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An overview of monitoring *for* raptors in Finland

Pregled monitoringa populacij ptic roparic na Finskem

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In Finland, population monitoring for both diurnal and nocturnal raptors has been almost entirely based on fieldwork carried out by voluntary raptor ringers. Responsible organisations include the Finnish Museum of Natural History, with economic support for administration from the Ministry of Environment, "Metsähallitus" (former National Board of Forestry) and WWF Finland. Since the early 1970s, numbers and productivity of four endangered species, the White-tailed Eagle *Haliaeetus albicilla*, Golden Eagle *Aquila chrysaetos*, Osprey *Pandion haliaetus* and Peregrine Falcon *Falco peregrinus* have been monitored by country-wide Comprehensive Surveys, with the aim of checking all known nest sites of these species every year. The Gyrfalcon *F. rusticolus* was included in this group in the late 1990s. Data for monitoring the populations of the other raptor species have been gathered by the Raptor Grid and Raptor Questionnaire projects. The Raptor Grid project produces annual population indices, which are calculated from the data collected from 10 × 10 km study plots (n = ca. 130/year) and quite well reflect the annual population fluctuations and long-term trends of seven common species of diurnal and six species of nocturnal raptors breeding in the southern part of Finland. For the rest of the species, which are either rare all over Finland or breed mostly in the north, outside the good coverage of the distribution of Raptor Grid study plots, conclusions on population changes are based on the total numbers of occupied territories and active nests reported annually by the Raptor Questionnaires.

Key words: monitoring for raptors, diurnal raptors, owls, Finnland
Ključne besede: monitoring populacij, ujede, sove, Finska

1. Introduction

Population monitoring is an absolute prerequisite and basis of conservation and sound management programmes. This means that regular surveys and well-planned long-term monitoring programmes should be included in official duties of every government of our continuously and rapidly changing world, and implies that all monitoring programmes should be funded by public resources. However, in our real world, in the competition of resources, short-sighted economic interests and human welfare instigate worries about the future of other animal and plant species and our entire environment. Thus, nature conservation in Finland, as in most other countries, has largely been based on activities of idealistic and responsible individuals and NGOs.

Monitoring of raptor populations is important firstly because the raptors have suffered more than many other groups from negative impacts caused by people (e.g. persecution, contaminants and habitat destruction; Newton 1979) and secondly, because they are at the top of their food chains, with changes in their numbers, productivity and survival reflecting changes in the environment of other species, including man (Sergio *et al.* 2006).

In Finland, the Finnish Nature Conservation Society organised the first Peregrine Falcon *Falco peregrinus* and Golden Eagle *Aquila chrysaetos* surveys as early as in the 1950s (see Saurola 1976). In the early 1970s, *Project Pandion*, systematic and nationwide monitoring of the Osprey *Pandion haliaetus* was initiated on the basis of voluntary work by bird ringers (Saurola 1980), and the WWF

Finland took the responsibility to monitor and save the vanishing population of the White-tailed Eagle *Haliaeetus albicilla* (Saurola 1976). Finally, in 1982, a new project to monitor "common" birds of prey based on voluntary fieldwork of ringers was launched (Saurola 1985a).

Description and evaluation of monitoring *for* diurnal and nocturnal birds of prey in Finland has been published recently and is not repeated here in detail (see Saurola 2006, 2008 & 2009). The main aim of this overview is to give answers to the questions raised by the EURAPMON to get a comparable view on the state-of-the-art of raptor monitoring in different parts of Europe. In addition, some selected examples of the updated results produced by different Finnish monitoring projects are given at the end of this contribution. Note: "raptor" includes here both diurnal and nocturnal birds of prey.

2. Questions raised by the EURAPMON

2.1. Main players

In Finland, the present main actors in monitoring *for* raptors are the Finnish Museum of Natural History, Ministry of Environment, "Metsähallitus" (former National Board of Forestry), WWF Finland and, the most important, raptor ringers. The Finnish Museum of Natural History is responsible for monitoring the Osprey population (started in 1971; Saurola 2011) and for two projects, the *Raptor Grid* (1982–) and *Raptor Questionnaire* (1986–) monitoring "common" raptors (Saurola 2006, Honkala *et al.* 2011). The Ministry of Environment has supported these projects by giving extra resources needed for the office work. Metsähallitus is responsible for monitoring the Golden Eagle (1971–; Ollila & Koskimies 2008, Ollila 2012), Peregrine Falcon (1974–; Ollila & Koskimies 2008) and Gyrfalcon *F. rusticolus* (1998–; Koskimies & Ollila 2009) since 1998; and WWF Finland is responsible for monitoring the White-tailed Eagle (1973–; Stjernberg *et al.* 2011).

Before obtaining a ringing licence, every Finnish bird ringer must have passed an exam, which proves that he is a high class field ornithologist and well aware of all aspects of bird protection (see Saurola *et al.* 2013). Thus, raptor ringers are an important voluntary resource with professional skills and are used for all fieldwork needed to monitor breeding raptors in Finland.

In addition to the monitoring projects carried out during the breeding season, migrating raptors have been counted systematically at the Hanko Bird Observatory located at the south-western corner of Finland's mainland (Lehikoinen *et al.* 2008).

Several international meetings have been arranged between Nordic researches working on the Golden Eagle, White-tailed Eagle, Peregrine Falcon and Gyrfalcon. Co-operation between Estonian, Latvian and Finnish raptor researchers has been close. Recently, a workshop was arranged to improve the co-operation between Russian and Finnish raptor researchers (see Koskimies & Lapshin 2006).

The main users of the results of raptor monitoring are Finnish government officials, European Commission, raptor researchers and conservation NGOs, i.e. all those in need of information on the population status and trends of Finnish raptors.

2.2. National coverage

In principle, all monitoring *for* raptors is co-ordinated nation-wide (Saurola 2008). *National network* is the network of raptor ringers, which means that the coverage of activities is, in practice, much better in the southern than northern parts of the country.

The goal of monitoring *for* the Osprey, White-tailed Eagle, Golden Eagle, Peregrine Falcon and Gyrfalcon populations is an annual *Comprehensive Survey* (Saurola 2008). In principle, all known territories all over the country are checked each year to obtain precise information on the annual breeding performance of these species.

Monitoring of the other, "common" raptor species, is patchy and concentrated to the southern half of the country. Voluntary ringers devoted to raptors have been encouraged to participate in the *Raptor Grid* monitoring project. This means that the ringers were asked (1) to join in teams, (2) to select a 10 × 10 km study plot based on the Finnish National Grid and (3) to try to locate active nests or at least occupied territories of raptors within their study plot by using the same searching effort from year to year (Saurola 1985a & 2006). In 2011, for example, 130 Raptor Grid 10 × 10 km study plots were surveyed (Honkala *et al.* 2012) (Figure 1). On the basis of these data from Raptor Grid it is possible to calculate relevant annual population indices and long-term trends for common raptors breeding in the southern half of Finland (Saurola 2008) (see also Figures 4 and 5).

In addition, information (1) on the total numbers of potential territories checked, (2) on the totals of active nests and occupied territories found and (3) on the breeding performance (clutch size and brood size) assessed by the ringers have been collected annually by using the *Raptor Questionnaire.* Because the data have been collected by the territories of local ornithological

societies, the population fluctuations in space and time can be detected (see Figure 6). The total number of breeding attempts of raptors is highly dependent on the phase of the vole cycle. In a top vole year 2009, 379 Raptor Questionnaires were filled by 256 individual raptor ringers or teams. Altogether, 47,767 potential nest sites of "common" diurnal and nocturnal raptors were inspected, 18,581 occupied territories detected as well as 12,259 breeding attempts verified and breeding performance reported (Honkala *et al.* 2010). In contrast, in a poor vole year 2010, when the number of potential nest sites checked was 43,514, only 9,068 occupied territories and 5,357 active nests were found and reported (Honkala *et al.* 2011). The Raptor Questionnaire is vital (1) in obtaining at least some information on population changes of species not covered by the Raptor Grid project and (2) in monitoring annual productivity of all raptor species.

2.3. Key species and key issues

Population status and trends of all raptor species breeding in Finland have been monitored during the last 30 years (Saurola 2008). If it is necessary to select some "key species", selection could be based e.g. on the specific IUCN category used in the national Red List.

The latest Finnish Red List of Birds included 14 species of raptors (Rassi *et al.* 2010). Of these, the Black Kite *Milvus migrans,* Greater Spotted Eagle *A. clanga*, and Snowy Owl *Bubo scandiacus* were classified as Critically Endangered (CR); Montagu's Harrier *Circus pygargus* and Gyrfalcon Endangered (EN); Honey Buzzard *Pernis apivorus,* White-tailed Eagle, Hen Harrier *C. cyaneus*, Buzzard *Buteo buteo*, Golden Eagle and Peregrine Falcon Vulnerable (VU); and Osprey, Eagle Owl *B. bubo* and Tengmalm´s Owl *Aegolius funereus* Near Threatened (NT).

All these 14 species could be defined as key species for monitoring *for* raptors, because these species need special protection and conservation measures. In addition, some of these species (e.g. the Osprey, White-tailed Eagle and Peregrine Falcon) can also be used as key indicators (sentinels) of the welfare of ecosystems in general (e.g. Helander *et al.* 2008, Henny *et al.* 2010).

At present, the most important "key issue" (threat) addressed by monitoring *for* raptors in Finland is land use, especially modern commercial forestry, which has reduced both the area of optimal habitat and availability of suitable nest sites needed by forest-dwelling species (Saurola 1997, 2008 & 2011, Saurola & Björklund 2011). Many other human related factors like direct persecution, environmental contaminants, traffic, power lines, wind turbines, fishing and disturbances during the breeding period may have an additional negative effect on the population trends of Finnish raptors (e.g. Saurola *et al.* 2013).

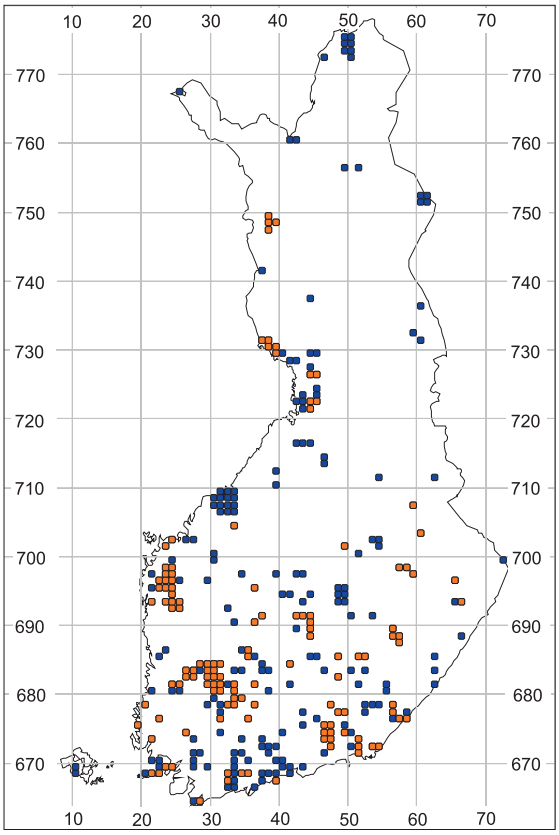

Figure 1: The locations of the 10 × 10 km study plots based on the Finnish National Grid. The plots studied at least once in 1982–2010 are depicted in blue, and the ones studied in 2011 in orange. The grid lines shown are 100 × 100 km (after Honkala *et al.* 2012).

Slika 1: Lokacije 10 × 10 km velikih popisnih ploskev, ki temeljijo na finski Nacionalni mreži. Ploskve, ki so bile v obdobju 1982–2010 preučevane najmanj enkrat, so obarvane modro, v letu 2011 preučevane ploskve pa oranžno. Prikazane mrežne črte so 100 × 100 km (po Honkala *et al.* 2012).

International networking gives the opportunity to compare the population trends detected in Finland with the corresponding trends in neighbouring countries and other parts of Europe.

2.4. Strengths and weaknesses

The main strength of monitoring *for* raptors in Finland is the availability of professional level manpower for fieldwork comprised by voluntary

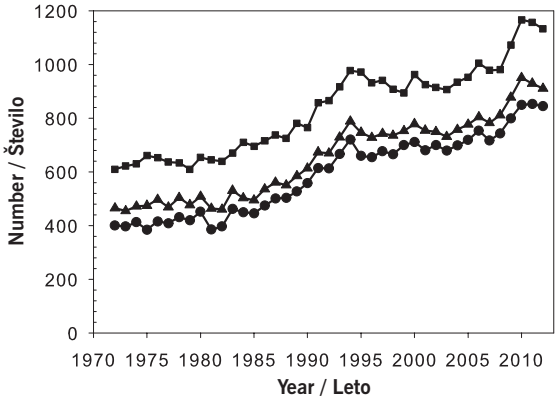

Figure 2: Annual numbers of occupied territories (squares), active nests (triangles) and successful nests (dots) of the Osprey *Pandion haliaetus* reported by the Finnish nationwide *Project Pandion* during the 1972–2012 period

Slika 2: Letna števila zasedenih teritorijev (kvadrati), aktivnih gnezd (trikotniki) in uspešnih gnezd (pike) ribjega orla *Pandion haliaetus*, zabeležena v okviru vsedržavnega *Projekta Pandion* v obdobju 1972–2012

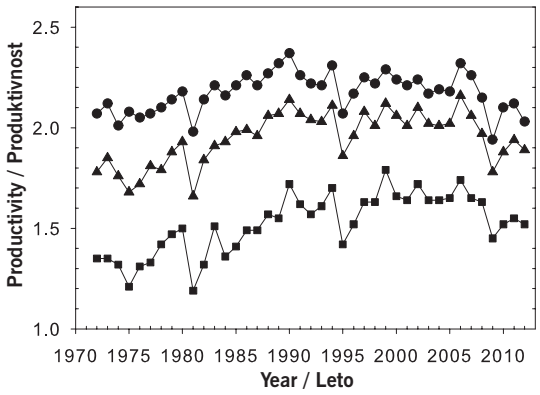

Figure 3: Average annual productivity of the Osprey *Pandion haliaetus* in 1972–2012; square – nestlings/occupied territory, triangle – nestlings/active nest, dot – nestlings/successful nest

Slika 3: Povprečna letna produktivnost ribjega orla *Pandion haliaetus* v obdobju 1972–2012; kvadrat – mladiči/zasedeni teritorij, trikotnik – mladiči/aktivno gnezdo, pika – mladiči/uspešno gnezdo

ringers and other trained amateur ornithologists interested in raptors. Very important strength of the Finnish raptor monitoring is the production of series of regular annual monitoring reports. The motivation of fieldworkers is maintained by these reports (in Finnish with English summaries and captions), which demonstrate the yearly fluctuations and long-term trends of different raptor species and the value of fieldwork carried out (e.g. Honkala *et al.* 2010, 2011 & 2012, Stjernberg *et al.* 2011, Saurola 2011 & 2012, Ollila 2012). Further, in addition to all ringing, recovery, recapture and resighting data, all monitoring data gathered by the Finnish Ringing Centre are stored in the Oracle Database Management System installed in the mainframe computer of the University of Helsinki and, thus, efficiently available, when needed for research and conservation (see Saurola *et al.* 2013).

The main weakness is the fact that the distribution of ringers is concentrated to the southern half of Finland. For this reason, the amount of data is not sufficient (1) to keep track of the status of the Critically Endangered Snowy Owl, and (2) for estimating reliable population trends of the "common" species breeding mainly in the northern half of the country like the Rough-legged Buzzard *B. lagopus*, Hen Harrier, Merlin *F. columbarius*, Hawk Owl *Surnia ulula*, Great Grey Owl *Strix nebulosa* and Short-eared Owl *Asio flammeus*. The Rough-legged Buzzard, Snowy Owl, Hawk Owl, Great Grey Owl and Short-eared Owl are at least partly nomadic species, which may change their breeding area thousands of kilometres depending on the fluctuations of their cyclic food, voles and lemmings. International co-operation is urgently needed to monitor population status and trends of these northern species, especially now, when the effects of global warming can only be speculated (Saurola 2009).

The other serious weakness is almost entire lack of reliable estimates of annual and long-term trends of survival of raptor species. To improve the situation, researchers and ringers have been encouraged to collect representative capture-recapture data needed to estimate survival of Finnish raptor species by using the new sophisticated statistical methods (see e.g. Saurola *et al.* 2003, Francis & Saurola 2008).

2.5. Priorities, capacity-building

At the moment, the highest priority to strengthen monitoring *for* both diurnal and nocturnal raptors in Finland should be given to the efforts to gather more relevant data from the northern half of the country. At least 20–30 new 10 × 10 km Raptor Grid study plots based on the National Grid and operating with standard effort from year-to-year should be urgently founded in the northern half of the country. Because this will not be possible only on the voluntary basis, extra national or/and international long-term funding is needed. Of course, more Raptor Grid study plots

would be welcome also in southern Finland, except that those study plots would have to be based on voluntary fieldwork.

3. Selected examples of results

3.1. Data collected

A rough idea of the amount of data on raptors collected annually in Finland is given in Tables 1 and 2. The tables show the highest numbers of (1) occupied territories and (2) active nests reported, and (3) nestlings ringed by Finnish ringers in the top year of the 1986–2012 period. The Greater Spotted Eagle, Montagu's Harrier, Pallid Harrier *C. macrourus* (first breeding record in 2011) and Black Kite are excluded from these tables, given that these species have always been very rare breeders in Finland, which is, in fact, situated outside the normal distribution area of these species.

3.2. Comprehensive Surveys

The Osprey has been selected here as an example of a species monitored by the Comprehensive Survey. The present estimate of the Finnish Osprey population is 1,300 pairs (Saurola 2011). In 2012, 2,046 potential nest sites of the Osprey were inspected; 1,133 occupied territories were detected, 911 of the nests were active, meaning that eggs were laid, and 845 successful with large young produced. The Finnish Osprey population remained at the same level through the 1970s, increased by 3% per year from 1982 to 1994 and has since remained relatively stable (Figure 2). The apparent increase during the very last years is at least partly due to the increased activity by ringers to construct artificial nests in the north-eastern part of the country. Also, the annual productivity increased steeply during the 1980s and has thereupon fluctuated at the same general level (Figure 3).

The positive trend can be attributed (1) to decreased persecution during migration and wintering (Saurola 1985b, Saurola *et al.* 2013), (2) to decreased impact of environmental toxicants (P. Saurola *unpubl.*) and (3) to construction of artificial nests to compensate for the losses of nest sites caused by the modern forestry procedures (Saurola 1997). Almost 50% of Finnish Ospreys breed in artificial nests constructed by voluntary ringers (Saurola 2011).

In the 1960s and 1970s, the Finnish populations of the White-tailed Eagle, Golden Eagle and Peregrine Falcon were on a very low level and even close to the verge of extinction (Saurola 1976). Careful monitoring through the decades indicates that the populations of all these three species have recovered well and are at the moment on 60-year record levels

Table 1: Diurnal raptors (Falconiformes): highest national totals per year during 1986–2012 of occupied territories and active nests with eggs laid at least, as reported by ringers, and nestlings ringed

Tabela 1. Ujede (Falconiformes): največja letna števila v obdobju 1986–2012 zasedenih teritorijev v državi in aktivnih gnezd vsaj z izleženimi jajci, o katerih so poročali obročkovalci, in število obročkanih mladičev

Species / Vrsta	No. of territories/ Št. teritorijev	No. of nests/ Št. gnezd	No. of nestlings ringed/ Št. obročkanih mladičev
Honey Buzzard *Pernis apivorus*	432	149	206
White-tailed Eagle *Haliaeetus albicilla*	386	304	267
Marsh Harrier *Circus aeruginosus*	402	209	418
Hen Harrier *Circus cyaneus*	294	47	123
Goshawk *Accipiter gentilis*	1,613	1,267	2,311
Sparrowhawk *Accipiter nisus*	753	462	1,248
Buzzard *Buteo buteo*	1,131	650	1,131
Rough-legged Buzzard *Buteo lagopus*	231	167	558
Golden Eagle *Aquila chrysaetos*	345	209	147
Osprey *Pandion haliaetus*	1,167	951	1,489
Kestrel *Falco tinnunculus*	3,496	3,189	12,645
Merlin *Falco columbarius*	100	57	110
Hobby *Falco subbuteo*	565	208	189
Gyrfalcon *Falco rusticolus*	32	22	26
Peregrine Falcon *Falco peregrinus*	194	173	359

Table 2: Nocturnal raptors (owls, Strigiformes): highest national totals per year during 1986–2012 of occupied territories and active nests reported by ringers, and nestlings ringed

Tabela 2. Nočne ptice roparice (sove Strigiformes): največja letna števila v obdobju 1986–2012 zasedenih teritorijev v državi in aktivnih gnezd, o katerih so poročali obročkovalci, in število obročkanih mladičev

Species / Vrsta	No. of territories/ Št. teritorijev	No. of nests/ Št. gnezd	No. of nestlings ringed/ Št. obročkanih mladičev
Eagle Owl *Bubo bubo*	1,106	537	854
Snowy Owl *Bubo scandiacus*	21	15	20
Hawk Owl *Surnia ulula*	182	120	399
Pygmy Owl *Glaucidium passerinum*	1,339	963	4,797
Tawny Owl *Strix aluco*	1,189	905	2,844
Ural Owl *Strix uralensis*	2,545	1,786	4,722
Great Grey Owl *Strix nebulosa*	145	103	200
Long-eared Owl *Asio otus*	1,486	1,135	554
Short-eared Owl *Asio flammeus*	581	298	532
Tengmalm's Owl *Aegolius funereus*	3,643	2,265	6,691

shown by the numbers in Table 1 (T. Stjernberg & T. Ollila *pers. comm.*). Very little is known about the Finnish Gyrfalcons before the start of this millennium; the population has probably fluctuated over the years around its present low level.

3.3. Raptor Grid

Annual population indices and long-term trends of six species of diurnal and six species of nocturnal raptors are shown in Figures 4 and 5.

Diurnal raptors

During the last three decades, the Honey Buzzard and Buzzard have been decreasing alarmingly steeply (Figure 4). The decreasing trend of the Goshawk *Accipiter gentilis* has not been as steep, but still statistically significant. Due to the modern commercial forestry, the amount of prime nesting habitat has continuously decreased and caused (1) increasing interspecific competition for high quality nesting sites between these forest-dwelling species and also (2) higher predation risk by the Goshawk on the nestlings of the other raptor species. Forestry has also caused a decrease of population densities in gallinaceous birds – important prey of the Goshawk (e.g. Sulkava 1964). Thus, the negative trends of these three medium-sized forest raptors are most probably connected with the effects of modern forestry (see Saurola 2008, Saurola & Björklund 2011).

In contrast to those typical forest-dwelling species mentioned above, the populations of three species breeding in more open habitats and independent of the effects of modern forestry have been increasing. The Kestrel *F. tinnunculus* and Marsh Harrier *C. aeruginosus* populations have increased steeply and the Hobby *F. subbuteo* moderately. The Kestrel has been recovering from the population crash in the 1960s and early 1970s. One of the important causes of the increase has been the effective nest box programme started by Erkki Korpimäki in the late 1970s (Valkama & Korpimäki 1999). According to the data from the Raptor Questionnaire, the number of artificial nests for small falcons (nearly all are nest boxes for Kestrels) has increased from 697 in 1986 to 7,003 in 2011. During the same period, the average productivity has increased because the nesting failures have decreased (see Figure 7).

The Marsh Harrier has extended its distribution towards the north during the last few decades, which have also been favourable for the Finnish population of the Hobby. No detailed studies on the causes of the success of these species are available.

Nocturnal raptors (Owls)

The Eagle Owl was increasing during the first decade of monitoring but, after that, has been on a continuous and very steep decrease (Figure 5). The increase phase can be attributed to (1) full protection since 1983, (2) increase of suitable open habitats (clear-cuts created by forestry) for nesting and hunting, and (3) year-round stable and rich food supply of Brown Rats *Rattus norvegicus* at the numerous poorly managed rubbish dumps. Since the mid-1990s, 90% of the local rubbish dumps have been closed. This dramatic change in food supply has surely been one of the

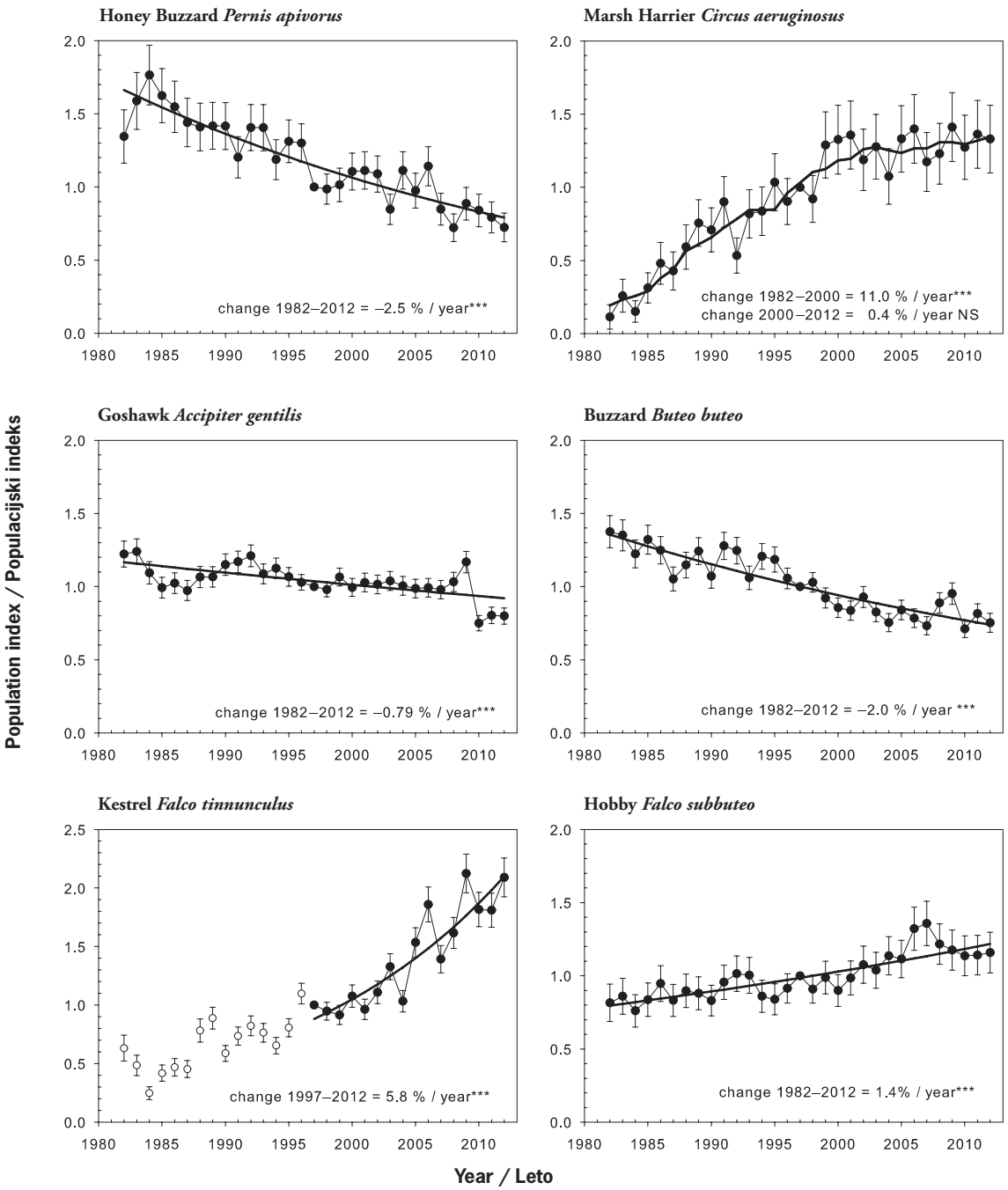

Figure 4: Annual population indices (dots) of six species of diurnal raptors, calculated from the numbers of occupied territories recorded on the *Raptor Grid* study plots during 1982–2012. Vertical bars indicate standard errors. Thick line = log-linear regression line, except in the panel of the Marsh Harrier = 7-point LOESS smoother (William 1978). Note: the indices of the Kestrel *Falco tinnunculus* from the 1982–1996 period are biased by the increasing number of nest boxes and not included in the estimation of population trend.

Slika 4: Letni populacijski indeksi (pike) šestih vrst uje, izračunani iz števila zasedenih teritorijev, zabeleženih v obdobju 1982–2012 na popisnih ploskvah *Mreža ptic roparic*. Stolpiči ponazarjajo standardne napake. Debela črta = log-linearna regresijska krivulja, razen pri rjavem lunju = 7-točkovni LOESS smoother (William 1978). Opomba: indeksi postovke *Falco tinnunculus* iz obdobja 1982–1996 so pristranski zaradi povečanega števila gnezdilnic in niso vključeni v oceno populacijskega trenda.

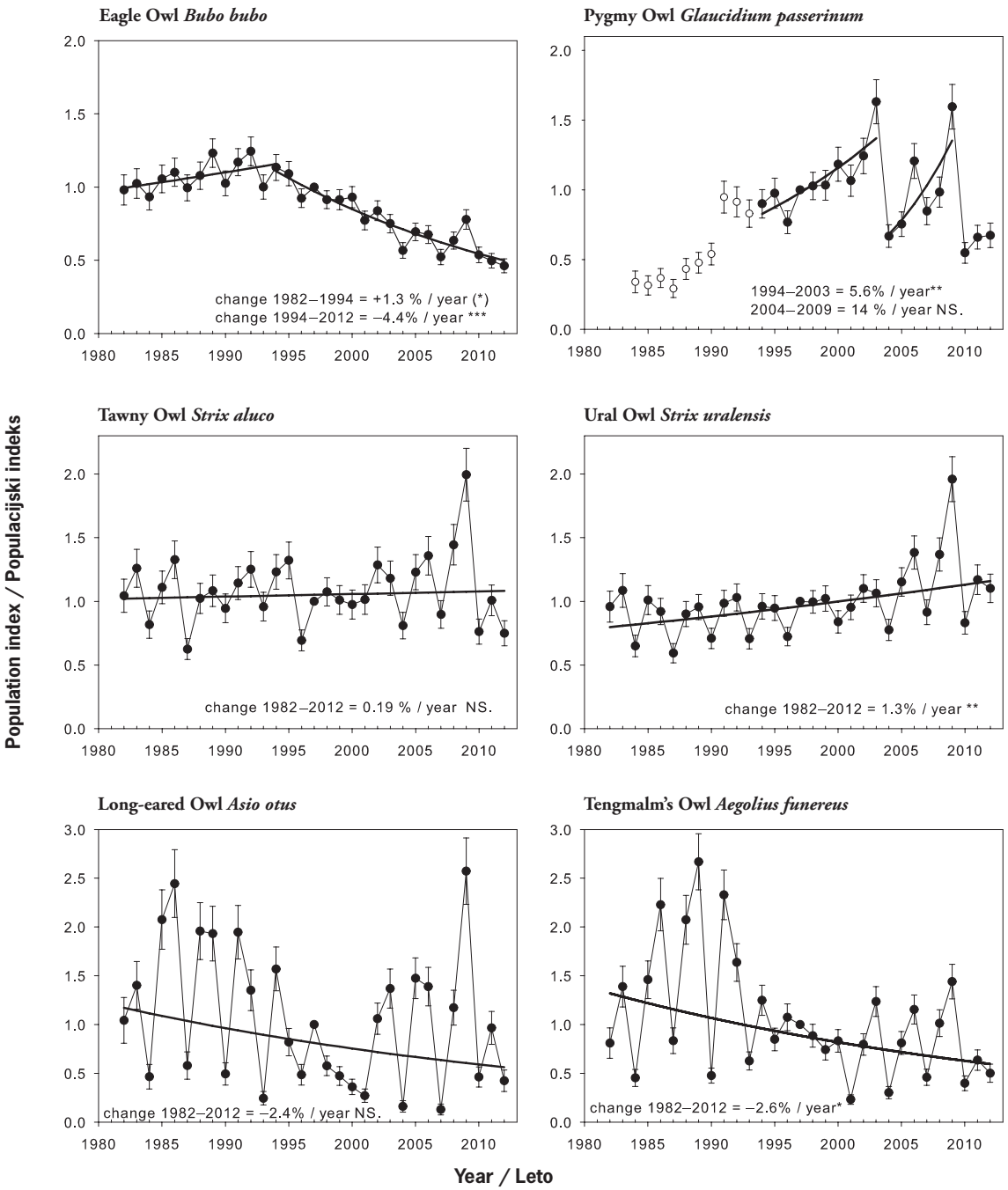

Figure 5: Annual population indices (dots) of six species of nocturnal raptors, calculated from the numbers of occupied territories recorded on the *Raptor Grid* study plots during 1982–2012. Vertical bars indicate standard errors. Thick line = log-linear regression line. Note: the indices of the Pygmy Owl *Glaucidium passerinum* from the 1984–1993 period are biased by the increasing number of nest boxes and not included in the estimation of population trends.

Slika 5: Letni populacijski indeksi (pike) šestih vrst sov, izračunani iz števila zasedenih teritorijev, zabeleženih v obdobju 1982–2012 na popisnih ploskvah *Mreža ptic roparic*. Stolpiči ponazarjajo standardne napake. Debela črta = log-linearna regresijska krivulja. Opomba: indeksi malega skovika *Glaucidium passerinum* iz obdobja 1984–1993 so pristranski zaradi povečanega števila gnezdilnic in niso vključeni v oceno populacijskih trendov.

most important factors causing the steep decline of the Finnish Eagle Owl population during the last two decades (Valkama & Saurola 2005, Saurola 2009).

The populations of the Tengmalm's Owl and Long-eared Owl *A. otus* have fluctuated widely according to their cyclic main prey, voles. In general, it is challenging to detect statistically significant long-term trends from widely scattered data set. In the Tengmalm's Owl, the decline is clear and significant, whereas in the Long-eared Owl, the trend is similar but not significant, mainly because of the record year 2009. The population decline of the Tengmalm's Owl has been attributed to the continuous degradation of forest habitat in Finland (for references, see Saurola 2009, Korpimäki & Hakkarainen 2012). No hypotheses have been proposed to explain the possible negative trend of the semi-nomadic Long-eared Owl population. Perhaps the "trend" happens to be an uncommon result of the nomadic life style of the species.

Of the two resident *Strix*-species, the population of the Ural Owl has been increasing, while the population of the Tawny Owl *S. aluco* has remained at the same level during the last decades. The welfare of both of these species and particularly of the Ural Owl is nowadays quite highly dependent on several thousands of nest boxes constructed by ringers. Some of the cavities made by the Black Woodpecker *Dryocopus martius* are large enough for the Tawny Owl. In contrast, most of the best natural nest sites of the Ural Owl, chimney-like old rotten stumps were some decades ago (not anymore) "cleaned" away by the foresters, and big old trees with large cavities had disappeared from Finnish forests long time ago. The Ural Owl is ready to breed in open stick nests constructed by the Goshawk and buzzards, but the breeding output seems to be much worse than in nest boxes.

Systematic monitoring of the breeding population and regular ringing activities at the bird observatories during the autumn have brought the pattern of the population changes of the Pygmy Owl *Glaucidium passerinum* to a new light (Saurola 2008 & 2009). The "increase" of the population during the first part of the monitoring period is heavily biased by the increase of the number of nest boxes constructed for the Pygmy Owls, because the detection probability of pairs breeding in nest boxes is higher than the ones breeding in woodpecker cavities. Since the mid-1990s, the data reflect the real changes in the population and indicate how the Pygmy Owl population has increased during favourable circumstances to a very high level and after that crashed owing to the strong autumn invasion in 2003 and 2009 detected at coastal bird observatories (e.g. Lehikoinen *et al.* 2011). The present data show that Pygmy Owls, which participated in the mass invasion, disappeared from the Finnish population. There are no data to show whether these owls started to breed elsewhere or did they simply die during the invasions, which seem to be an important part of the population regulation of the Pygmy Owl (Saurola 2008).

3.4. Raptor Questionnaire

Nests and territories

By the end of each breeding season, ringers have to report on the Raptor Questionnaire their data on breeding of all other raptor species except of the species monitored by the Comprehensive Surveys. Data from the Raptor Questionnaire are dependent on the variation of the activities of ringers and, if not corrected, may be in the worst case biased and even misleading. Keeping this potential source of error in mind, these data are "better-than-nothing", giving valuable additional information on numbers of nests and territories found in different parts of the country of all common species, also of the ones monitored by the Raptor Grid project, e.g. the Goshawk (Figure 6, but note that these data have not yet been corrected by taking the variation in ringers' activities into account).

For monitoring raptor species that are either rare or relatively common but breed in the northern or north-eastern parts of the country, the present distribution and number of Raptor Grid study plots are not representative enough for calculating annual indices (see Table 1 and 2). For these species, data from Raptor Questionnaire are the only piece of information on annual fluctuations and long-term trends (Figure 6).

The Hawk Owl is a true nomadic species: two nestlings ringed in Finland were encountered east of the Ural Mountains, almost 3,000 km to the east of their natal sites, and three others were found in southern Norway, 1,200–1,400 km southwest of their natal sites (Saurola 2002). Thus, the occurrence of Hawk Owls in Finland shown by the data from Raptor Questionnaire is as irregular as expected: during 1986–2012, the number of nests found per year has varied between 1 and 120!

According to the present knowledge, the Great Grey Owl is a semi-nomadic species: a part of the population is nomadic and the other part resident (Stefansson 1997, Saurola 2002). During 1986–2012, the annual total of active nests reported by the Raptor Questionnaire has varied a great deal, from 4 and 103 nests, but the population seems to have remained at the same general level. Contributions

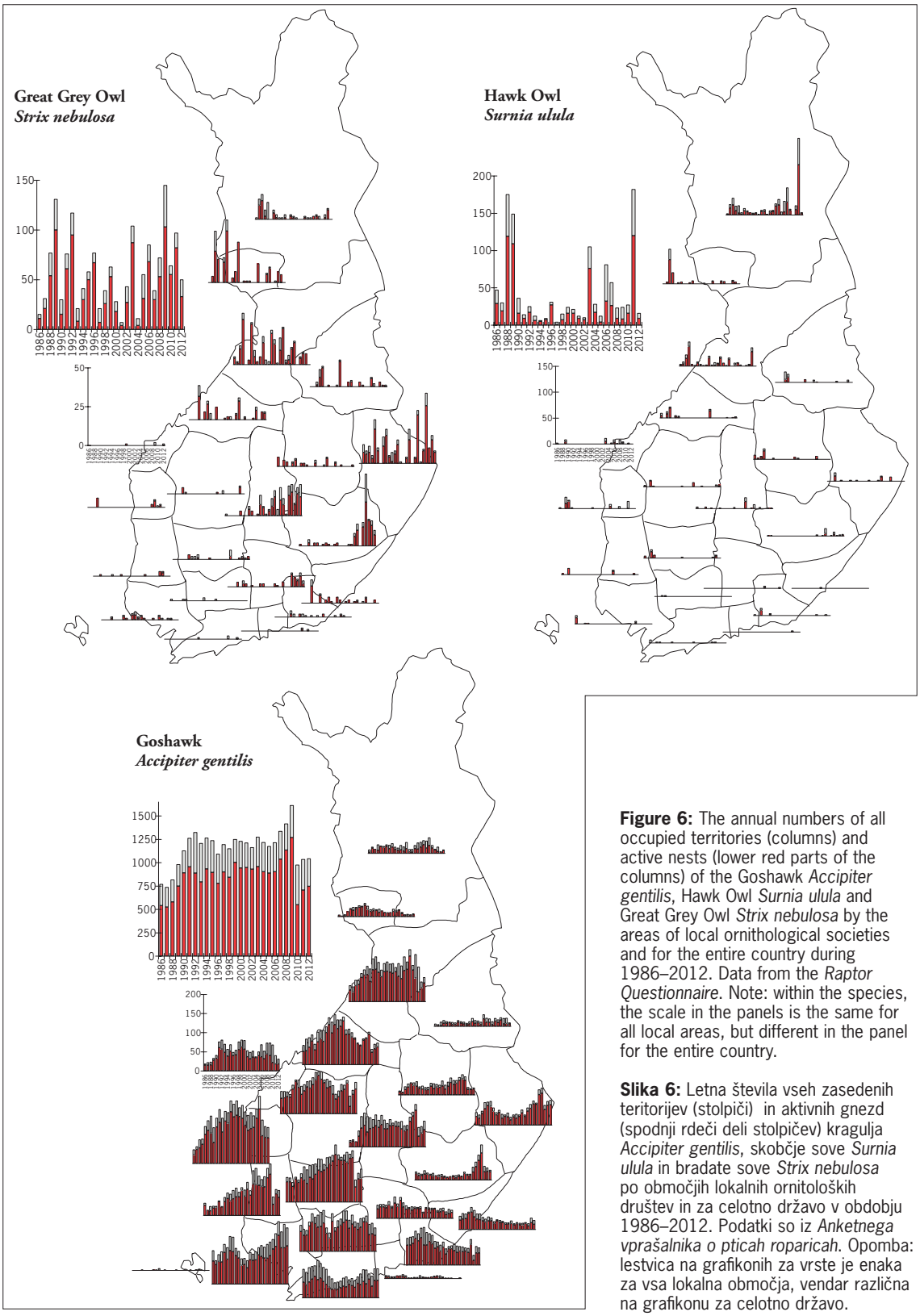

Figure 6: The annual numbers of all occupied territories (columns) and active nests (lower red parts of the columns) of the Goshawk *Accipiter gentilis*, Hawk Owl *Surnia ulula* and Great Grey Owl *Strix nebulosa* by the areas of local ornithological societies and for the entire country during 1986–2012. Data from the *Raptor Questionnaire*. Note: within the species, the scale in the panels is the same for all local areas, but different in the panel for the entire country.

Slika 6: Letna števila vseh zasedenih teritorijev (stolpiči) in aktivnih gnezd (spodnji rdeči deli stolpičev) kragulja *Accipiter gentilis*, skobčje sove *Surnia ulula* in bradate sove *Strix nebulosa* po območjih lokalnih ornitoloških društev in za celotno državo v obdobju 1986–2012. Podatki so iz *Anketnega vprašalnika o pticah roparicah*. Opomba: lestvica na grafikonih za vrste je enaka za vsa lokalna območja, vendar različna na grafikonu za celotno državo.

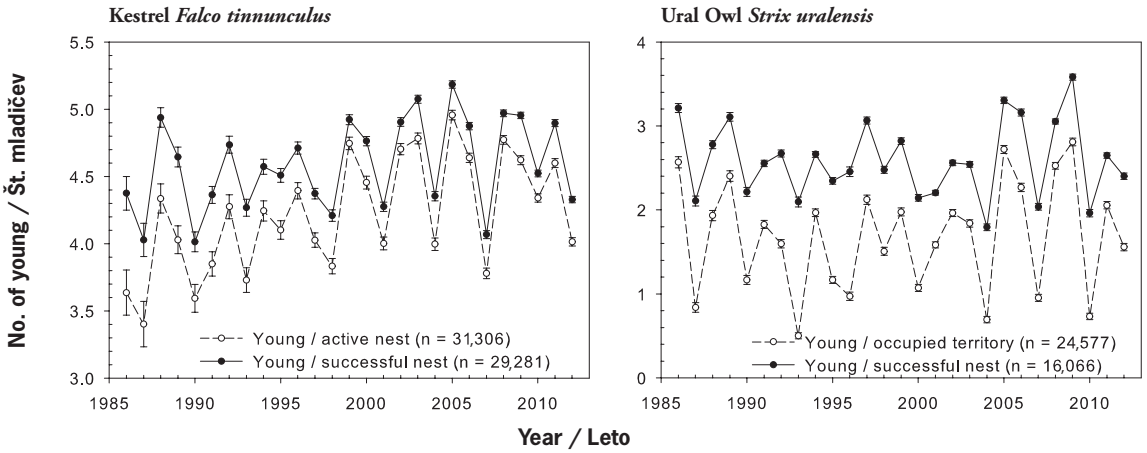

Figure 7: Average annual productivity of the Kestrel *Falco tinnunculus* and Ural Owl *Strix uralensis* during 1986–2012; filled circles – young/successful nest, open circles – young/active nest (Kestrel) or young/occupied territory (Ural Owl). Vertical bars indicate standard errors.

Slika 7: Povprečna letna produktivnost postovke *Falco tinnunculus* in kozače *Strix uralensis* v obdobju 1986–2012; polni krogci – mladiči/uspešno gnezdo, prazni krogci – mladiči/aktivno gnezdo (postovka) ali mladiči/zasedeni teritorij (kozača). Stolpiči ponazarjajo standardne napake.

from local areas to the national total have been very different from year to year, depending on the local fluctuations of vole populations and perhaps movements of the owls.

Productivity

In addition, the Raptor Questionnaire has produced important information for monitoring annual productivity of all raptor species, e.g. of the Kestrel and Ural Owl shown here as examples in Figure 7. The annual average productivity of the Kestrel seems to have increased during 1986–2012, although the annual fluctuations are large. This can probably be attributed to the increasing number of pairs breeding in nest boxes, where the risks of nesting failures caused by avian and mammalian predators are lower than in open stick nests. The average annual productivity of the Ural Owl varies also much from year to year according to the fluctuations of voles. Although the Ural Owl population has been slowly increasing, no long-term trend in productivity can be detected.

4. Concluding remarks

(1) Monitoring the three Critically Endangered and one Endangered raptor species is based on sporadic and random field observations made by amateur ornithologists around the country; only the Gyrfalcon has been systematically surveyed.
(2) The Finnish monitoring projects produce reliable data to assess the annual population size (or index), long-term population trend and productivity of almost all Vulnerable and Near Threatened raptor species; for the Hen Harrier, the distribution and number of Raptor Grid study plots should be much more representative.
(3) More resources and international co-operation are needed for reliable monitoring of species, which belong to the Finnish Red List category Least Concern (LC) and breed in northern Finland.
(4) More effort should be devoted to collect capture-recapture data for survival monitoring.

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5. Povzetek

Monitoring populacij tako dnevnih kot nočnih ptic roparic na Finskem skoraj v celoti temelji na terenskem delu prostovoljnih obročkovalcev teh ptic. Nad monitoringom bdi Finski prirodoslovni muzej, gmotna sredstva za administrativno delo pa prispevajo

Ministrstvo za okolje, "Metsähallitus" (nekdanji Nacionalni odbor za gozdarstvo) in finski WWF. Od začetka 70. let 20. stoletja skrbijo za monitoring številčnosti in produktivnosti štirih ogroženih vrst – belorepca *Haliaeetus albicilla*, planinskega orla *Aquila chrysaetos*, ribjega orla *Pandion haliaetus* in sokola selca *Falco peregrinus* – v okviru popisov, ki potekajo po celotni državi, in sicer z namenom, da se vsako leto preverijo vsa znana gnezdišča teh ptic, med katere je bil v 90-ih letih vključen tudi arktični sokol *F. rusticolus*. Podatki o populacijah drugih vrstah ptic roparic se zbirajo v okviru projektov, imenovanih Mreža ptic roparic in Anketni vprašalnik o pticah roparicah. S prvim projektom se vsako leto pridobijo podatki o letnih populacijskih indeksih, ki so izračunani na osnovi opažanj na 10 × 10 km velikih popisnih ploskvah (n = ca. 130/leto) in dobro odsevajo letna populacijska nihanja ter dolgoročne trende sedmih pogostih dnevnih in šestih nočnih ptic roparic, ki gnezdijo v južnem delu Finske. Za druge vrste, ki so bodisi redke po vsej Finski bodisi gnezdijo predvsem na severu države, zunaj območja dobre pokritosti ozemlja s popisnimi ploskvami Mreže ptic roparic, ugotovitve o populacijskih spremembah slonijo na skupnem številu zasedenih teritorijev in aktivnih gnezd, o katerih vsako leto poročajo v okviru anketnega vprašalnika.

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