation was close to significant (r = 0.631 vs. confidence limit = 0.708) (fig. 7).

DISCUSSION

Grouse typically dominate in the diet of Goshawks in boreal forests in spring (Sulkava 1964, Höglund 1964, Lindén & Wikman 1983, Widen 1987, Tornberg 1997). It must be remembered that spring diet consists prey specimens predated by males only. It, hence, cannot be considered representative for the diet selection of the whole population. In the Goshawk, having a marked sexual dimorphism, sexes differ remarkably in prey choice (Kenward et al. 1981, Tornberg & Colpaert 2001). Small grouse species, the Willow Grouse and the Hazel Grouse, dominate in early spring, but the bigger Black Grouse become more important during the breeding season (Tornberg 1997). Especially Black Grouse hens become most important during the nestling period, while importance of the cocks vanishes, likely due to the end of lekking period, which follows increasing difficulties to find them.

The decline of the proportion of grouse species in the diet of the Goshawk during the breeding season is clearly due to the increase in numbers of young birds, mainly thrushes and corvids, which are easier to hunt (Lindén & Wikman 1983, Tornberg 1997). Grouse chicks become more important prey towards late summer, when they grow and become more profitable as prey (Tornberg 1997). Young of large grouse species seem to be more preferred than smaller ones (Sulkava 1964, Reif et al. 2004b). It is likely that predation on young grouse remains at the same level later in autumn as observed in August. When females start to hunt in the late nestling period, they likely hunt similar prey as males (Gronnesby & Nygård 2000, Reif & Tornberg unpubl.). Later in autumn, however, females start to kill full-grown hares, and they also take more Capercaillies, even adult cocks (Tornberg & Colpaert 2001).

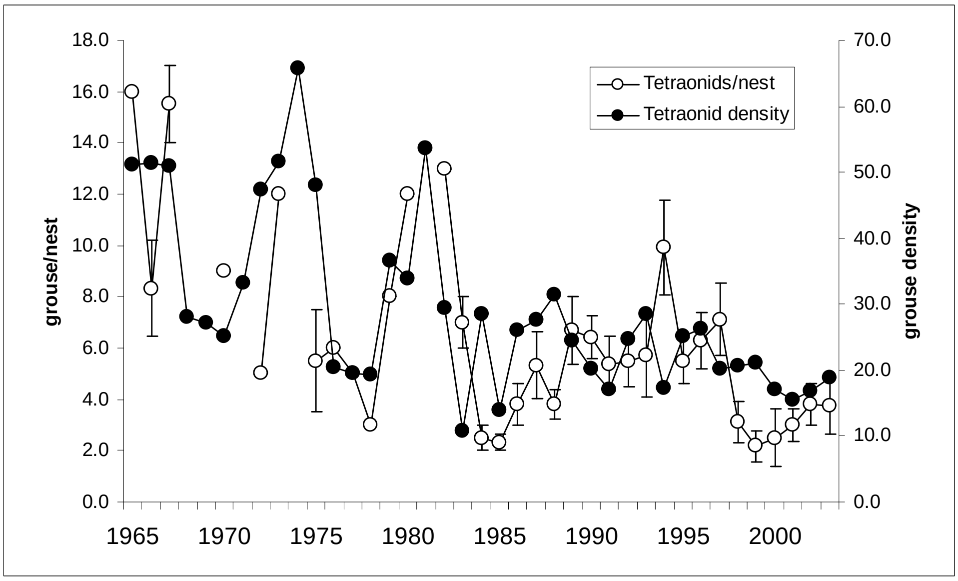

Figure 4. The mean annual number, with standard error of mean, of grouse specimens found in the nests, and the total density of grouses near Oulu during 1965–2003.

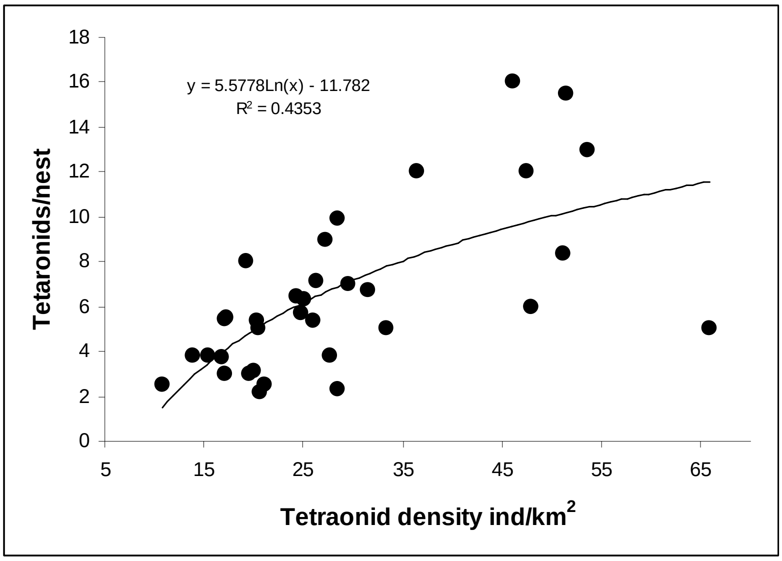

Figure 5. The mean annual number of grouses found as prey of the Goshawk plotted against the total density of grouses (individuals/km^2) near Oulu during 1965–2003.

Hares can account up to 30% of diet by number, and 70% by weight, in winter, but they are killed only by female Goshawks. Therefore, the proportion of grouse in the diet of males is somewhat higher than in that of females (about 40%, Tornberg unpubl.). When squirrels are abundant, they form an important winter food for both sexes (Widén 1987). In boreal forests of North America, Goshawks hunt mainly on mammals, especially snowshoe hares *Lepus americana* (Doyle & Smith 2001).

Goshawk's preferences for different grouse species show interesting patterns. Willow Grouses are strongly favoured as a prey while Capercaillie females are taken remarkably less than expected by their abundance in the field. Tornberg & Sulkava (1991) found that preference of the Willow Grouse population declined during the 1980s in my study area. New data show that this species is taken with as high a rate as previously. Reasons for this probably lie in the high vulnerability of the Willow Grouse to Goshawk´s predation during the lekking period. Willow Grouse males are white and noisy in spring, which inevitably makes it easier for the Goshawk to hunt them compared with other grouse. Avoidance of Capercaillie females might be due to their relatively large size for hunting by male Goshawks.

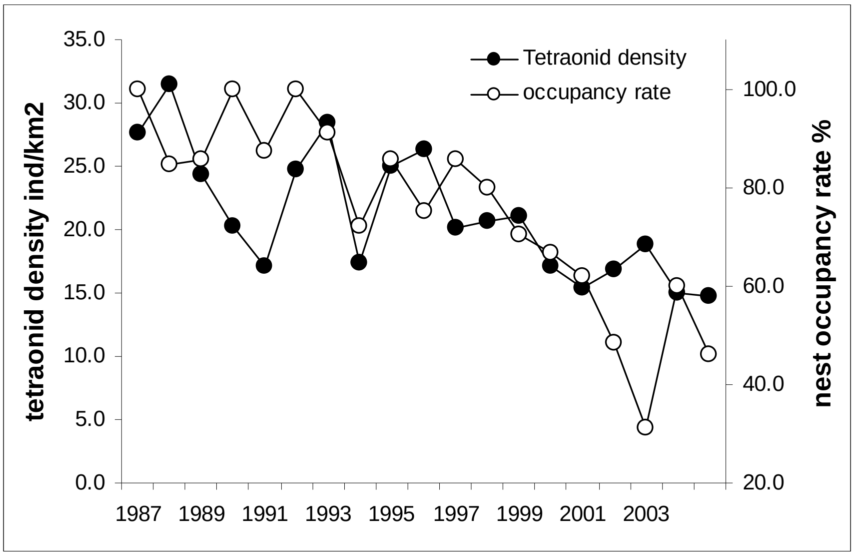

Figure 6. The occupancy rate of Goshawk territories and the grouse density near Oulu during 1987–2005.

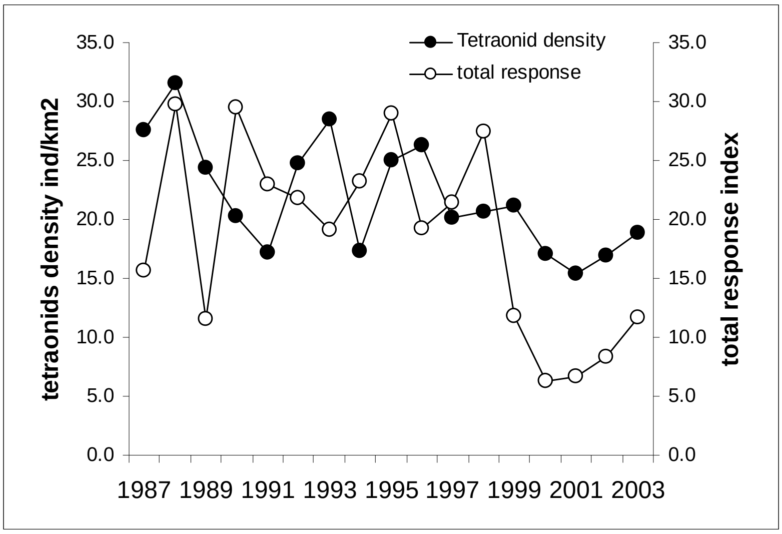

Figure 7. Total response of the Goshawks and the grouse density near Oulu during 1987–2005.

In comparison, the preferences of the Golden Eagle *Aquila chrysaetos* for grouse species are strongly related to the size of prey. Capercaillie females are taken twice more often than they are found in the field, respectively. However, Willow Grouse are more preferred than Black Grouse hens (Sulkava et al. 2003). In the Goshawk, size-related preference is not so clear, while the males tend to take relatively less Black Grouse cocks than hens during winter (Tornberg unpubl.). Similar pattern has been observed in relation to sexes of Pheasants *Phasianus colchicus* (Kenward et al. 1981).

The number of grouse in Goshawk's diet followed in accordance the density of grouse. My response variable, grouse remains found per nesting site, is independent of other prey species taken (in opposite to percentages that depend on the number of other prey). Therefore measuring response in this way might indicate more reliably the true response percentages than percentages that have been used in most other studies. Shape of the functional response curve obtained was concave, when diet variable was plotted against grouse density. Tornberg & Sulkava (1991) observed a similar pattern when using grouse proportions as a dependent variable. In North America, Goshawks responded in a similar way for snowshoe hares (Doyle & Smith 2001). Lindén & Wikman (1983) observed, however, a convex shaped curve for the Hazel Grouse. Generally, a concave curve (type 2) refers to a generalist predator that has a strong preference for main prey (Kenward 1986). This sort of predation possesses inherently a destabilising effect on prey (Begon et al. 1996). Predator having a convex shaped functional response curve (type 3) possesses an ability to regulate prey population at low density. It indicates also that prey has a refuge at low density, as might be the case for Hazel Grouse–Goshawk interaction (Lindén & Wikman 1983), or alternative prey is richly available. This is a very likely explanation for type 3 response curve in southern boreal forests. More northern areas, where alternative prey is less available, type 2 curve is expected. In areas where alternative prey is very scarce, functional response may be lacking, because Goshawks cannot breed at all when grouse are scarce. Functional response may also be lacking if grouse are abundantly available, as was the case in Finland during the 1960s and 1970s with high grouse densities (Kauko Huhtala, unpubl. data). Icelandic Gyrfalcons *Falco rusticolus* which are very dependent on Ptarmigans *Lagopus mutus* during breeding season showed no functional response for changes in the density of prey (Nielsen 1999).

Dependence of Goshawk's breeding success on grouses has been shown in many studies in Finland (Huhtala & Sulkava 1981, Tornberg & Sulkava 1991, Sulkava et al. 1994, Tornberg 2001, Byholm et al. 2002, Tornberg et al. 2005), and in Norway (Selås 1997, 1998, Gundersen et al. 2004). Time lag of 0.5–1 year after grouse population cycles is typical in clutch and brood sizes of Goshawks (Sulkava et al. 1994, Tornberg 2001, this study). In North America, Goshawks lag one year after snowshoe hare peak expressed as sightings and productivity (Doyle & Smith 1994, 2001). Tornberg et al. (2005) observed that Goshawk's occupancy rate lagged two years after grouse peak in western Finland. A similar tendency in total response was also observed in the present study but, likely due to relatively weak cyclicity of grouse population during the study years, this phenomenon remained obscure. These studies show that Goshawks might have a strong destabilizing effect on grouse populations, which raises Goshawk predation as one candidate for grouse cycles in northern latitudes. Because cyclicity in Finnish grouse populations has practically ceased, the idea could be tested only in large intact areas of Russian taiga forests, where cyclicity might still be going on in grouse populations (see Beskariev et al. 1994, but see Bortcevski 1993).

Goshawk's important role in grouse mortality is proved in many grouse studies (e.g. Angelstam 1984, Willebrand 1988, Wegge et al. 1990, Bortchevski 1993, Valkeajärvi & Ijäs 1994). Based on several studies, predation impact on different grouse species by breeding Goshawks has varied from 2 to 20% (Lindén & Wikman 1983, Widén 1987, Tornberg 2001). Goshawk's percentage of annual mortality was estimated from 5% (in Capercaillie) up to 60% (Willow Grouse) in northern Finland (Tornberg 2001). In western Russian taiga forest, Goshawks were responsible for 70–90% of annual mortality of Capercaillies (Bortchevski 1993). It is likely that in intact taiga forest Capercaillies are Goshawk's most important prey species because Black Grouse and Hazel Grouse are relatively scarce there, as well as important winter prey animals, hares and squirrels (Bortchevski 1993).

In the future, densities and food habits of the Goshawk should be studied in large intact areas of Russian middle and north boreal forests, from where there are practically no data at present. This might give important insight to the dynamics of grouse species in natural conditions.

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A REVIEW OF RARE DIURNAL RAPTOR SPECIES BREEDING IN KARELIA

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A description of the present status of populations of 12 diurnal raptor species listed in the national and regional Red Data Books and breeding in Karelia is provided, including data on their distribution and abundance. Maps of distribution of rare raptors in Karelia and adjacent areas are supplied. The situation is the most strenuous for the Spotted Eagle, Peregrine Falcon and Golden Eagle (8, 10 and 36 pairs). The Short-toed Eagle and Red-footed Falcon in the region are at the limit of the distribution ranges; the Pallid Harrier is an accidental breeder in Karelia. The populations of the rest of raptors are either relatively stable or increasing in the long term (White-tailed Sea Eagle, Osprey and partly Merlin).

Key words: diurnal raptor species, Karelia, rare species.

ОБЗОР РЕДКИХ ВИДОВ ДНЕВНЫХ ХИЩНЫХ ПТИЦ, ГНЕЗДЯЩИХСЯ В КАРЕЛИИ. Зимин В.Б., Сазонов С.В., Лапшин Н.В., Артемьев А.В., Медведев Н.В., Хохлова Т.Ю., Яковлева М.В. *Институт биологии КарНЦ РАН, Институт леса КарНЦ РАН, Заповедник «Кивач», Карелия, Россия.*

Охарактеризовано современное состояние популяций 12 видов дневных хищных птиц, занесенных в российскую и региональные Красные книги и гнездящихся в Карелии. Приводятся сведения по их размещению и численности. Даны карты распространения редких хищных птиц в Карелии и на сопредельных территориях. В наиболее неблагополучном положении находятся большой подорлик, сапсан и беркут (8, 10 и 36 пар). Змееяд и кобчик встречаются в регионе у границ ареалов, степной лунь эпизодически гнездится в Карелии. Население остальных хищных птиц сравнительно стабильно в многолетнем плане или отмечается рост численности ряда видов (орлан-белохвост, скопа и отчасти дербник).

Ключевые слова: дневные хищные птицы, Карелия, редкие виды.

In Karelia there annually breed 9 species of diurnal raptors listed in Red Data Books of Russia, Karelia and East Fennoscandia: the Golden Eagle, Spotted Eagle, Hen Harrier, White-tailed Sea Eagle, Black Kite, Osprey, Kestrel, Peregrine Falcon and Merlin. Accidental breeding of three more red-listed species – the Short-toed Eagle, Pallid Harrier and Red-footed Falcon – is presumed, but not yet confirmed by nest or brood finds. Some data on the abundance and distribution of red-listed raptors in 1991 can be found in the review "Bird fauna of Karelia" and in the Red Data Book of Karelia (Zimin et al. 1993, 1995). The present review summarizes data on the distribution and abundance of rare diurnal raptors, including those collected during inventories carried out in 1992–2005 in Karelia and adjacent districts of the Arkhangelsk and Vologda regions. Distributions of individual raptor species are described using dot maps based on the network of ornithological landscape districts of Karelia substantiated in detail elsewhere (Sazonov 2004).

Short-toed Eagle *Circaetus gallicus*. The species belongs to the avifauna pertinent to European broadleaved forests. Registered irregularly from SE Lake Ladoga area, which is the northernmost point of the species range in European Russia.

Known registrations of the Short-toed Eagle in spring and summer are mostly limited to the Olonets federal zoological reserve. In the second half of April 1975 one individual was sighted three times, once at the Segezhskoye mire edge near the border with the Leningrad region. In mid-June 1996 a single individual, tentatively identified as one of the species, was seen on a forested islet amidst the Segezhskoye mire, nearby a newly built nest of a large raptor on a pine tree.

In June and July of 1997–1999, several times lone birds and once a pair of the Short-toed Eagle were seen around the village of Sarmyagi, by the northern boundary of the Olonets nature reserve. One of the birds was carrying prey (a snake) southwards, towards the Verkhneropakskoye mire.

Most probably one or two pairs of Short-toed Eagles nest in the Olonets federal zoological reserve area, at least in some seasons with a hot and dry summer. One should note also that SE Lake Ladoga area, alongside with the Zaonezhje Peninsula, is one of the few districts in Karelia with high species diversity and population density of reptiles.

Golden Eagle *Aquila chrysaetos*. The species is azonal for flatland taiga, representing the fauna of northern Palaearctic mountains. It was initially related to piedmont steppe and semi-open montane forest landscapes, from where it spread widely to flatland taiga regions. Being a eurytopic species, the Golden Eagle requires extensive open spaces in its hunting grounds. In flatland taiga, such are heavily paludified areas with forest and mire complexes, shore areas of large water-bodies with semi-open habitats, as well as large-scale harvested and burnt areas. Furthermore, the Golden Eagle needs large trees with a branched crown and flattened top for its nests, and thus tends to settle in high old-growth forests.

A clearly distinguishable tendency now already is concentration of breeding Golden Eagles around the largest protected areas (PAs) of Karelia and western Arkhangelsk region – Kostomukshsky strict nature reserve, Paanajärvi and Vodlozersky national parks, Kozhozersky nature park, etc. They offer a favourable combination of several factors: active logging is underway along their periphery providing extensive supply of freshly harvested areas, whereas old-growth forests within PAs provide shelter from human persecution and disturbance, as well as optimal conditions for construction of the species' massive nests. This tendency for the birds' immigration to PAs is sure to gain momentum in the future, as resources of mature coniferous forests in intensively harvested areas get exhausted.

In cohabitation areas, the Golden Eagle and the White-tailed Sea Eagle compete for nest areas, the latter, as a larger and more aggressive bird, forcing the former out. In areas with a high density of the White-tailed Sea Eagle population, Golden Eagles have to settle in drainage divides, in heavily paludified remote localities far away from large water-bodies (Sazonov et al. 2001).

The present Golden Eagle abundance in Karelia is estimated at 36 pairs, of which 21 are found in northern taiga and 15 in middle taiga (fig. 1). Five Golden Eagle pairs breed in the Paanajärvi national park (0.5 pairs per 100 km^2). Eleven Golden Eagle pairs live in the Vodlozersky national park and the neighbouring Kozhozersky nature park, situated in Karelia and western Arkhangelsk region and forming an integral Vodlozero–Kozhozero taiga reserve with an area of 670,000 ha (Sazonov 2005). Fifteen pairs are known from the Vodlozero–Kozhozero reserve area including its immediate surroundings (0.2 pairs per 100 km^2).

All registrations from Karelia and western Arkhangelsk region include 21 occupied Golden Eagle nests, of which 11 were located on pine trees (two on dead standing trees) and 10 on top and middle platforms of triangulation towers. Two of the nests at triangulation points fell together with the towers in 1998–2002: one in the Karelian part of the Vodlozersky park, the other one in the Plesetsky game reserve (Arkhangelsk region). Another nest which the Golden Eagle had used for several years collapsed from a tower in the upstream of River Vyg, at the border between Karelia and Arkhangelsk region in March 2005.

Golden Eagle nests on triangulation towers have been found also in other taiga regions, e.g. in the Pechora river drainage area and Northern Urals area (Neufeld 1989). Frequent settlement on triangulation towers is a feature distinguishing the Golden Eagle from other raptors. This way of nesting is, on the one hand, induced by a deficit of old large trees with a well developed crown in felled forest areas. On the other hand, it reflects the species' preference for triangulation towers, which are situated in drainage divides and on dominant elevations, and provide the birds with a good panoramic view and control over the surroundings. Because of prolonged lack of maintenance and collapse of the towers (in addition to the ones mentioned above, a case is known when a tower with a Raven *Corvus corax* nest fell down), the Golden Eagle loses convenient nesting facilities, which is another motive for them to move from felled areas to old-growth forests surviving mostly in PAs.

Total Golden Eagle abundance in Northwest Russia is estimated at ca. 60 pairs: 36 pairs in Karelia, 10 in western Arkhangelsk region, including Onega river drainage basin and the Onega Peninsula, at least 10 in the Murmansk region, 3 pairs in the Leningrad region (Pchelintsev 2001, Red Data Book of the Murmansk Region 2003, Sazonov 2004, Red Data Book… 1998). The breeding grouping of the Vodlozero–Kozhozero reserve and its immediate surroundings (15 pairs) makes up about a fourth of the species numbers in the taiga regions of Northwest Russia. At the moment, it is the largest among those known from flatland taiga of European Russia.

Spotted Eagle *Aquila clanga*. A Palaearctic forest species; prefers flatland forest areas. Over several past decades, the Spotted Eagle abundance has been declining heavily throughout. It is listed in Red Data Books of Russia and Europe, and in the International Red Data Book. In taiga regions of northern Europe the species demonstrates distinct southeastern affiliations. Marginal population close to the western limit of the distribution range has become one of the basic reasons for the Spotted Eagle's disappearance from Finland already after 1975 (Red Data Book … 1998). The Spotted Eagle differs from the Golden Eagle in the choice of habitats and nests mostly in very wet forests situated in low river floodplains and heavily paludified drainage divides.

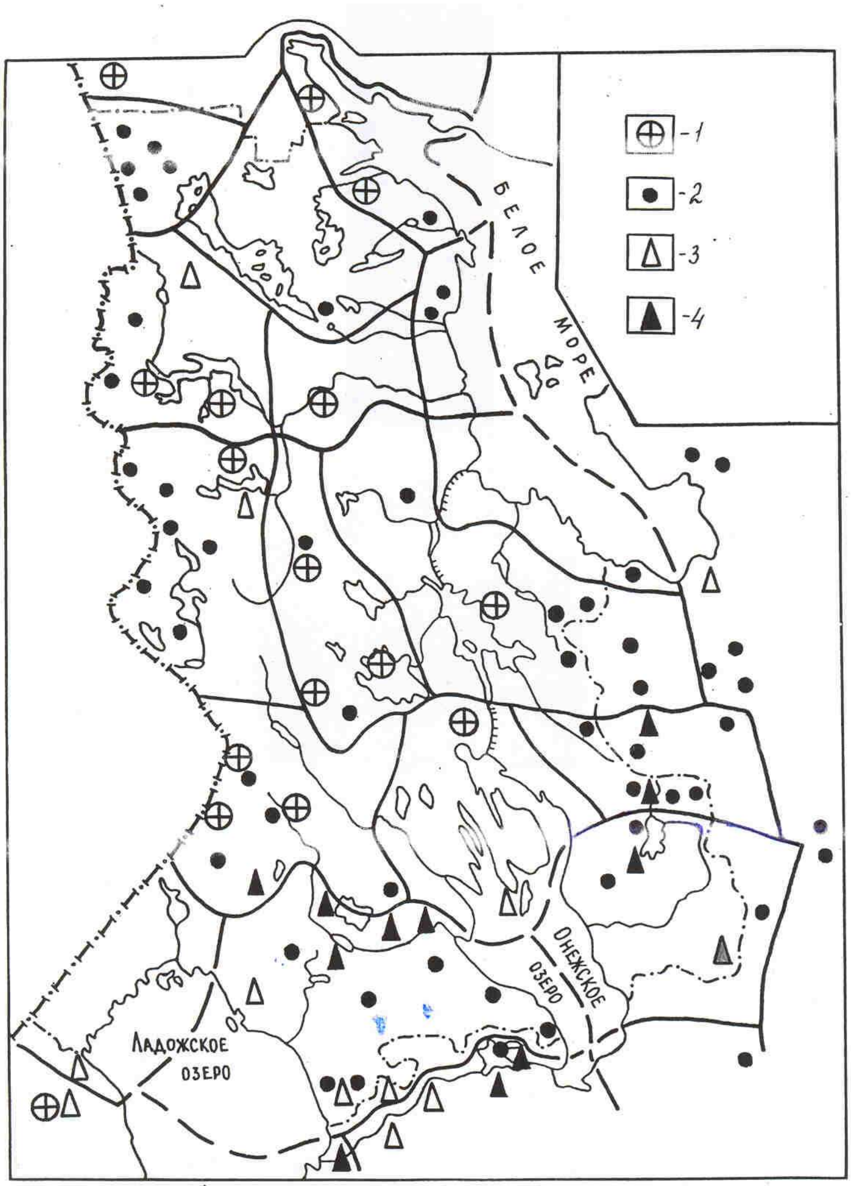

Figure 1. Distribution of the Golden Eagle *Aquila chrysaetos* and Spotted Eagle *A. clanga* in Karelia and adjacent areas.
1, 2 – Golden Eagle sightings in the past (before 1960) and recently; 3, 4 – the same for the Spotted Eagle.

In the mid-20th century, the Spotted Eagle was much more widespread than today. It was, for instance, a few times observed in northern taiga of Karelia and adjacent regions. In June 1941, one individual was killed near the village of Kholmogory, Arkhangelsk region (Parovshchikov, cited after Birds of the Soviet Union 1951, Vol. I). In the summer of 1941, a Spotted Eagle nest on a pine tree was found in the Kananainen village area, south of the contact point of Lakes Pyaozero and Topozero in Karelia (65°45' N, 31°21' E); on July 30 the nest contained two large fledglings (Lehtonen 1942). This nest is the northernmost find of all known previously in European Russia. In early July 1950, a single Spotted Eagle was seen by the southern shore of Lake Nyuk (Zimin et al. 1993). In the 1970s, the species was registered only once, from the lower reaches of River Onega late in August (Korneeva et al. 1984).

Since the 1980s, the Spotted Eagle has been registered as a very rare breeder only from middle- and southern taiga of Karelia and adjacent regions (fig. 1). While in the 1970s the breeding population in the Leningrad region was 18–20 pairs, in the 1990s it fell to just 10 pairs (Malchevskiy & Pukinskiy 1983, Pchelintsev 2001).

The present Spotted Eagle abundance in Karelia is estimated at 7–8 pairs. Most registrations in the breeding season come from the Shuja River watershed, which is heavily paludified and contains many extensive open mires – it is estimated that 5 pairs of the Spotted Eagle breed there. A Spotted Eagle brood was seen on the left bank of River Shuja, in the Padozero forestry unit, west of Petrozavodsk on 5 August 1988: two young poorly flying birds stayed at the edge of a large partially drained transitional mire.

Another two or three Spotted Eagle pairs are presumed to live in Lake Vodlozero area, as well as in the Kolodozero locality in the SE corner of the Pudozh district. Breeding of the Spotted Eagle known from Ileksa River middle reaches in the Arkhangelsk part of the Vodlozersky national park in 1981–1988 may still be taking place (Borshchevskiy 1991). The only registration of the species from northern taiga of Karelia during the latest period is an observation of a lone individual in a fen by the White Sea coast opposite to the Syrovatka Island, north of the Pon'goma village and Von'ga river mouth on 3 August 1991.

Hen Harrier *Circus cyaneus*. The species is azonal for taiga, and has a distinct northern distribution. Being a species of open habitats, the Hen Harrier clearly avoids drainage divide forests with dense closed-canopy stands. Its breeding population in taiga regions is split into two relatively independent subpopulations located at the northern and southern margins of taiga.

The southern, or agrarian subpopulation is concentrated in the middle- and southern taiga subzones, i.e. in areas most widely covered by human activities, where it breeds mostly in extensive farmland. The northern, or pre-tundra subpopulation lives in high latitudes, in open forest-tundra or southern dwarf shrub tundra habitats. The subpopulations are separated by taiga regions very little used in agriculture and with very thin Hen Harrier density. The species penetrates deeper into the northern and middle taiga, especially on drainage divides owing to clear-cutting, which generates a rich supply of freshly harvested areas and open-canopy young stands. An exception in a way is part of the southern White Sea area – from the town of Belomorsk and the village of Vir'ma to the town of Onega, where the Hen Harrier is quite common. Even there, however, it settles almost exclusively in the belt of semi-open habitats along the seacoast, where natural coastal meadows and reed-dominated fens are plentiful.

This pattern of the Hen Harrier distribution is strongly influenced by its nomadism – a close relationship between the distribution and abundance of the species and reproductive outbreaks of small rodents. Thus, the species' population density in southern Karelia, in Shuja fields near Petrozavodsk, varies depending on the abundance of small rodents, from 3 to 10 pairs per 3000 ha of farmland. Fluctuations of the Hen Harrier abundance in northern Finland are even wider, reaching 4-fold or even 18-fold levels (Saurola 1985).

Other nomadic species alongside with the Hen Harrier are the Rough-legged Buzzard *Buteo lagopus*, Kestrel *Falco tinnunculus* and many *Strigidae* – especially the Short-eared, Hawk and Long-eared Owls *Asio flammeus, Surnia olula* and *Asio otus*, as well as partially Tengmalm's and Great Grey Owls *Aegolius funereus* and *Strix nebulosa* (Saurola 1985). The taiga zone breeding distributionn of a species like the Kestrel largely resembles that of the Hen Harrier. In contrast to the latter, the Kestrel reaches into alpine tundra areas and sea archipelagoes, but it does not spread widely across flatland forest-tundra or, even more so, southern dwarf shrub tundra.

The bulk of the Hen Harrier population in Karelia concentrates in the farmland in the south of the republic, its preferred habitats being extensive areas of modern agricultural landscape with large meadows and arable fields (fig. 2). Meanwhile, there are hardly any breeding Hen Harriers in Finnish farming areas at the Karelian Isthmus and South Karelia latitudes (Hyytiä et al. 1983, Saurola 1985). This is apparently related to characteristics of the agricultural landscapes and excessive intensity of agriculture in the country: drainage is mostly managed with subsurface systems resulting in the loss of the landscape diversity; fields in ridge- and cliff-dominated landscapes often get "overdrained"; crop rotation is very intensive and sward establishment in ploughed fields is minimal.

The present Hen Harrier population in Karelia is estimated at ca. 200 pairs, with among-year variations from 100 to 300 pairs. Population in middle taiga is 130–150 pairs, in northern taiga – 30–50 pairs. In addition to farmland, the Hen Harrier settles in felled areas and young open-canopy stands (about a fourth of the population). In the southern White Sea area the species nests also in coastal meadows and reed-dominated fens.

In most protected areas, where primary taiga dominates, the Hen Harrier is rare. E.g., its abundance in the Vodlozero–Kozhozero reserve is estimated at 10–30 pairs, of which 7–20 nest in the Vodlozersky park and 3–10 pairs in the Kozhozersky park (Sazonov 2005). The species breeds most regularly in farmland (ca. 10 pairs), whereas its breeding in overgrowing felled and abandoned areas within PAs or in felled areas along the reserve border has been observed only in years with high rodent abundance, and it is limited to the earliest stages in the forest ecosystem succession before closed-canopy young stands develop there.

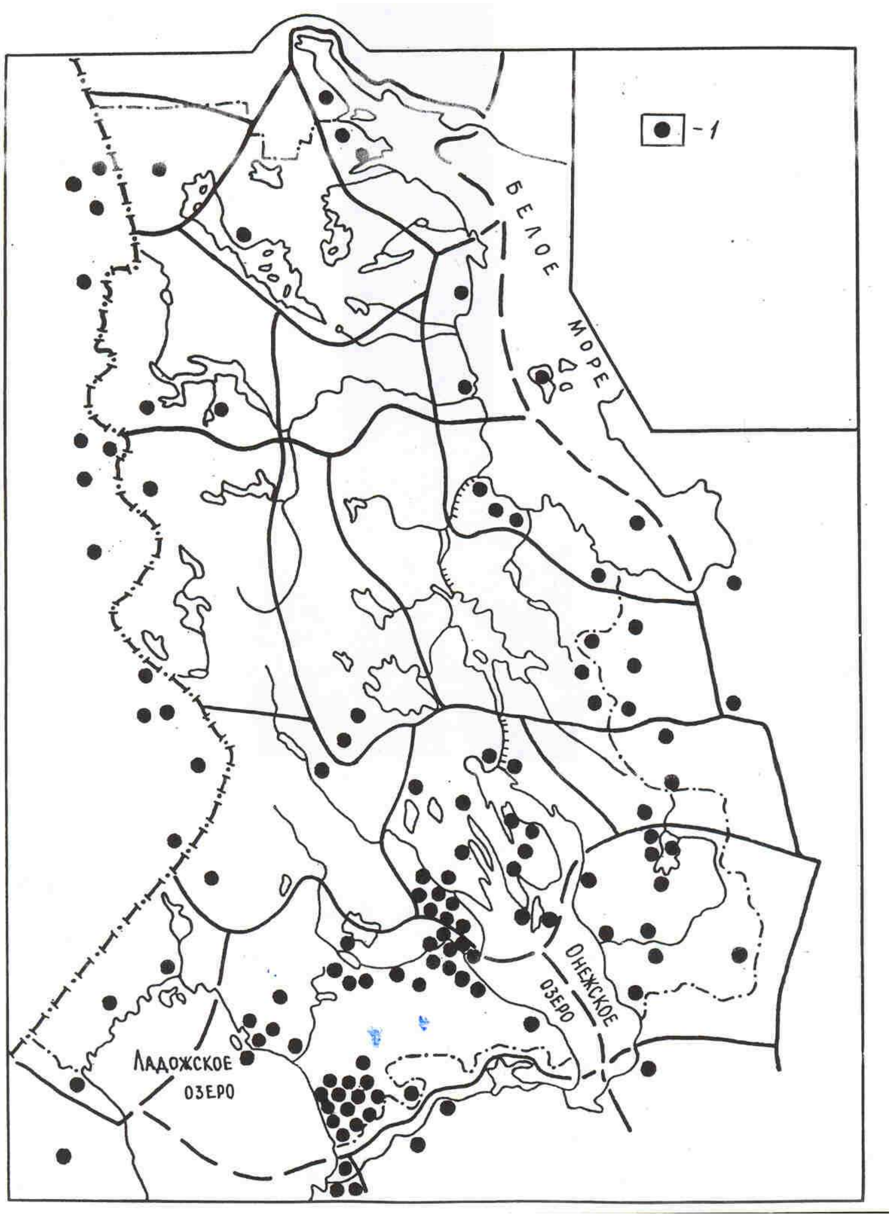

Figure 2. Distribution of the Hen Harrier *Circus cyaneus* in Karelia and adjacent areas.
1 – sightings in the breeding season, recent data.

Pallid Harrier *Circus macrourus.* A representative of the semiarid fauna, a native of dry steppes of SW Asia. The species irregularly appears in northern plains of eastern and western Europe, including the taiga zone (Formozov 1959). Its breeding was episodically registered in the Leningrad region in the late 19th – mid-20th centuries: 1897, 1913, 1935, and 1952–1953 (Malchevskiy & Pukinskiy 1981). In the summer of 1931, a Pallid Harrier was taken from the Tundra station, 40 km south of Arkhangelsk (Parovshchikov 1941).

In Karelia, the Pallid Harrier appeared in 1995–1999 in farmland in the Olonets plain (Zimin et al. 1997, 2000). In early May 1999 and mid-April 2002, Pallid Harrier males were seen in Shuja fields near Petrozavodsk. The species is presumed to breed in the Olonets plain, at least in some years. Thus, on 10–17 May 1995, the birds were registered there a few times (three males and three females), and display flights of a male Pallid Harrier were observed several times in Sarmyagi village area, at the margin of the drained part of the Sarmyagi–Segezha mire (Zimin et al. 1997).

White-tailed Sea Eagle *Haliaeetus albicilla*. The species is azonal for taiga. In any geographic zone the species settles along large bodies of either fresh or salt water with high fish production. The present optimum of the species' distribution range, i.e. northern taiga regions of European Russia, is largely of secondary nature. It is the result of persecution of the Sea Eagle by humans in densely populated regions of central and southern Russia, which had been invariably heavy up to the 1960s–1970s.

Owing to well organized conservation of the species in its breeding and wintering grounds (first of all in the Baltic region) in the past 15 years, a tendency or recovery of the White-tailed Sea Eagle abundance has been going on in many regions of Russia and adjacent countries, including southern parts of the forest zone. Between 1990 and 2000, the Sea Eagle population in Finland increased from 80 to 130 pairs, in Karelia from 40 to 70 pairs, in the Leningrad region from 12 to 20 pairs, i.e. more than 1.5–fold (Malchevskiy & Pukinskiy 1983, Pchelintsev 2001, Sazonov 2004, Red Data Book … 1998). The constantly controlled Vodlozero population now numbers 23 pairs, and 3 more pairs breed in the immediate vicinity of the Vodlozersky park. In 1988–1989, there were 11–12 pairs registered from the Vodlozero area, in 1993 – 15–16 pairs, in 1998–2000 – 23–26 pairs (Sazonov et al. 2001). Equally significant was the rise in abundance in another region with optimal conditions for the species: the population in the Darwin reserve on Rybinsk reservoir increased from 10–12 pairs in 1988 to 22–24 pairs in 2000 and to 28–30 pairs in 2005 (Nemtsev 1988, Kuznetsov & Nemtsev 2005).

The White-tailed Sea Eagle abundance in Karelia is estimated at 80 pairs at present. If the habitats known previously or still undetected are taken into account, the Sea Eagle population may reach 85 pairs (fig. 3). Its largest concentrations are situated in Lake Vodlozero area and on the Karelian part of the White Sea coast (16 pairs).

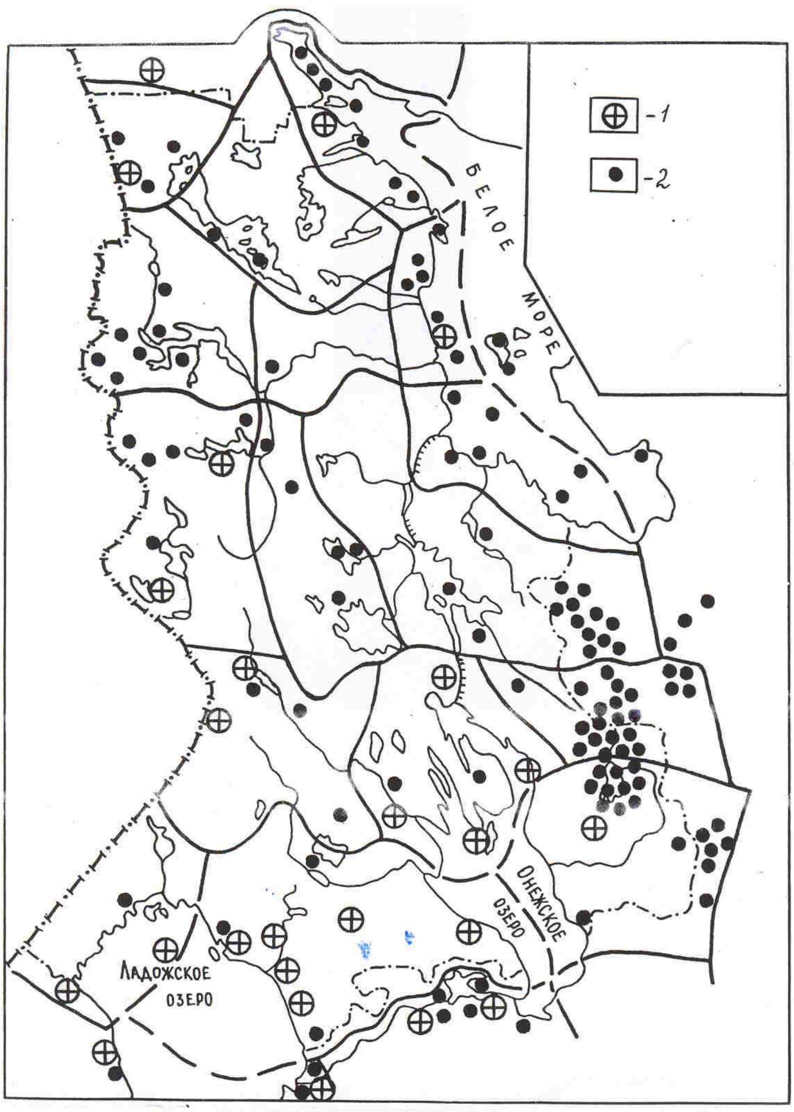

Figure 3. Distribution of the White-tailed Sea Eagle *Haliaeetus albicilla* in Karelia and adjacent areas.
1 – sightings in the breeding season in the past (before 1960), 2 – the same recently.

In the Vodlozersky national park, breeding of 46 White-tailed Sea Eagle pairs was recorded, 20 of them on the Arkhangelsk side of the region. At least 5 Sea Eagle pairs nest in the Kozhozersky park. Two more pairs live north of the park, in the middle reaches of River Kozha (Sazonov 2005). The species' population density is 2 pairs per 100 km^2 including waters in the Vodlozero area, 0.6 pairs in the Ileksa river watershed, 0.25 pairs in the Kozhozersky park.

A total of 56 occupied White-tailed Sea Eagle nests have been found through all years of studies in Karelia and the Arkhangelsk region. Of these, 52 were situated on pine trees, 2 on aspen trees (Vodlozero), and 2 on triangulation towers (White Sea, Kozhozersky park). A case of the Sea Eagle nesting on a triangulation tower is known also along the middle reaches of River Kuloi, Arkhangelsk region (Rykova & Rykov 1989).

In 1995–1997, the Vodlozero population of the White-tailed Sea Eagle was studied by Högmander et al. (2001). Overall breeding success of the Sea Eagle in 1994–1997 was 1.8 young per a successful breeding attempt. According to ring recovery data, the nearest wintering grounds for Sea Eagles from the Vodlozero area are around the Baltic Sea. Of the 28 Sea Eagles ringed as nestlings, three were observed in the following years on Saaremaa Island (Estonia), on the Åland islands and in the mainland by the SE coast of Finland (Högmander et al. 2001).

The Vodlozero–Kozhozero taiga reserve hosts the largest breeding group of the White-tailed Sea Eagle in European Russia, estimated to be 51–53 pairs. Breeding population in the western White Sea area is estimated of 25–30 pairs, that around Rybinsk reservoir 30–35 pairs of Sea Eagles. Present-day abundance of the White-tailed Sea Eagle in NW Russia is estimated at 175 pairs: Kola Peninsula 35, Karelia 80, western Arkhangelsk region 40, and Leningrad region 20 pairs (Ganusevich 1988, Pleshak 2000, Pchelintsev 2001, Khokhlova et al. 2001, Red Data Book of the Murmansk Region 2003, Sazonov 2004, Red Data Book… 1998). Thus, ca. 30% of all White-tailed Sea Eagles in taiga regions of NW Russia concentrate in the Vodlozero–Kozhozero reserve.

Black Kite *Milvus migrans*. Represents the avifauna of broadleaved forests, typically lives in floodplain landscapes with a dense network of small lakes, oxbow lakes and fens. The birds prefer open river valleys and low shores of large lakes, including farmland habitats. The species has distinct southeasterly affiliations; its breeding range in East Fennoscandia is strongly asymmetric with a southeastward shift. Thus, the Black Kite is a very rare breeder in southern Karelia, in areas west of Lake Onego.

In western Arkhangelsk region, especially in its southern parts, the Black Kite is relatively common. The boundary of the species' continuous breeding range is much further north there than in Karelia (fig. 4). The northernmost confirmed breeding point is the south of the Onega Peninsula, around Lake Solozero, where a Black Kite nest with 2 eggs was found on 12 June 1966 (Butjev & Nikerov 1969). The species occurs along Onega River valley to its lower reaches, where it was registered early in August 1980 (Korneeva et al. 1984). In Severnaya Dvina floodplain the Black Kite nests up to the village of Kholmogory and in some years possibly near Arkhangelsk (Parovshchikov 1941, Butjev et al. 1999). At the same time, it is no more observed breeding in the Karelian part of the White Sea southern coast.

Present-day abundance of the Black Kite in Karelia is estimated at 80 pairs. About 60 pairs nest in southern Karelia, most of them (40) inhabiting areas east of Lake Onego. An isolated group numbering ca. 15 pairs lives around lakes Kamennoye and Verhnee Kuito in NW Karelia. Three to five more pairs live in an adjacent area of Finland, from the town of Kuhmo to the village of Suomussalmi (Hyytiä et al. 1983). In 1999, the Black Kite was registered during the breeding season in the Paanajärvi national park (A. Rajasärkkä, pers. comm.). Prior to that, in mid-July 1989, it was sighted twice in the Sofporog village area, at the meeting point of Lakes Pyaozero and Topozero (Sazonov 1997).

Very few cases of the Black Kite breeding in northern taiga of Karelia and Finland have been confirmed (Kuhmo), or its nesting there is presumed (Kostomuksha, Kuito, Pyaozero). Obviously, the birds in northern Karelia are predominantly single or pairs wandering widely around the territory or occupying permanent areas where food supply is rich. Thus, the northern boundary of the species' continuous breeding range runs from lower reaches of River Onega and upper reaches of River Ileksa across central Lake Onego and northern parts of the Ladoga–Onego isthmus, partially covering NW Ladoga region (Salmi, Kuznechnoye station in the Karelian Isthmus).

Total Black Kite abundance in the Vodlozersky national park is 19–21 pairs (11–12 in the Karelian part), in the Kozhozersky nature park – 8–10 pairs. Average species' population density around Lake Vodlozero is 1.3 pairs, in the Ileksa river watershed 0.3 pairs, in the Kozhozersky park 0.5 pairs per 100 km^2. Local density in the Karelian part of the Vodlozersky park is 3–4 pairs (Pilmasozero and Kuganavolok localities). Counts in SE Pudozh district in 1984 yielded a value of 3.5–4 pairs per 100 km^2.

A male Black Kite carrying prey to the nest was regularly observed in the Karelian part of the Vodlozersky national park, on River Ileksa close to the mouth of River Novguda in June–July 1994–1995. The pair probably occupied the former nest of a large raptor sitting on a pine tree at the edge of a mire. In June 1996, an occupied Black Kite nest was found on a pine tree by the SE shore of Lake Kelkozero, Pilmasozero locality of the park (Högmander et al. 1998). A nest on a pine tree, which had probably belonged to the Black Kite, is known from the Arkhangelsk part of the park, from Murojgora range SE of Lake Nyukhchozero. In 1992–1997, a pair of adult birds was seen there a few times. Since mid-August, as young birds leave the nest, the number of Black Kite registrations from River Ileksa watershed, Lake Kozhozero area increased notably (from 0.2–0.3 to 1–2 individuals per 100 km^2 – Borshchevskiy 1991, Sazonov 2005).

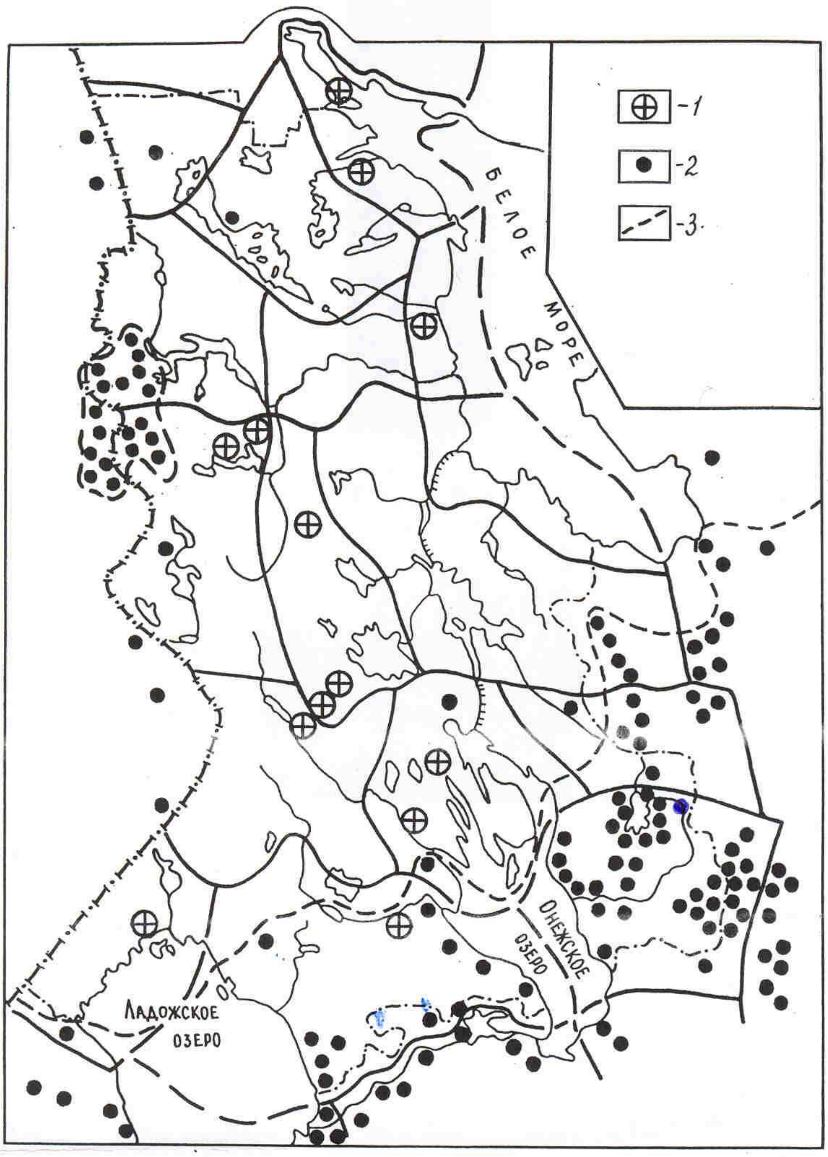

Figure 4. Distribution of the Black Kite *Milvus migrans* in Karelia and adjacent areas.
1 – sightings in the breeding season in the past (before 1960), 2 – the same recently,
3 – continuous breeding range.

Osprey *Pandion haliaetus*. The species is azonal for taiga. Like the White-tailed Sea Eagle, it lives around fresh- and saltwater bodies with high fish production. The Osprey may respond well to construction of hydraulic facilities: on Rybinsk reservoir, e.g., as extensive shallow areas became available, a dense Osprey population evolved since starting the late 1940s, and especially in the 1980s (Nemtsev 1988).

In the past 15 years, a tendency has been observed for a significant increase in Osprey abundance in many taiga regions. The population in Finland increased from 760 to 1000 pairs (Saurola 1990, Red Data Book … 1998). The Osprey population in the Darwin Reserve on Rybinsk reservoir doubled over the 1980s from 10–12 to 22–27 pairs (Nemtsev 1988). By 2005 there lived 40–45 Osprey pairs already (Kuznetsov & Nemtsev 2005). The number of known nest areas in Karelia increased in the 1990s from 75 to 130 (Sazonov et al. 2001). Leningrad region's largest breeding population of the Osprey was found in the southern Ladoga area, where it increased during 1995–2000 from 20 to 30 pairs (Vysotskiy 2000, Pchelintsev 2001).

The Osprey population in Lake Vodlozero area increased from 12–15 pairs in 1988–1989 to 20–25 pairs in 1998–2000. The abundance in River Ileksa watershed was 10–12 pairs in 1986–1988 (somewhat higher than in 1981–1985), the number in 1997–2000 remaining about the same (Borshchevksiy 1991, Sazonov et al. 2001).

It is estimated that 37–40 Osprey pairs live in the Vodlozersky national park (24–26 in its Karelian part), and 13–14 pairs in the Kozhozersky nature park. The species' population density is 1.9 pairs per 100 km^2 in Lake Vodlozero area, 0.4 pairs in Ileksa watershed, and 0.7 pairs in Kozhozersky park. Local counts yielded 3 pairs per 100 km^2 for the northern Vodlozero area, 2.5 pairs along Lake Kozhozero shore, and 2 pairs in the Shidmozero locality of the park.

In most operating and planned PAs in northern taiga of Karelia the Osprey population density is within 0.5–1.5 pairs per 100 km^2: Kostomukshsky strict nature reserve (0.8), Paanajärvi national park (0.6), planned national parks Kalevalsky (1.4), Tulos (1.6) and Pongomsky (1.1), and Soroksky integrated marine reserve (0.5). Osprey abundance in the western part of the White Sea, including the Onega Peninsula is estimated at 45–50 pairs, of which 30 pairs live in the Karelian part of the coast.

Where the conditions in middle taiga are optimal – high fish production in waters, low recreation pressure, availability of tall forest areas – there is capacity for high-density breeding of the Osprey even outside protected areas (1–2 pairs per 100 km^2). In 1996, an occupied Osprey nest was found in the Sortavala city surroundings in the midst of a densely populated area (summer cottage communities and farmland), on Lake Hympelänjärvi shore 3–4 km away from the village of Zaozernyi. On 28 April a female was incubating 2 eggs there (Klibanyuk, personal communication – one of the earliest clutches ever in Karelia).

The Osprey abundance in Karelia today is estimated at 250 pairs, the number of nest areas known by year 2005 being 165. The number of Ospreys nesting in northern and middle taiga is about the same, 110 and 140 pairs, respectively (fig. 5).

A total of 51 occupied nests of the Osprey have been detected in Karelian and western Arkhangelsk region in all years. Most of them (46) were located on pine trees (including dead standing trees), two nests on spruce trees (Paanajärvi), one on a dead standing aspen tree (Vodlozero), one on a larch tree (SE Pudozh district). In central Karelia, a nest was found also on the platform of a metal tower of a transmission line running near the village of Tiksha (Zimin et al. 1993). In Finland, Ospreys settle willingly on artificial nest platforms (up to 40% of nests found, Saurola 1990).

The Osprey breeding group inhabiting the Vodlozero–Kozhozero taiga reserve (50–54 pairs) is now one of the largest in the north of European Russia. It is comparable in size with the abundant Osprey population of the Rybinsk reservoir, estimated by different authors to comprise 40–50 to 55–60 pairs (Important bird areas of Russia 2000, Kuznetsov & Nemtsev 2005). The total number of the species in NW Russia is estimated at 410 pairs: Kola Peninsula 25, Karelia 250, western Arkhangelsk region at least 85, and Leningrad region ca. 50 pairs (Ganusevich 1988, Important bird areas of Russia 2000, Pleshak 2000, Pchelintsev 2001, Khokhlova et al. 2001, Red Data Book of the Murmansk Region 2003, Sazonov 2004, Red Data Book … 1998). Thus, over 10% of the Osprey population breeding in taiga regions of NW Russia concentrate in the Vodlozero–Kozhozero reserve.

Kestrel *Falco tinnunculus*. The species is azonal for taiga, initially coming from piedmont steppe and semi-open landscapes of southern Palaearctic mountains. The distribution in the taiga zone is similar to that of the Hen Harrier. It is mostly limited to southern and middle taiga, where farmland is the main breeding habitat. Simultaneously, Kestrel breeding is quite stable also at the northern margin of taiga. The species reaches out into extrazonal habitats – coastal meadows and treeless sea archipelagoes, alpine tundra heathlands, and open elfin woodland in forest tundra areas. On the other hand, the Kestrel hardly ever appears in the midst of northern taiga growing in drainage divides, with few exceptions of registrations made from mosaic agricultural landscapes.

A few occasions are known of the Kestrel settling in freshly harvested and overgrowing felling sites in middle taiga of Karelia: e.g. in the Lahdenpohja and Suojärvi districts (1976 and 1992), in the Pudozh district at the Vodlozersky park border and in the Vytegra district of the Vologda region near the Soidozersky nature reserve (1995 and 1998). In the 1950s–1960s, however, when logging volumes were the highest and the species depression had not yet begun, Kestrel breeding in freshly harvested areas was much more common (Neufeldt 1958).

In terms of the abundance dynamics, the Kestrel is a nomadic species heavily dependent on the abundance of small rodents (Saurola 1985). Abundance fluctuations among years may be 5-fold. Even given among-year variations in the population, however, the Kestrel occurrence and abundance have dropped dramatically over the past three or four decades, since the 1950s–1960s.

The Kestrel abundance in Karelia is estimated at 200 pairs at present, varying from 150 to 300 pairs in different years. The bulk of the population concentrates in the farmland of southern Karelia (180 pairs), whereas that in the north, mostly in the White Sea area, consists of no more than 20–30 pairs.

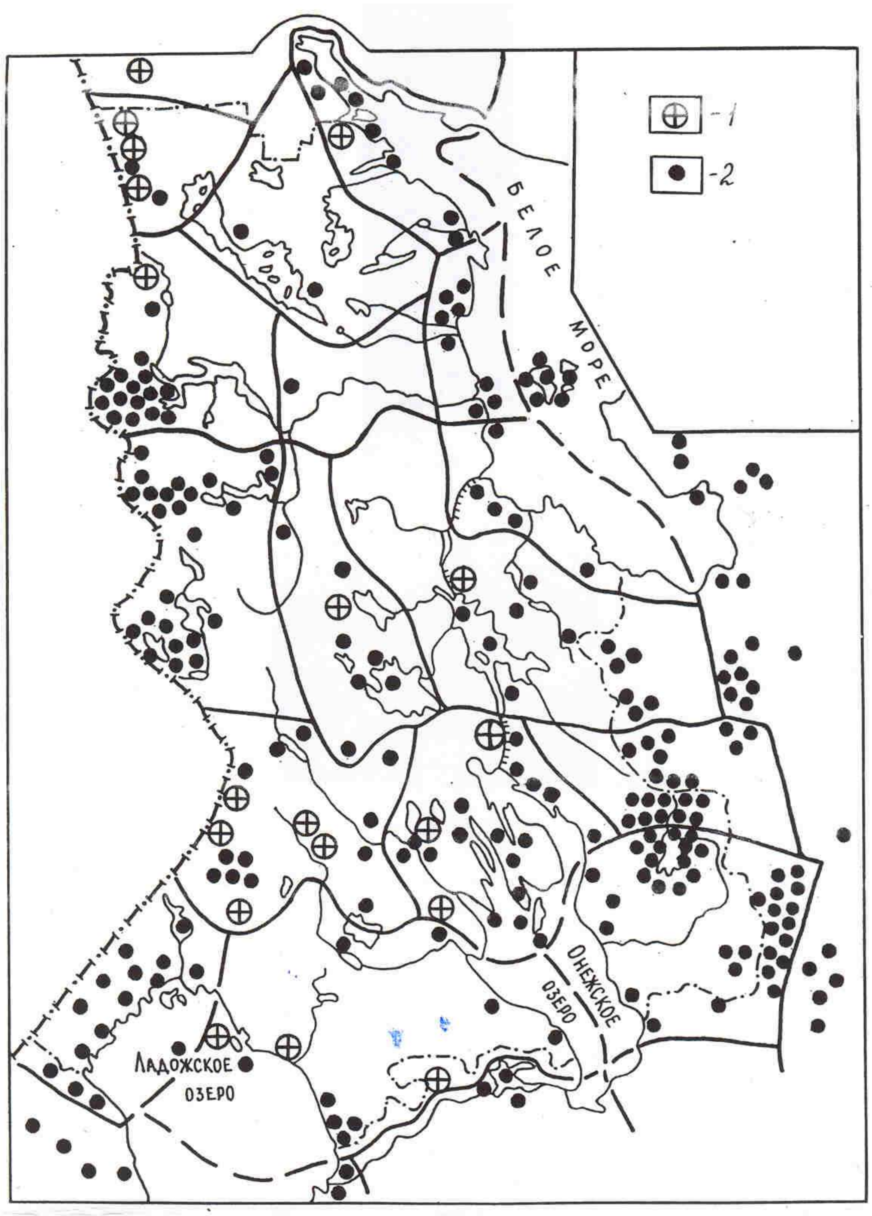

Figure 5. Distribution of the Osprey *Pandion haliaetus* in Karelia and adjacent areas. 1 – sightings in the breeding season in the past (before 1960), 2 – the same recently.

In average years, 3–4 Kestrel pairs breed in the Karelian part of the Vodlozersky park, in insular meadows and on shores of Lake Vodlozero. In years with high rodent numbers, e.g. in 1995–1996, the Kestrel abundance there grows to 7–10 pairs (fig. 6). In such years, the species is encountered outside farmland – in the waterlogged zone along Lake Kolonzhozero with its meadow wetlands with a cover of tall *Carex rostrata* hummocks (1986, 1996), as well as in freshly felled areas adjoining the park in the west (2 pairs in 1995).

A curious feature of the Kestrel biology in the Vodlozero area is frequent nesting in buildings (2 of the 4 known nests). Only one case like that is known from the rest of Karelia – nesting for several years (1981–1983) at the chimney of a wooden house in the abandoned village of Kashkany, Pryaza district. In 1984, a Kestel pair succeeded in raising young in a niche of the hip roof of the belfry on the wooden church in the Ilyinsky graveyard (Malyi Kolgostrov Island). In the summer of 1986, a nest with down-covered nestlings was found in a Goldeneye *Bucephala clangula* nest box placed at the water edge on Lake Kolonzhozero shore. In early June 1995, a Kestrel nest with a recently laid clutch of 5 eggs was discovered on a wooden chapel standing amidst meadows in Kolgostrov Island; the nest sat on logs in the corner underneath the chapel roof. In 1997, a Kestrel pair settled in an old nest of the Hooded Crow *Corvus corone* on a spruce tree at the edge of village Koskosalma meadows (Kanzanavolok Island); in the second ten days of June there were down-covered nestlings in the nest (Högmander et al. 1998). The reasons for the high frequency of Kestrel nest finds in buildings must be the very low density of the Vodlozero area population of the Hooded Crow (main source of nests for small falcons) and late timing of breeding (fledglings leave the nest on 15–20 June), as well as the fact that available vacant Crow nests get occupied also by other falcon species (Merlin, Hobby), which start breeding nearly simultaneously with the Kestrel.

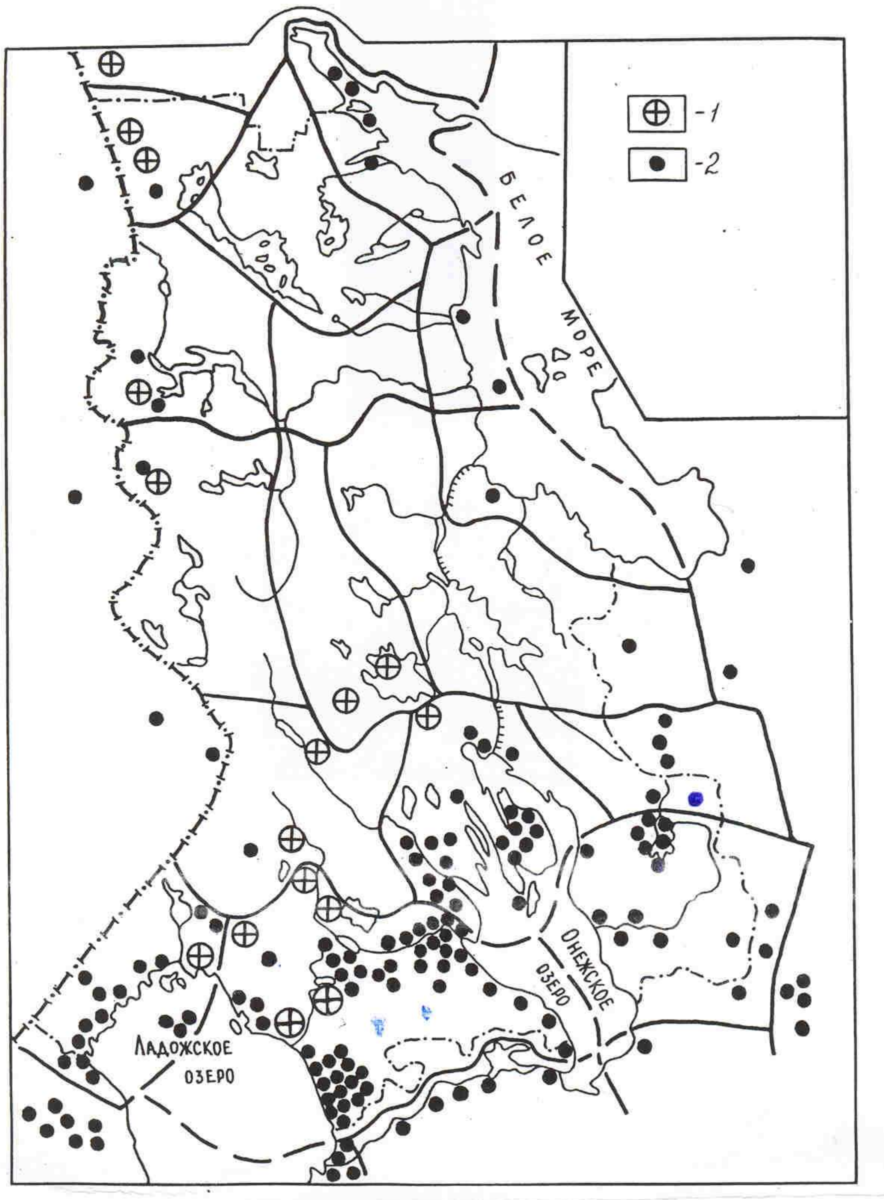

Figure 6. Distribution of the Kestrel *Falco tinnunculus* in Karelia and adjacent areas.
1 – sightings in the breeding season in the past (before 1960), 2 – the same recently.

Merlin *Falco columbarius*. A hypoarctic species, whith optimal range in forest tundra and southern dwarf shrub tundra. The Merlin breeds with relatively high stability also in the northern periphery of taiga, especially in its extrazonal habitats – coastal landscapes, treeless uplands of the "tunturi" (fjell) type with alpine tundra heathlands and coniferous-birch elfin woodland. In taiga regions of northern European Russia the species has clear northeasterly affiliations.

Settling within large continuous areas of northern and middle taiga growing on drainage divides, the Merlin prefers intrazonal habitats – heavily paludified areas, shores of large lakes and river valleys, as well as edges of felled sites and farmland. It often chooses to breed in forest fragments surrounded by open mires or open lake water, which reflects the Merlin's close connectedness with its main nest suppliers, the Hooded Crow *Corvus cornix*, Raven *Corvus corone* and some raptors (Rough-legged Buzzard, Osprey, etc.).

Middle and southern taiga regions are suboptimal for the Merlin, wherefore it remains a rare breeder there. Merlin breeding in southern Karelia and Leningrad region is registered mainly in years with a high crop of coniferous seeds (spruce, pine, larch) and forest berries (rowan, bird cherry, cowberry, blueberry, etc.), and hence, with high abundance of granivorous and carnivorous passerines, which are the main prey for this bird-eating raptor. In addition, voles would also be found in the Merlin diet in seasons with peak abundances of small rodents (Semyonov-Tyan-Shansky & Gilyazov 1991).

In the 1950s–1960s, the Merlin population in Karelia and Finland declined sharply (Zimin et al. 1993, Saurola 1985, Järvinen & Koskimies 1990). In 2001–2003, a tendency for an increase in the frequency of the species breeding in western Onego area was observed, namely in Shuja farmland near Petrozavodsk. In 2004, a pair succeeded in raising young in a spruce forest patch within Petrozavodsk city line.

In the lower reaches of River Onega, the Merlin was very common in riparian forests and overgrowing clearcut areas in 1971–1974 seasons (Korneeva et al. 1984), i.e. in years with high yields of coniferous seeds and berries and simultaneous marked rise in the breeding density of *Fringillidae, Emberizidae, Turdidae, Anthus, Bombycillidae* and other passerines constituting the bulk of the falcon's diet. In about the same seasons (1973–1975 and 1977), when the crops of coniferous seeds and berries were similarly high, Merlins were quite often observed breeding in southern Karelia and the Leningrad region (Malchevskiy & Pukinskiy 1983, Zimin et al. 1993).

The present Merlin abundance in Karelia is estimated at 700 pairs, including 250 pairs in middle taiga and 450 in northern taiga. The population density in most forest regions is within 0.3–0.5 pairs per 100 km2, reaching 1–2 pairs only in low mountainous landscapes of the Paanajärvi catchment and on the White Sea coast in 1989–1999 (fig. 7).

In 2002–2005, Merlin registrations from eastern parts of Karelia and western Arkhangelsk region (in addition to the above mentioned western Onego area) became more frequent. The areas include the Vodlozero–Kozhozero taiga reserve and eastern shore of Lake Onego, northern White Sea coast.

According to 1981–1988 observations, e.g., the Merlin was a rare breeder in the Arkhangelsk part of the Vodlozersky park (Ileksa river watershed). Its population density was within 0.1–0.3 pairs/100 km^2 and nearly all registrations were from heavily paludified habitats outside the main lake-river systems of the region (Borshchevskiy 1991). During 1994–1999 surveys in the Vodlozero area and Ileksa river watershed, the Merlin was registered just twice and only from the Karelian part of the park: from the Pilmasozero locality near Lake Kelkozero shore in June 1997, and from a drainage divide wetland in the Novguda locality near Lake Varozero in June 1999.

In the Kozhozersky park in the summer of 2003–2004, the Merlin was observed more often than in earlier study years (twice in a breeding season). A male with small prey in its talons was seen in a pine forest on the northern shore of Lake Shidmozero early in July 2003. At Krivoi Poyas, an alerted male Merlin was noted in a mire near Lake Startsevo in mid-June 2004. Local densities of the species in these seasons reached 1–2 pairs/100 km^2 of forests and wetlands. In the northern Vodlozero area, however, Merlin counts in 1997–1999 did not yield more than 0.3–0.5 pairs/100 km^2.

In mid-June 2005, an alarmed pair of Merlins was noted in the Umba locality of the Vodlozersky park, near the border between Karelia and Arkhangelsk region (density ca. 2 pairs/100 km^2). In June 2003, two Merlin registrations were made from the eastern shore of Lake Onego, between River Tuba and Pudozhgorskiy village. In mid-July 2003, 2 Merlin pairs were registered from a monitored area of 4,000–5,000 ha in the territory of the planned Pongomsky national park (density over 4 pairs/100 km^2). In 1991, however, the species counts around villages of Kuzema and Pongoma yielded an index of just 1.5 pairs/100 km^2. One can thus speak about an upward tendency in the Merlin abundance in the last 5 years, at least for eastern parts of southern and northern Karelia and western Arkhangelsk region.

Red-footed Falcon *Falco vespertinus*. A representative of the broadleaved forest avifauna, inhabitant of forest steppe landscapes and arid steppe regions. The species' distribution in the European North indicates clear southeasterly affiliations. In years when anticyclones predominate and the weather in summer months is hot and dry, mass arrivals of Red-footed Falcons take place in the west of the taiga zone, resembling invasions. For some years with an early spring and warm summer, the species breeding has been confirmed: e.g. on the Svir Bay of Lake Ladoga, within the Nizhne-Svirsky strict nature reserve in 1997 and 1999 (Rezvyi & Noskov 1998, Kovaljov 2001).

The earliest known registrations of the Red-footed Falcon in the north of European Russia were made in 1842 and 1847 from southern Lake Ladoga area and Northern Ural region (Portenko 1937). Later on, Hobbies were registered in the summer of 1869 from two locations – Andomskiy graveyard by the SE shore of Lake Onego and Kargopol city surroundings by Lake Lacha (Meves 1871 cited after Bianki 1916).

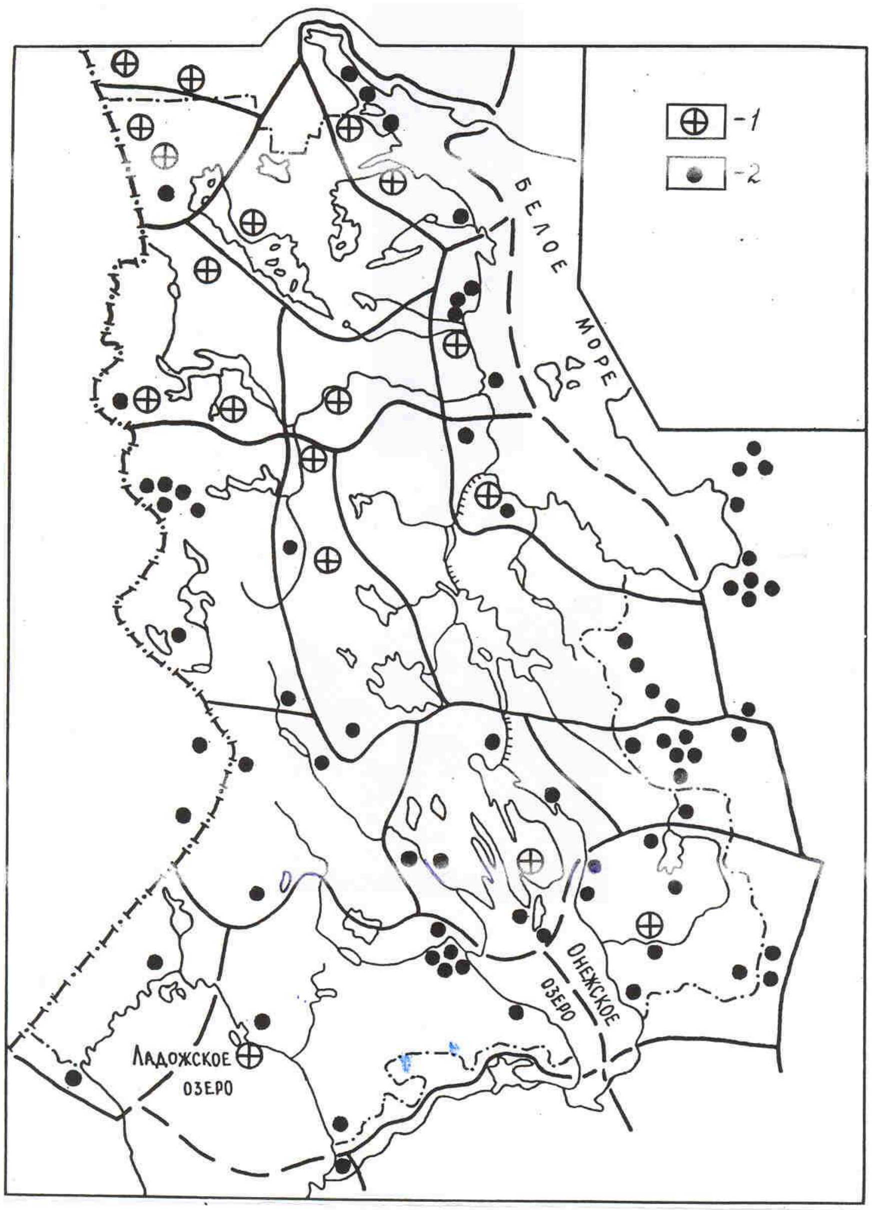

Figure 7. Distribution of the Merlin *Falco columbarius* in Karelia and adjacent areas.
1 – sightings in the breeding season in the past (before 1960), 2 – the same recently.

In the late 19th and first of half of the 20th century, invasions were more frequent than in the following three decades. They concurred during the warming periods of the 1880s, 1920s and 1930s. In the North, such climate changes entailed extreme phenomena – intense heat spells, frequent droughts, drying out of navigation pathways (Potakhin 1999). There is good correlation between years of falcon invasions into the taiga zone of European Russia and periods of climatic extremes:

– 1875–1876 – 5 records from the Svir River area in 1875, 4 finds between Zaonezhje Peninsula and Lake Segozero in 1876 (Sievers 1878);

– 1879–1880 – observations of several individuals near Petrozavodsk in 1879, 3–4 contacts in the Suojärvi district, western Karelia (Göbel 1879, Schulman 1882);

– 1908–1910 – multiple contacts in the Ust'-Sysolje district of the Vologda province from Sol'vychegodsk to the present-day Syktyvkar (one of the most common raptors around settlements), including a find of a nest with down-covered nestlings late in June 1909 (Andreev & Bianki 1910);

– 1923–1928 – frequent summer contacts in the Priozersk area, Karelian Isthmus (Malchevskiy & Pukinskiy 1983); besides, a vagrant was seen from Murmansk surroundings in August 1921, and over 10 registrations of Hobbies were made between May and August of 1926–1928 from the northern Ural region (Portenko 1937; Kohanov 1987);

– 1934–1935, 1938 – a number of records from the Pudozh district, one seen near Petrozavodsk (Novikov 1935, Neufeldt 1958);

– 1942–1943 – four registrations from western parts of southern, central and northern Karelia in 1942; two birds near Olonets in 1943 (Koskimies 1979).

During earlier invasions the Red-footed Falcon apparently nested in southern parts of the above–mentioned taiga regions, including Onego, Svir, Pudozh and Vodlozero areas (fig. 8). Being a southerly species, however, it remained an accidental breeder in the taiga of NW Russia even in periods of optimal climate. In the past few decades the species' registrations became far more rare, mostly made from the Svir area and Ileksa river watershed (Malchevksiy & Pukinskiy 1983, Zimin et al. 1993, Sazonov et al. 2001).

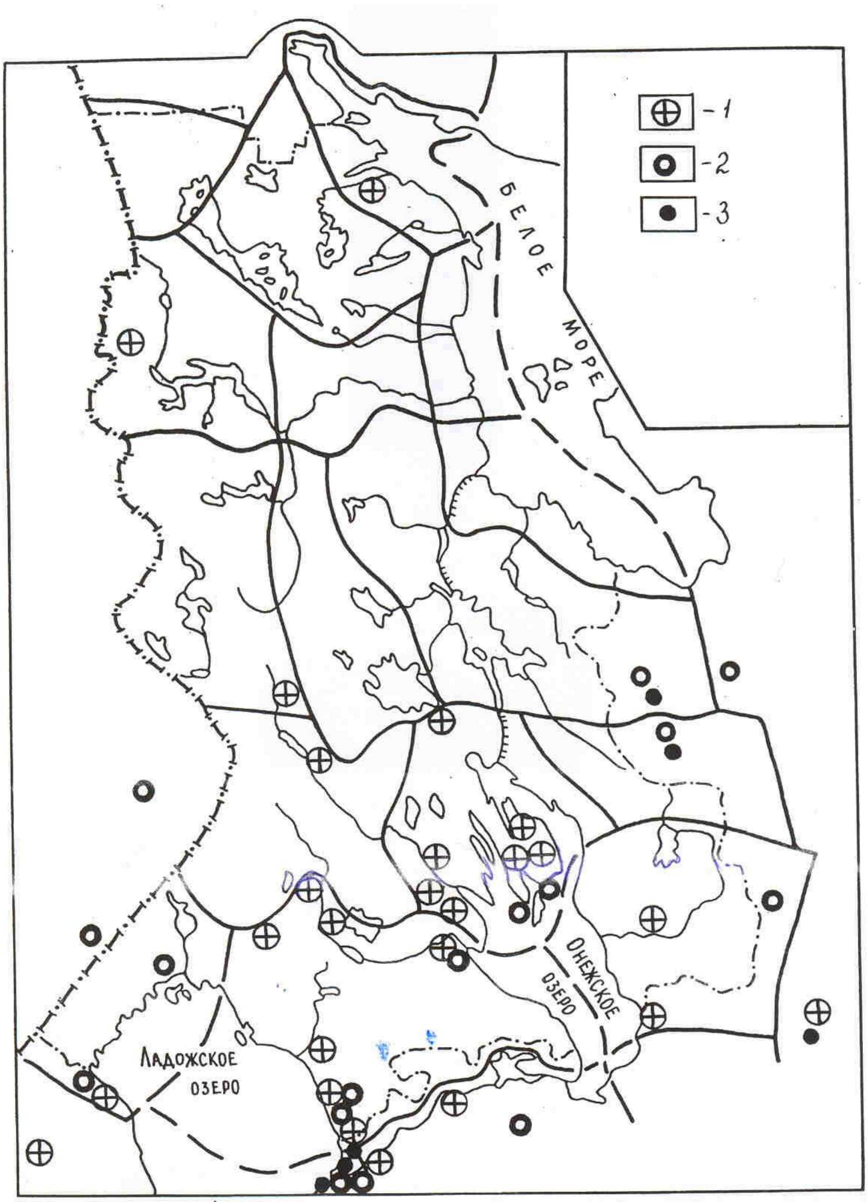

Figure 8. Distribution of the Red-footed Falcon *Falco vespertinus* in Karelia and adjacent areas.
1 – sightings of summer vagrants in the past (before 1960), 2 – the same recently,
3 – sightings in the breeding season.

In the Arkhangelsk part of the Vodlozersky park the Red-footed Falcon was a relatively common summer resident in 1982–1984. It was seen from May to August, mainly from heavily paludified habitats in drainage divides, the population density being 1-3 individuals per 100 km^2 of grounds. In some seasons with an early spring and warm summer, birds probably nested in the middle reaches of River Ileksa. From 1985–1988 onwards, falcons became much more rare there (Borshchevskiy 1991).

In the following years, the Red-footed Falcon was noted from the Ileksa River watershed three times. Three individuals were seen on the southern shore of Lake Toun on 2 August 1992. One bird was noted there on 7–12 July 1997, and on 13 July of the same year two individuals stayed over Tunemokh mire 12 km north of Lake Toun, at the confluence of rivers Ileksa and Uhta. In the Kozhozersky park, a single individual was seen in meadows by Kozhposyolok village on 5–6 August 1994. According to data from interviews, falcons occurred there near monastery buildings also in June and July of 1992–1993. Besides, the species was registered from the Konosha village area, Arkhangelsk region in mid-June 2000 (Sazonov et al. 2001). In July 2001, the species was reported also from Lake Lacha (Artemiev et al. 2001).

Thus, Red-footed Falcon were breeding in the eastern and southern border areas of Karelia in the past decades, most probably in 1982–1984, 1992–1994 and 1997–1999.

Peregrine Falcon *Falco peregrinus*. The species is azonal for taiga, initially coming from mountainous and alpine tundra landscapes. It belongs to the ecological group of eurybiotic birds, occupying a wide range of habitats. In the North, the Peregrine Falcon mostly breeds in zonal tundras and mountainous taiga regions. In flatland taiga, the species is confined to heavily paludified areas, sea coasts and archipelagoes. Large-scale logging leads to expansion of Peregrine hunting grounds and facilitates its spread into continuous taiga in drainage divides. Freshly harvested and overgrowing cutover sites in northern taiga feature a sharply increased abundance of the Willow Grouse – the main prey for the Peregrine away from coastal areas. In freshly felled areas, especially when they are paludified, the population numbers of quite a few breeding waders – Greenshank *Tringa nebularia*, Wood Sandpiper *T. glareola,* Green Sandpiper *T. ochropus,* Common Snipe *Gallinago gallinago*, Whimbrel *Numenius phaeopus*, etc., increased for a period of 3–5 to 10 and more years, also expanding the food supply for the Peregrine.

In 1987–1990, the Peregrine started breeding (two pairs) in the Kostomukshsky reserve, around which intensive logging is underway. In 1998–1999, a Peregrine pair appeared in the territory of the planned Kalevalsky national park – extensive fresh cutovers have lately reached its very borders (Sazonov 1997, Sazonov et al. 1998). In 1992–1995, the species was registered (1 pair) from the Karelian part of the Vodlozersky park, where forests in the immediate vicinity have been actively clear-cut in the past 15 years.

Present abundance of the Peregrine Falcon in Karelia is estimated at 8–10 pairs, of which 3–4 live in the south and 5–6 pairs – in the north of the republic. The Peregrine population dropped sharply, particularly obviously in the White Sea area, where in the 1950s the species was far more frequent on passage and during migration than today (Zimin et al. 1993, Sazonov 2004). In the past few years, 2–3 pairs of the Peregrine Falcon have bred in the Karelian part of the White Sea area.

In 1994–2000, records of the Peregrine on passage in southern Karelia became somewhat more frequent: at least 5 registrations from Salmi, Kaskesnavolok, Kivach areas and Shuja fields near Petrozavodsk. In the latter case, Peregrines hunting Feral Doves were seen twice in October and November of 2000. In 2002, the Peregrine was observed in Shuja fields 4 times between 9 April and 16 May. In the 2003 season, a Peregrine pair apparently nested in the downstream of River Shuja: two registrations were made in April and June, including a bird flying with prey in talons (plumed dove) seen on 6 June. Dove-hunting Peregrines were observed in the western part of Petrozavodsk, by the embankment, in late April and early May of 2004.

In mid-August 2004, an adult and a juvenile Peregrine were seen by the village of Sheltozero. A pair probably nested nearby or on the Ivinsky Razliv pool (Verkhnesvirsky reservoir), where the Peregrine had been observed earlier (Pchelintsev 2000).

Among protected diurnal raptors breeding in Karelia the situation is the most critical for the Spotted Eagle, Peregrine Falcon and Golden Eagle (8, 10 and 36 pairs). The Short-toed Eagle, Hobby and Pallid Harrier breed occasionally. In Karelia, the Short-toed Eagle lives at the northern limit of its distribution range, the Hobby breeds during temporary invasions, the Pallid Harrier appears in years of massive northward dispersal from arid regions in the south of Eastern Europe and southwestern Asia. Quite stable is the Black Kite population, which is predominantly concentrated in the Pudozh district of the Karelian Republic.

The abundance of the Hen Harrier and Kestrel varies widely (3–5 times) due to their nomadic life style and close relationship to small rodent numbers. For the Kestrel, a series of years with higher breeding frequency and population density may be followed by nearly total absence from the area under control.

Substantial population growth has been observed for fish-eating raptors – the White-tailed Sea Eagle and Osprey in the 1980–1990s and thereafter (1.5-fold and locally 2-fold). It mostly took place in protected areas and water-bodies outside them with rich fish stocks maintained, the White Sea, Lakes Onego and Ladoga, Vodlozero–Kozhozero taiga reserve, forest belt along the border between Karelia and Finland, Rybinsk reservoir, etc.

In the past 5 years, a tendency has appeared for a rise in the breeding frequency and abundance of the Merlin, at least in eastern parts of Karelia and western Arkhangelsk region. Among small falcons, a notable increase in the population density has been observed also in the Hobby. Its abundance increased in 1996–1998 and especially in 1999–2000 and following years in some of the surveyed districts of southern Karelia and western Arkhangelsk region: western Lake Onego area, Lake Vodlozero area, northwestern Lake Ladoga area, Ileksa River watershed, Lake Kozhozero area and others.

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