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Conservation status of birds of prey and owls in Norway

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NORSK ORNITOLOGISK FORENING

BirdLife INTERNATIONAL

Partnership for nature and people

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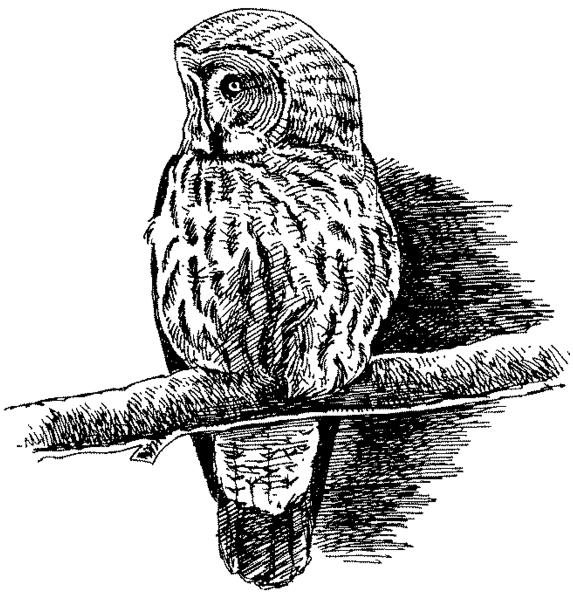

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SUMMARY

Many of the migratory birds of prey species in the African-Eurasian region have undergone rapid long-term declines in recent years. In 2005, a year-long study concluded that 50% of the populations in the region had poor conservation status. The study provided a foundation for the development of an international instrument under the Convention on the Conservation of Migratory Species of Wild Animals (CMS). A Memorandum of Understanding on the Conservation of Migratory Birds of Prey in Africa and Eurasia was concluded and signed by 28 Parties in Abu Dhabi, United Arab Emirates in October 2008. Norway was one of the Signatories at this meeting.

In general, all wildlife, including birds of prey, is protected by law in Norway. Eleven species of birds of prey are listed on the Norwegian 2010 Red List for species, including northern goshawk *Accipiter gentilis*, eagle owl *Bubo bubo*, snowy owl *Bubo scandiacus*, Eurasian marsh harrier *Circus aeruginosus*, hen harrier *Circus cyaneus*, gyrfalcon *Falco rusticolus*, Eurasian hobby *Falco subbuteo*, osprey *Pandion haliaetus*, honey buzzard *Pernis apivorus*, great grey owl *Strix nebulosa* and Ural owl *Strix uralensis*. In addition to being one of the Parties under the Bonn Convention, Norway is also among the Parties under the Washington Convention (CITES), Ramsar Convention, Bern Convention and Stockholm Convention. None of the Norwegian breeding birds of prey are listed in the International Union for the Conservation of Nature (IUCN) Red List.

The Nature Diversity Act is presently the most comprehensive legislation in Norway concerning the protection of biodiversity and ecological processes. Sustainability and the precautionary principle are important points of the Act. The Wildlife Act regulates hunting, killing, introduction and preparation of animals, and provides some general regulations for the keeping of animals in captivity. Sustainable management of forest resources in Norway is regulated by the Forestry Act, and this Act is especially relevant for forest breeding birds of prey, such as the northern goshawk. In general, all regional plans and all municipal plans with guidelines or framework for future development shall be risk assessed, to evaluate influences on the environment and the community, according to the Planning and Building Act.

In several instances, the general legislation does not provide sufficient protection for Norwegian species of birds of prey. In the case of the Forestry Act, birds of prey nests are not protected by law, and regulations on forestry close to such nests are more in the form of guidelines. The guidelines are fairly satisfactory, but forest owners or management are not obliged to follow them. There are also weaknesses in the present Norwegian documentation system for sheep and domesticated reindeer killed by golden eagle *Aquila chrysaetos*. Compensation is in many cases granted despite lack of documentation, and an increasing number of compensation payments contribute to a negative reputation of the golden eagle. Requirements for environmental impact assessments and follow-up related to windfarm (and power line) development should be more comprehensive, and mitigating measures, compensation and cumulative effects should be considered. Professional advice and scientific research should also be taken more into consideration in these cases.

The mainland of Norway has 2,757 protected areas, of which 2,048 are nature reserves, 202 are landscape protected areas and 34 are national parks (the rest have other forms of protection). This covers a total land area of 54,402.49 km^2, which is around 16,8% of mainland Norway. However, the protected land area consists mainly of mountain areas and glaciers, and to a lesser extent lowland and forest areas. Thus, a large proportion of Norwegian forest-dwelling birds of prey do not breed within protected areas. Protection along important migration routes and flyways is in general lacking. A total of 52 Important Bird Areas (IBAs) are identified in mainland Norway, covering a total area of 9,307 km^2 (3% of national land surface). The IBAs are mainly situated along the coast, but two large mountain areas and some wetland systems have been identified in the south. IBAs have been identified for white-tailed eagle *Haliaeetus albicilla*,

osprey and gyrfalcon, in addition to some other species of birds of prey in Norway. 36% of the IBAs have no overlap with national protected areas.

Despite the wording of the Nature Diversity Act, Norwegian birds of prey face many threats, including environmental crime, collision with human constructions electrocution risk at power pylons, environmental contaminants and lack of habitat protection. The most important of these are probably the collision risk at power lines and windfarms, as well as electrocution. For some species, negative attitude among sheep farmers and reindeer herdsmen is suggested to be one of the major threats.

Requirements for environmental impact assessment and follow-up related to windfarm development should be more comprehensive. Cumulative effects should be evaluated, and compensation and mitigating measures carried out. Professional advice and scientific research should also be taken more into account. Electrocution can be avoided by replacement of open transformers with closed transformers, and replacement of low voltage overhead power lines with ground cables, or isolation of open power lines at poles and pylons.

Migration monitoring in Norway is carried out at Lista and Jomfruland bird observatories in southern Norway. Some monitoring have also been carried out at Mølen bird observatory (SE-Norway), while shorter time series exist from Mønstremyr (SW-Norway), Hå municipality (SW-Norway) and Borrevannet (SE-Norway). Most birds of prey breeding in the southern part of Norway probably migrate through Falsterbo in Sweden in autumn, and population trends for several migratory species are largely based on migration counts from Falsterbo Bird Observatory. Some studies of birds of prey breeding in the northernmost parts of Norway are indicative of a more eastern migration route through Finland and Russia.

Several monitoring and ringing programmes on birds of prey are carried out in Norway, many of these coordinated by the Norwegian Ornithological Society (NOF). Most work is carried out on the larger species: honey buzzard, white-tailed eagle, northern goshawk, osprey, golden eagle, gyrfalcon, peregrine falcon *Falco peregrinus*, eagle owl, snowy owl, great grey owl, Ural owl and Eurasian tawny owl *Strix aluco*. Some work is also carried out on smaller species such as the Eurasian sparrowhawk *Accipiter nisus,* common kestrel *Falco tinnunculus*, Eurasian hobby, boreal owl *Aegolius funereus* and Eurasian pygmy owl *Glaucidium passerinum*. In general, species such as Eurasian marsh harrier, hen harrier, common buzzard *Buteo buteo*, rough-legged buzzard *Buteo lagopus*, merlin *Falco columbarius*, northern hawk owl *Surnia ulula*, long-eared owl *Asio otus* and short-eared owl *Asio flammeus* are not monitored in Norway.

Most Norwegian birds of prey populations are considered stable or increasing. The most prominent exceptions are northern goshawk and eagle owl, where populations are declining. The Fennoscandian snowy owl population underwent a major decline throughout the last century. Breeding populations may also have declined for other species, including honey buzzard and rough-legged buzzard, but data is lacking. Declines in national populations are partly due to threaths caused by human activities in Norway and partly due to threats outside of Norway for migratory species.

NOF-BirdLife Norway's priority measures to protect Norwegian birds of prey are the following:

- Ensure that forest management takes into consideration breeding birds of prey, and make such considerations legally binding.
- Enhance protection of forests.
- Improve requirements for environmental impact assessments associated with establishment of new windfarms and power lines.
- Reduce harvest of willow ptarmigan (and rock ptarmigan) to maximum 15% of August populations for regional management plans. Closing of hunting season in early

November or reducing late season quotas are suggested measures to minimise impacts of winter harvest.

- Change to a depredation compensation system similar to those in neighbouring Finland and Sweden, where payments to reindeer managers are higher in areas with a large number of golden eagles. This would encourage measures to prevent damage and to maintain a larger population of golden eagles.
- Encourage studies on population density and population size for species where population size and trend is currently unknown.
- Encourage studies on nomadic movements and migration routes, to improve management of Norwegian breeding species, and to establish more accurate regional estimates of populations shared with other North-European countries.

CONTENTS

1 INTRODUCTION

Birds of prey face a number of anthropogenic threats around the world today. Examples include loss and degradation of habitat, hunting and persecution, environmental contaminants, collision with wind turbines and power lines and electrocution. There are also several problems associated with a warmer climate, e. g. changes in habitats, prey abundance and competing species. Migratory species are especially at risk, as they move over large distances, beyond national boundaries and regulations. The impacts of some of these threats are enhanced due to the fact that many species migrate in groups or concentrate along natural leading lines.

Many of the migratory raptors and owls in the African-Eurasian region show rapid or long-term population declines. This was emphasised in a year-long study commissioned by the United Kingdom Department for Environment, Food and Rural Affairs in 2005 (Defra 2005). It was further concluded that 50% of migratory birds of prey populations in the region had poor conservation status. The study provided a foundation for the development of an international instrument under the Convention on the Conservation of Migratory Species of Wild Animals (CMS – Bonn Convention). The study was presented to the 8th Conference of Parties to the Convention on the Conservation of Migratory Species of Wild Animals (CMS) in Nairobi, Kenya in November 2005, and Parties were urged to evaluate whether a future CMS instrument would be beneficial towards the conservation of migratory birds of prey in Africa and Eurasia (Convention of Migratory Species of Wild Animals (CMS) 2012).

The Memorandum of Understanding (MoU) on the Conservation of Migratory Birds of Prey in Africa and Eurasia (AEBOP) was concluded and signed by 28 nations on 22nd of October 2008 in Abu Dhabi, United Arab Emirates, as a part of the CMS. The general aim of the agreement is to "ensure that all populations of African-Eurasian migratory birds of prey (including owls) are maintained in, or returned to, Favourable Conservation Status within the meaning of Article 1(c) of the Convention". Assignments for each nation are specified with three main objectives in an action plan that was agreed simultaneously as the MoU (Convention of Migratory Species of Wild Animals (CMS) 2008):

- Population declines of globally threatened (Critically Endangered, Endangered and Vulnerable) and near threatened birds of prey should be halted or reversed, and threats to them should be alleviated so that they are no longer threatened.
- Population declines of other birds of prey within Africa and Eurasia with an Unfavourable Conservation Status should be halted or reversed, and threats to them should be alleviated so that they return their populations to Favourable Conservation Status.
- Potential and new threats to all birds of prey species should be anticipated or reduced, so that long-term decline in populations of any species is prevented.

The species are assigned within one of three categories according to their population size and to what degree they are threatened. Category 1 includes globally or near threatened species according to the most recent IUCN Red List (Red List status: EN (endangered), VU (vulnerable) or NT (near threatened). Species assigned within category 2 are considered to have unfavourable conservation status at a regional level within a defined area (listed in Annex 2 of the MoU), while category 3 includes all other migratory species.

None of the bird of prey species listed in category 1 breed in Norway, but eight species breeding in Norway are found in category 2. These are common kestrel *Falco tinnunculus*, gyrfalcon *Falco rusticolus*, osprey *Pandion haliaetus*, white-tailed eagle *Haliaeetus albicilla*, hen harrier *Circus cyaneus*, golden eagle *Aquila chrysaetos*, snowy owl *Bubo scandiacus* and short-eared owl. In addition 14 Norwegian species are included in category 3, namely merlin *Falco columbarius*, Eurasian hobby *Falco subbuteo*, peregrine falcon *Falco peregrinus*, Eurasian marsh harrier, European honey buzzard, Eurasian sparrowhawk *Accipiter nisus*, northern goshawk *Accipiter gentilis*, common buzzard *Buteo buteo*, rough-legged buzzard *Buteo lagopus*, Ural owl *Strix uralensis*, great grey owl *Strix nebulosa*, northern hawk owl, boreal owl *Aegolius funereus* and long-eared owl.

Priority actions listed in § 4 of the action plan are:

- Protection of all species of birds of prey from illegal killing (poisoning, shooting, persecution, unsustainable exploitation)
- Promotion of high environmental standards in the planning and construction of structures (e. g. wind turbines, power lines) to reduce negative impact on species, in addition to improve existing structures.
- Conservation of important bird of prey habitats (ecosystem approach)
- Protection and good management of important localities, especially for important migration bottlenecks and breeding sites for category 1 species.
- Ensure that needs of bird of prey conservation are taken into account in agriculture, fisheries, forestry, industries, tourism, energy production and in the use of chemicals and pesticides.
- Increase public awareness and knowledge of birds of prey, including current plight, threats and what needs to be done to conserve them.
- Monitor populations to ensure and establish reliable population trends, in addition to conducting research on the impacts of current threats.
- Investigate and map migration routes and conduct research on species ecology.
- Building of capacity for conservation actions in institutions and communities.

Priorities are to prevent global extinction of species and then prevent and reverse population declines in globally and near threatened species and as many species with an unfavourable conservation status as possible. On a longer time scale, these populations should be restored, in addition to the populations of all species with an unfavourable conservation status. Declines in populations in all species with a favourable conservation status should ultimately be prevented. The action plan came into effect on the same date as the MoU and is effective for a period of seven years.

Signatories are through the action plan urged to:

- Give some general information of the signatory
- Review relevant legislation
- Review conservation and protection at important sites and along migration routes and flyways
- Review habitat conservation and management in general
- Evaluate information access and –output of the problems faced by birds of prey, and the measures needed to conserve them
- Present monitoring programmes and research on birds of prey populations
- Give information on supporting measures, e. g. plans of action

(Convention of Migratory Species of Wild Animals (CMS) 2008)

This report aims to provide the information asked for in the headers above.

2 PRESERVATION – HISTORY AND LEGISLATION

2.1 National conservation status for birds of prey in Norway

2.1.1 National conservation status

According to the Nature Diversity Act all Norwegian bird species, including birds of prey, are protected by law (Ministry of the Environment - Miljødepartementet 2009). This has not always been the case, and is considered to be one of the reasons why some birds of prey species still have small populations in Norway compared to historical population sizes.

Important dates for the conservation status for birds of prey in Norway are listed in Table 1. The list is by no means complete, and focuses on major events. There have also been local and regional protection measures through the years that are not listed here (Holme *et al.* 1994).

Table 1 - Important dates for the protection of birds of prey in Norway (modified from Holme *et al*. 1994)

1 July 1930	All Norwegian owls except snowy owl and eagle owl protected by law.
14 December 1951	Enactment of the Wildlife Act. All owls, except eagle owl and snowy owl protected by law. The following bird of prey species were hunted all year round: golden eagle, white-tailed eagle, northern goshawk, Eurasian sparrowhawk and eagle owl. Some species were hunted all year round if written permission from the local game committee (Viltnemnda) was provided: rough-legged buzzard, common buzzard, peregrine falcon, gyrfalcon and snowy owl. Other species of birds of prey (not listed above) achieved legal protection in the breeding period (1st March and 20th August; this also included a ban on collection of eggs).
30 April 1962	Osprey protected by law
3 April 1965	Snowy owl protected by law. The snowy owl was protected from hunting activities in Sweden and Finland in 1951 and 1962 respectively (Jacobsen *et al.* 2014).
6 September 1968	Golden eagle and white-tailed eagle protected by law.
16 June 1971	All raptors protected by law, including eagle owl. This was the first time all birds of prey were protected by law in Norway.
29 May 1981	The Wildlife Act was revised. All wildlife, including their eggs, nests, lairs and burrows were protected by law, unless harvesting and other removal was authorised by law. A similar regulation is still in force today, but much of the Wildlife Act was replaced by the Nature Diversity Act in 2009.

2.1.2 The Norwegian Red List for Species

The 2010 Norwegian Red List for Species is the official document of Norwegian species at risk of extinction. The Red List is prepared by the Norwegian Biodiversity Information Centre in collaboration with scientific institutions and experts. The evaluation of species is based on the criteria prepared by the International Union for the Conservation of Nature (IUCN; Kålås *et al.* 2010). Of the total 21 000 species evaluated in the process of preparing the Red List, 4 599 species have been included and 2 398 of these have been categorised as threatened. In total 93 species of birds breeding in Norway are included on the Red List, 77 of which can be found on the mainland. Of the latter, four are categorised as "Regionally Extinct (RE)", five are Critically Endangered (CR), eight are Endangered (EN), 23 are Vulnerable (VU) and 37 are Near Threatened (NT). Furthermore, each Red Listed species is assigned to one of four criteria according to population trend: A – severe population reduction, B – limited area in decline, C – small population in decline, D – very small population/area. If the category of a species has been downgraded on the Red List due to positive influence from neighbouring populations, this is denoted by circles ("°"). Eleven species of birds of prey are currently on the Norwegian Red List:

northern goshawk (NT), eagle owl (EN, C1), snowy owl (EN°, D1), Eurasian marsh harrier *Circus aeruginosus* (VU°, D1), hen harrier (VU, D1), gyrfalcon (NT), Eurasian hobby (VU°, D1), osprey (NT°), honey buzzard *Pernis apivorus* (VU, A2bc), great grey owl (VU°, D1) and Ural owl (VU°, D1) (Kålås *et al.* 2010).
Because birds of prey are long-lived species in general, the evaluation period for population trends are 20-30 years, compared to ten years for most passerines (Kålås *et al.* 2010).

One of the greatest threats to Norwegian Red List birds is presently believed to be changes in land use. Construction of power lines, windfarms and new holiday cabins, as well as outdoor pursuits, may be the greatest threats in this context (Kålås *et al.* 2010).

2.2 International conservation status for birds of prey in Norway

2.2.1 Convention on the Conservation of Migratory Species of Wild Animals (CMS)

The Convention on the Conservation of Migratory Species of Wild Animals (CMS; Bonn Convention) was agreed in 1979, and came into force in 1983, as an intergovernmental treaty. The aim of the Convention is to conserve terrestrial, avian and aquatic migratory species across borders throughout their range. Membership now includes 118 Parties from five continents (as of 1st January 2013). The Bonn Convention is the only global convention specialising in the conservation of migratory species, including their habitats and migration routes. Obligations are established for each State joining the Convention. In addition to several legally binding agreements concerning mammals, there are also legally binding agreements for birds, including "African-Eurasian Migratory Waterbirds (AEWA)" and "Albatrosses and Petrels (ACAP)". Several less formal instruments, such as Memoranda of Understanding, have also been concluded. Many of them deal with specific species of mammals, reptiles, fishes and birds. The MoU on the Conservation of Migratory Birds of Prey in Africa and Eurasia is also included here (Convention of Migratory Species of Wild Animals (CMS)/United Nations Environmental Program (UNEP) 2004).

2.2.2 Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES)

The Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES), also known as the Washington Convention, was agreed on 3rd March 1973 and entered into force on 1st July 1975. CITES is an international agreement between governments, and is one of the conservation agreements with the largest membership, currently numbering 179 Parties. Norway signed the Agreement in 1976. The aim of the agreement is to prevent that international trade in wild plants and animals threatens their survival. This includes trading of live animals and plants, but also trading of wildlife and plant products such as clothing, timber, medicines, souvenirs and food products (Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES) 2013). More than 34,000 species of animals and plants are now protected through CITES to varying degrees. All birds of prey breeding in Norway are included, with most of them listed in Appendix II ("species that are not necessarily now threatened with extinction but that may become so unless trade is closely controlled. It also includes so-called "look-alike species", i. e. species of which the specimens in trade look like those of species listed for conservation reasons of the Convention"; UNEP-WCMC 2011). Three species breeding in Norway are listed in Appendix I ("species that are the most endangered among CITES-listed animals and plants"), namely white-tailed eagle, gyrfalcon and peregrine falcon (UNEP-WCMC 2011). International trade of these species is prohibited by CITES, with an exception if the purpose is non-commercial, such as scientific research (Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES) 2013).

2.2.3 Convention on Wetlands of International Importance (Ramsar Convention)

The Convention on Wetlands of International Importance, or simply Ramsar Convention, is an international agreement for "the conservation and wise use of all wetlands through local and national actions and international cooperation, as a contribution towards achieving sustainable development throughout the world" (Ramsar Convention 2013b). The treaty was adopted in 1971 in the Iranian city of Ramsar, and entered into force in 1975. The Convention entered into force in Norway also in 1975, and by 3rd May 2013 a total of 164 Parties have agreed on the three commitments of the Convention, known as the "three pillars" (Ramsar Convention 2013b):

1) To designate suitable wetlands for the List of Wetlands of International Importance ("Ramsar List") and ensure their effective management
2) To work towards the wise use of all their wetlands through national land-use planning, appropriate policies and legislation, management actions, and public education
3) To cooperate internationally concerning transboundary wetlands, shared wetland systems, shared species, and development projects that may affect wetlands.

In addition to the "classic" wetlands, lakes and rivers, oases, tidal flats, near-shore marine areas, mangroves and coral reefs, fish ponds, rice paddies, reservoirs and salt pans are also covered in the Convention's mission (Ramsar Convention 2013b).

A total of 51 Ramsar Sites are found in Norway, nine of which are situated in Spitsbergen. Most of the sites are of importance to various species of seabirds and waterbirds. Some are of special importance to birds of prey, but mostly this is secondary to waterbirds (Ramsar Convention 2013a). Fokstumyra in Oppland is probably the most important breeding site for hen harrier in Norway. The large marshes and water systems are also of great importance as a feeding area to other species breeding in the vicinity. Some of the coastal Ramsar Sites are important breeding areas for the white-tailed eagle, e. g. Froan, Vest-Vikna coastal landscape, Bliksvær, Karlsøyvær, Skogvoll and Stabbursneset and Røstøyan. Eurasian marsh harrier is found in association with the Kurefjorden area, and is also found breeding at Øra, Jæren and Lista Wetland System. The Lista Wetland System and Jæren are in addition of national importance to wintering and migratory birds of prey. Outer parts of Kurefjorden, as well as some of the other Ramsar Sites situated in southernmost parts of Norway are of importance to wintering birds of prey. Many of the other Ramsar Sites are of course also of importance to birds of prey, either as breeding, feeding or migratory areas, as a consequence of the rich flora and fauna. Åkersvika, Ilene and Presterødkilen Wetland System, Nordre Øyeren, Ørland Wetland System, Glomådeltaet and Pasvik may be of particular importance in this concern, but many others are undoubtedly also of importance.

2.2.4 Convention on the conservation of European wildlife and natural habitats (Bern Convention)

The Convention on the conservation of European wildlife and natural habitats (Bern Convention) entered into force on 1st June 1982. The Convention is open for signature by the member States of the Council of Europe and the European Union, and the non-member States which have participated in the elaboration of the Convention. The aim of the Bern Convention is to "ensure conservation of wild flora and fauna species and their habitats", with special concern to vulnerable and endangered species, including some specified migratory species. Parties are committed to take all appropriate measures to secure conservation of species and their respective habitats, and the measures should be included in planning and development policies and pollution control. They are also committed to encourage education and provide information concerning the need to conserve species of wild fauna and flora and their habitats. Research related to the purposes of the Convention should be encouraged and coordinated, especially to enhance the effectiveness of efforts to protect migratory species and the exchange of information and sharing of expertise and experience (Council of Europe 1979). A Standing Committee of the Convention, where Parties are represented by their delegates, evaluates the implementation of the Convention at each meeting by reviewing reports and case-files and giving recommendations to the Parties (Council of Europe 1979).

Strictly protected fauna species are listed under Annex II of the Convention. Included in Annex II are all *Falconiformes* (diurnal birds of prey) and all *Strigiformes* (owls; Council of Europe 1979). The Bern Convention is now establishing a network of sites of conservation interest (ASCI) called Emerald Network, along similar lines as EUs Natura 2000 network. The Emerald Network is applicable to all European States, neighbouring states (e. g. Caucasus) and North-Africa. The criteria for selecting sites follow listed species and listed habitats. For Norwegian birds of prey these include golden eagle, Eurasian marsh harrier, hen harrier, white-tailed eagle, honey buzzard, merlin, peregrine falcon, gyrfalcon, osprey, Tengmalm's owl, short-eared owl, eagle owl, pygmy owl, snowy owl, Ural owl, great grey owl and Northern hawk owl. Sufficient protection of sites for these species should be accomplished by each Party to the Bern Convention.

2.2.5 Convention on Persistent Organic Pollutants (Stockholm Convention)

The Stockholm Convention on Persistent Organic Pollutants entered into force on 17th May 2004. The Convention is a global treaty "to protect human health and the environment from chemicals that remain intact in the environment for long periods, become widely distributed geographically, accumulate in the fatty tissue of humans and wildlife, and have adverse effects on human health or to the environment" (Stockholm Convention 2013). International agreements like this are essential to cope with these pollutants, given their long-range transport. The treaty requires the Parties to reduce or eliminate the environmental release of persistent organic pollutants (POPs). Initially, 12 POPs were recognised and placed in one of three categories (pesticides, industrial chemicals, by-products) under the Convention. By 2013, 25 POPs are targeted by the Stockholm Convention. Measures to eliminate chemicals listed in Annex A of the convention text must be carried out by the Parties. For the chemicals listed in Annex B, Parties must take measures to restrict their production and use. Measures to reduce unintentional release of chemicals listed in Annex C should also be carried out. For the pesticide DDT, known for its eggshell thinning effects in birds and listed in Annex B of the Convention, use is allowed in certain malaria areas for disease vector control.

By 2013, the number of Signatories is 152, and the number of Parties is 179. Norway signed the Convention in 2001. The international community has worked on enhancing coordination and cooperation between the Stockholm Convention and the environmental agreements of the Basel and Rotterdam Convention over the past years, which share the common objective of "protecting human health and the environment from hazardous chemicals and wastes (Stockholm Convention 2013).

2.2.6 The IUCN Red List of Threatened Species

The International Union for the Conservation of Nature (IUCN) Species Programme has assessed the conservation status for species, subspecies, varieties and subpopulations on a global scale for more than four decades. The aim of the programme is to highlight taxa threatened with extinction to promote their conservation and prevent their extinction, particularly species facing a higher risk of global extinction found in categories *Critically Endangered* (CR), *Endangered* (EN) and *Vulnerable* (VU). The Norwegian Red List for Species (Kålås *et al*. 2010) is based on the criteria prepared by the IUCN, and thus the categorisation of species is the same. *Extinct species* (EX) and *extinct species in the wild* (EW) are also included in the IUCN list. Species with a smaller risk of extinction can be found in the *Near threatened* (NT) and *Least concern* (LC) categories.

The remaining species are found in the categories *Data Deficient* (DD) and *Not Evaluated* (NE). The fact that the plants and animals with a low risk of extinction, classified as LC, have been included in the IUCN Red List since 2003 means that the List does not only consider threatened species, but evaluates the status of all species. All Norwegian birds of prey species are classified as LC in the IUCN Red List of Threatened Species.

2.3 Legal framework relevant for Norwegian birds of prey

2.3.1 The Nature Diversity Act (Naturmangfoldloven)

The Act of 19th June 2009 No. 100 "relating to the management of biological, geological and landscape diversity", recognised as the Nature Diversity Act, replaces the former "Nature Conservation Act" (Naturvernloven) and also much of The Wildlife Act (Viltloven). The purpose of the Nature Diversity Act is to "protect biological, geological and landscape diversity and ecological processes through conservation and sustainable use, and in such a way that the environment provides a basis for human activity, culture, health and well-being, now and in the future, including basis for Sami culture" (Ministry of the Enironment – Miljøverndepartementet 2009). Within the scope of the Act are management objectives for species, habitat types and ecosystems, harvesting of wildlife, priority species (and priority habitats) and protection of individual populations, in addition to some general aspects relating to nature conservation. According to § 15 of the Act, ***all wildlife (i. e. free living mammals, birds, amphibians and reptiles – (for definition: see the Wildlife Act)) is protected unless otherwise stated in the law*** (Ministry of the Enironment – Miljøverndepartementet 2009)***.*** This means that harvesting or removal of natural wildlife shall be authorised by law. All birds of prey, including owls, are thus protected in Norway. § 15 also states that no unnecessary harm or suffering should be caused to free-living animals. Furthermore, their nests, lairs or burrows shall not be intentionally damaged.

§ 5, concerning "the management objectives for species", is founded partly on § 1 of the Wildlife Act and § 1 of the Act relating to Salmonids and Fresh-Water Fish, and is considered equal to these. The objective of the Section is to "maintain species and their genetic diversity for the long term and to ensure that species occur in viable populations in their natural ranges". This also includes natural occurring species that can cause damage (i. e. golden eagle, white-tailed eagle, northern goshawk), but does not apply to foreign organisms. Special rules apply for domesticated species. To achieve maintenance of species and their genetic diversity, areas on which the species depend are also to be maintained. This applies for both larger and smaller areas, and areas on which species depend for a limited period of time, ***including feeding and roosting areas and migration routes*** (Ministry of the Enironment – Miljøverndepartementet 2009)***.*** Cultivated landscapes are also included if such areas are necessary for a species to survive. According to § 5, populations of species on which one species depends (such as different kinds of prey) should also be maintained, and disturbance should be avoided during the breeding season. If such measures are not enough to maintain a viable population, measures *ex situ* should be considered. Extermination of species is illegal in Norway. This was not the case before the Nature Diversity Act came into force in 2009. The precautionary principle is central in § 5. The Section does not impose managers or private enterprises any direct duties, but has importance in exercise of discretion and interpretation of the Nature Diversity Act and other laws, and formulation of new regulations. Other important public interests, such as economic, social or cultural interests, may require that the objective is reached in alternative ways, according to § 14. § 5 has relevance for § 23 (priority species), § 6 (general duty of care) and § 33 (objectives relating to protected areas).

§ 5 together with § 4 (management objectives for habitat types and ecosystems) have turned out to be very effective and useful in specific cases (Christian Steel, SABIMA pers. comm.). All public decisions related to biodiversity have to consider how the objectives of §§ 4 and 5 have been met. If a public decision is in conflict with the objectives, the basis for the decision has to be stronger than normal. If, for instance, a road is planned in an area where an eagle owl, a species categorised as "Endangered" on the Norwegian Red List, is breeding, the decision to build the road is in conflict with the objectives in § 5. In this context § 14 is relevant: "Measures under this Act shall be weighed against other important public interests" (Ministry of the Enironment – Miljøverndepartementet 2009). Thus, economic, social and cultural interests in addition to effective resource management have to be considered. Such interests have to be elucidated in each case.

§§ 8-12 have also general relevance to the protection of species, giving guidelines to required knowledge base in cases of intervention, the precautionary principle, the ecosystem approach and cumulative environmental effects, the user-pays principle and environmentally sound techniques and methods of operation. § 6 concerns the general duty of care, and states that "any person shall act with care and take all reasonable steps to avoid causing damage to biological, geological and landscape diversity contrary to the objectives set out in sections 4 and 5" (Ministry of the Enironment – Miljøverndepartementet 2009). These Sections have most relevance to non-regulated activities.

Access to, and passage through, uncultivated land is regulated by § 22, to prevent damage or disturbance to plants and animals. Examples of activities with relevance to this Section include major events, nature study and photography. Concerning birds of prey, the latter may be of most relevance, especially for breeding birds. The growing interest for photography makes every rare species a vulnerable target, and many photographers do not evaluate the ethics of their actions in order to take "the best" picture.

No birds of prey have so far been included in the list of the so-called "priority species", referred to in § 23. Even so, the eagle owl may become a future priority species. This would lead to special regulations of activities potentially affecting the species in different ways. Of relevance to one species, namely the golden eagle, is Section 19 concerning compensation for loss and consequential costs when livestock and domesticated reindeer *Rangifer tarandus* are killed or injured by predators protected by law. It is stated that "the State shall provide full compensation for the loss and consequential costs in accordance with regulations made by the King" (Ministry of the Enironment – Miljøverndepartementet 2009). § 12a of the Wildlife Act is also relevant in this context.

According to §§ 28-32 of the Nature Diversity Act, concerning foreign species, those responsible for the introduction of live organisms or organisms capable of surviving in the wild, must exercise caution, and the introduction must be approved by the delegated authority. Foreign species include organisms not occurring naturally in Norway, as well as organisms foreign to any local district (Ministry of the Environment - Miljøverndepartementet 2009). Introduction of foreign tree species is specifically treated in the "Regulation concerning introduction of foreign tree species for forestry purposes", where the Norwegian Environment Agency is the head authority (Ministry of Climate and Environment – Klima- og miljøverndepartementet 2012).

2.3.2 Regulation concerning management of predators

The purpose of the Regulation is, according to § 1, to ensure a sustainable management of lynx *Lynx lynx*, wolverine *Gulo gulo*, brown bear *Ursus arctos*, wolf *Canis lupus* and golden eagle (Ministry of the Environment – Miljøverndepartementet 2005). Within this frame, the management shall also protect business activities and other social interests. Considerations to different interests should be emphasised in relation to area and the species in question. § 3 states further that the golden eagle population in Norway shall number 850-1200 breeding pairs. A national monitoring programme shall provide population data for these predators, including data on annual breeding success. The results shall be available to the general public. §

12 is also an important section for the golden eagle, delegating the County Governor the authority to give permission to kill individual eagles that cause substantial damage to domesticated reindeer or livestock, provided that a single individual can be pointed out as the one causing damage. The killing shall be accomplished within a determined area and within a defined period of time, and the permission may be based on certain conditions. Other measures to prevent the damage must have been tested to a reasonable extent before permission is given. Killing or attempts to kill shall immediately be reported to the County Governor, and the dead eagle shall be forwarded to the State Nature Inspectorate (SNO) for immediate control (§ 16; Ministry of the Environment - Miljøverndepartementet 2005).

It is believed that the golden eagle population in Norway presently makes the most of its potential in relation to distribution and number of breeding pairs. Damage to livestock and domesticated reindeer is usually limited to certain periods of the year, and is normally prevented by simple measures. Hunting licenses are not issued to prevent possible future damage. Although the County Governor is delegated the authority to issue killing licenses for golden eagle, the regional predator advisory committee (Rovviltnemnda) may still include the golden eagle in their regional management plan (Ministry of the Environment - Miljøverndepartementet 2005).

2.3.3 Compensation for livestock or domesticated reindeer killed or injured by predators

Two Regulations give animal keepers compensation for livestock or domesticated reindeer killed or injured by predators (Ministry of the Environment - Miljøverndepartementet 1999, 2001). Compensation is given on certain conditions, i. e. provided that the dead livestock/reindeer is found and investigated by the County Governor or a person with delegated authority from the Ministry of the Environment, establishing that the animal is most likely killed by a predator (Ministry of the Environment - Miljøverndepartementet 1999, 2001).

2.3.4 The Wildlife Act

Some Sections of the Wildlife Act are not (yet) replaced by the Nature Diversity Act. This includes some regulations regarding hunting, killing, keeping, introduction and handling of dead animals (including taxidermy). According to § 9, the King decides which species are to be hunted, and to what time of year the hunting may take place (Ministry of the Environment - Miljøverndepartementet 1982). The Norwegian Environment Agency determines hunting season for each species, at what time of the day and in what parts of the country the hunt may take place. Different hunting seasons may be determined in different parts of the country, and regulations may also differ in relation to age and sex. § 15 states that the Norwegian Environment Agency may, without consideration to regulations concerning protection and hunting season, issue a hunting license for:

1) Released animals in fenced areas or on islands
2) Seabirds or ducks for use as human food where this is common.

The use of trapping devices is illegal if not otherwise stated by law or authorised by law, according to § 24. The Ministry of the Environment (MoE) may impose obligation to report hunting bags and other information (§ 50). Bounties may only be determined for wildlife species with a determined hunting season which may cause harm or damage (§ 51). Such bounties must be approved by the County Governor or by the County Governor in collaboration with The Ministry (Ministry of the Environment - Miljøverndepartementet 1982).

No wildlife shall be kept in captivity unless otherwise stated by law or with authority in law (§ 7). ***Use of chemicals or poison for killing of wildlife other than small rodents or reptiles is illegal***, as stated in § 25. The Ministry may in some cases make exceptions (Ministry of the

Environment - Miljøverndepartementet 1982). Other regulations regarding keeping of and experimenting with animals are included in the Animal Welfare Act, and may be relevant in cases of handling or keeping of birds of prey in captivity for rehabilitation (Ministry of Agriculture and Food – Landbruks- og matdepartementet 2009).

Without a licence issued by the Norwegian Environment Agency, it is illegal to introduce wildlife to Norway or introduce wildlife to areas where the species does not normally occur (§ 47). According to § 48, illegally killed wildlife, introduced wildlife or wildlife illegally held captive is the property of the state game fund (Viltfondet). The same is true for e. g. eggs. According to § 48a, ***no one is allowed to keep, offer for sale or sell protected wildlife or eggs without permission***. The King may make exceptions for older specimens in private possession before this section came into force. ***Taxidermists shall be authorised*** and have a written overview of wildlife in possession and from whom such is received from (§ 49). Regulations regarding marking and registration of dead/living wildlife, eggs and prepared specimens may be given by the King (§ 49a; Ministry of the environment - Miljøverndepartementet 1982).

2.3.5 The Outdoor Recreation Act

The public right of access to, and passage through, uncultivated land is a fundamental right in Norway. The purpose is that everyone should have the opportunity for outdoor recreation, to promote healthy and environmentally sound activities. § 2 of the Outdoor Recreation Act gives any person free access to, and passage through, uncultivated land throughout the year, provided they are considerate and cautious. According to § 15, in areas with great number of visitors municipalities may, with consent from the landowner or the user, set conditions on behaviour which any visitor is obliged to follow. The regulations should aim to maintain peace and order, protect plants and animals and promote health measures and sanitary conditions. The regulations must be confirmed by the County Governor. If buildings, fences or similar are built without license, the municipality may stop or remove the construction, as stated in § 40 (Ministry of the Environment - Miljøverndepartementet 1957). To summarise, although there is a public right of access to uncultivated land, the activity should be allowed on nature's terms, and not on human terms (Axelsen 1999).

2.3.6 The Forestry Act (Skogbruksloven)

The purpose of the Forestry Act is, according to § 1, to "promote sustainable management of forest resources in Norway". The Act shall promote local and national economic development, secure biodiversity, landscape considerations and the values of the forest associated with recreation and cultural values. Concerning protection of birds (of prey), § 4 is an important Section, making the forest owner responsible for having adequate knowledge about environmental values in his own forest and pay regard to them when carrying out activities there. Within this framework, the forest owner is free to manage the forest as he pleases, provided no further regulations with regard to the environment are issued by the Ministry of the Environment. This Section confers to the Regulation concerning sustainable forest management (Ministry of Agriculture and Food - Landbruks- og matdepartementet - 2006). The purpose of the Regulation is to promote sustainable forest management to secure environmental values, active reforestation and good health of the forest (c. f. § 1 of the Forestry Act). It is the forest owner's duty to make sure that necessary consideration is taken regarding biodiversity (§ 3), and this should be notified by the forest owner if necessary (§ 4). Forestry is only to occur where environmental values have been catalogued, and if such registration is not carried out the logging shall be based on the precautionary measures stated in the "Living Forest"-standards (Living Forest 2010, Ministry of Agriculture and Food - Landbruks- og matdepartementet - 2006).

§§ 7 and 8 concerning road building in forest and felling and timber scaling, respectively, both mention consideration for important environmental values. If the logging is in conflict with the Act (i. e. has negative consequences for environmental values), the local municipality has the authority to refuse logging or set terms for how it should be carried out. According to Section 11, the municipality may decide that forest owners shall be obliged to notify plans concerning logging activities if this is necessary in order to ensure compliance with the Act. In forest areas of particular environmental value, the Ministry may impose more stringent restrictions on forest management in the form of regulations. Such environmental value could be associated with biodiversity, but also with landscape and cultural and recreational values, according to Section 13 (Ministry of Agriculture and Food - Landbruks- og matdepartementet - 2006).

The municipality is supposed to control that decisions pursuant to the Act are carried out, and shall supervise compliance with the provisions of the Act, according to § 20. The power afforded to local municipalities regarding regulation of forestry activities may be regulated by the Ministry of Agriculture and Food (Ministry of Agriculture and Food - Landbruks- og matdepartementet - 2006).

2.3.7 Act relating to governmental nature surveillance (Lov om statlig naturoppsyn)

To ensure national environmental values and prevent environmental crime, the King may establish a regulatory body. The regulatory body controls that the purpose of the Outdoor Recreation Act, the Act relating to motor traffic on uncultivated land and in watercourses, the Wildlife Act and the Natural Diversity Act are complied with. The supervision is meant to provide advice and information, in addition to carry out management, recording and documentation, and is pledged to secrecy according to §13 of the Public Administration Act. Scientists are also included under the same section (Ministry of Justice and Public Security-Justisdepartementet 1967, Ministry of the Environment - Miljøverndepartementet 1996). In Norway, this regulatory body is the State Nature Inspectorate (SNO), established in 1997.

2.3.8 The Planning and Building Act (Plan- og bygningsloven)

The Planning and Building Act regulates land planning in Norway, and is thus a central Act in environmental management. The purpose of the Act is to promote sustainable development for the good of the individual, society in general and future generations. The connection and interaction between the Planning and Building Act and the Nature Diversity Act is important to protect nature, and especially protection and management of priority biotopes. Another purpose of the Act is to arrange and coordinate governmental, regional (county) and local (municipality) tasks, and provide a foundation for use and protection of resources. Long-term solutions shall be emphasised, and predictability, openness and involvement of all affected parts ensured. Consequences for the environment and society of certain activities shall also be described (Ministry of the Environment - Miljøverndepartementet 2008).

The principal rule concerning environmental impact assessment is that all regional plans and all municipal plans with guidelines or framework for future development shall be risk assessed to evaluate potential influences on the environment and the community. In addition, all development plans that may have potential influence on the environment or the society shall be risk assessed. The rules about environmental impact assessment are now incorporated in the regulations for each type of plan, while environmental impact assessment for measures following other legislation and protection plans still appear in its own section. The Ministry of the Environment is the head authority in land use politics in Norway (Ministry of the Environment - Miljøverndepartementet 2008).

There is also a general prohibition of measures close to the sea or along watercourses, according to the Act (§ 1-8). Special considerations should be taken to the natural and cultural environment, outdoor life and scenery within the distance of 100 meters from the sea or watercourse. Some exceptions to this Section exist, e. g. in association with municipal plans for land use.

2.3.9 Act relating to motor traffic on uncultivated land and in watercourses (Motorferdselloven)

The Act regulates motor traffic on uncultivated land and in watercourses on the basis of considerations of public interests and the land owner's rights and interests. The Act gives some opportunities for motor traffic on uncultivated land, either directly or by dispensation from the local municipality. Priority outdoor pursuits are one of the main reasons for restrictions. However, cross-country vehicles may also be important equipment used in poaching. Restrictions may also be a valuable tool to minimise traffic during the breeding season in some areas (Axelsen 1999, Ministry of the Environment - Miljødirektoratet 1977).

2.4 National regulations in environmental impact assessment

The Norwegian Government aims to prepare and organise increased development of wind power in areas where conflicts are acceptable in relation to other considerations, to increase the production of renewable energy. "Guidelines for planning and localisation of windfarms" were prepared by the Ministry of the Environment (MD) and the Ministry of Petroleum and Energy (OED) in 2007 (Ministry of Petroleum and Energy – Olje- og energidepartementet 2007). These guidelines are meant to ensure development based on broad and long term evaluations, and to keep conflicts with other land use interests and environmental values at an acceptable level. The Energy Act, the Nature Diversity Act and the Planning and Building Act set the legal framework for concessionary treatment (Ministry of Petroleum and Energy – Olje- og energidepartementet 2007).

The Energy Act states that complete evaluations of all advantages and disadvantages shall be carried out in relation to development of windfarms. Concessions shall be based on a satisfactory knowledge base (Ministry of Petroleum and Energy – Olje- og Enegidepartementet 1991). "Thematic conflict evaluation" (tematisk konfliktvurdering) of windfarms have been carried out since 2005, as a supplement that the Norwegian Water Resources and Energy Directorate (NVE) shall consider when treating concessions, and that municipalities shall take into account when handling plans and regulations for windfarms. Conflict evaluations in relation to the natural environment are carried out by the Norwegian Environment Agency, while conflict evaluations of the cultural environment are carried out by the Directorate of Cultural Heritage (Norsk Telegrambyrå 2013).

The Norwegian Water Resources and Energy Directorate (NVE) determines the programme for environmental impact assessment in each case. A proposition for the area development plan is prepared by the developer. When the risk evaluation is carried out, it is synthesised with the area development plan, and the developer may prepare a licence application. The application is supposed to describe the project and the results of the environmental impact assessment. The impact assessment and licence application is then made available for public inquiry. The licence application, including environmental impact assessment, is considered according to the Energy Act, while the proposed area development plan is considered according to the Planning and Building Act. Following the public inquiry, NVE decides whether further investigations are necessary. When the basis for decisions is considered sufficient, it is determined whether a licence is granted and, if so, under what conditions. Municipalities, land owners, developers or other stakeholders may make complaints against the decision. Complaints are finally handled by the Ministry of Petroleum and Energy (Ministry of Petroleum and Energy –Olje- og Energidepartementet 2007).

In practice, environmental impact assessment in relation to development of power lines is similar to environmental impact assessment in relation to development of windfarms. Power lines with 132 kV voltage or more, and which are more than 20 km long must be risk assessed and require public inquiry (Norwegian Water Resources and Energy Directorate - Norges Vassdrags- og Energidirektorat unknown year). It is important to keep in mind that new production of energy often requires more and larger power lines. The many currently planned and licensed windfarms, in addition to several hundred small hydroelectric power stations, will require hundreds of kilometers of power lines. Plans to upgrade the central power grid in Norway (320-400 kV) will also require large land areas (Sjong 2012).

2.5 Need for new legislation?

2.5.1 Legally manifested protection of birds of prey nests

Forest management and protection of environmental values, including birds of prey, are difficult issues, due to an unnecessarily complicated legal framework and legal organisation. The Forestry Act includes many important points, but there are also many drawbacks regarding the protection of environmental values. One of the most considerable problems is the inadequate level of enforcement and follow-up of the legal framework. Lack of precision concerning what is meant by the Act results in lack of understanding and knowledge gaps among decision makers (Bjørn Rangbru, Environmental Department, County Governor of Sør-Trøndelag pers. comm.).

In principle, there are two "regulating authorities" that deal with forestry in Norway: the governmental management body and the certification body. The Living Forest Standard is a voluntary agreement concerning requirements for environmental considerations in forestry. For many years, environmental protection organisations and industry agreed upon this standard. Following a breach in the collaboration in 2010, the industry has maintained and further developed the standard (Living Forest 2010), now recognised as the Pan European Forest Certification (PEFC). The PEFC is presently the world's most extensive forest certification system (PEFC, 2013). If the Standard is breached, the forest owner may lose his certification, although in practice this has never occured. To date, none have lost their certification despite forestry destroying hundreds of so-called MiS (MiS is a value for environmental values in forest/"Miljøverdier i Skog"). The MiS figures are no-go areas for forestry, where environmental values, e. g. threatened plants and animals, should be protected (e. g. Hjorth 2011, Bjørn Rangbru, County Governor of Sør-Trøndelag pers. comm.). One of the reasons that not one have lost their certification may be the low level of follow up and supervision in these cases. In many ways, the Forestry Act is based upon the former Living Forest standard (= PEFC). If the latter is violated, the Forestry Act is in principle also breached. The municipality, which is supposed to follow up these matters, often argues that these cases are followed up by the certification body. This may be perceived as ignoring liability. If the industry changes the PECF/Living Forest standard, the legislation is changed in a similar matter, and thus *the industry* in principle provides the legal framework (Bjørn Rangbru, County Governor of Sør-Trøndelag pers. comm.).

Regarding birds of prey, the industry (The Norwegian Forest owner's Association - Norges Skogeierforbund (NSF)) has proposed some guidelines regarding forest management close to birds of prey nests (Søgnen 2011). The guidelines are fairly satisfactory, but they are not included in the PECF/Living Forest standards. Thus, forest owners or management are not obliged to follow these guidelines, which therefore may be considered as voluntary recommendations. If the guidelines are breached, there are no sanction possibilities (Bjørn Rangbru, County Governor of Sør-Trøndelag pers. comm.). § 7 of the Forestry Act, concerning road building in forests, is in principle a good Section. However, in the past, routines have failed to provide a sufficient overview and knowledge when roads are built. There are no guidelines for the County Governor when evaluating applications to build new forest roads, while the municipality has to make sure that the case is as enlightened as possible. The County Governor may in certain cases provide opinions on environmental values. In several cases, municipalities are not aware of the environmental values they are supposed to protect. In these cases one cannot expect that the County Governor's opinions are asked for, who then will know nothing about the road building plans. This means that environmental values, like birds of prey nests, in some cases are not evaluated. The Ministry of Agriculture and Food was asked by the Government to revise regulations and routines many years ago, but nothing has happened since (Bjørn Rangbru, County Governor of Sør-Trøndelag pers. comm.). § 8 concerning felling and timber scaling states that the local municipality has the authority to refuse logging or set terms for how it should be carried out. This is rarely or never done, and is probably a "sleeping" Section (Bjørn Rangbru, County Governor of Sør-Trøndelag pers. comm.). Previously, breeding sites for birds of prey were mostly kept secret, but this led to forest owners claiming ignorance when nesting trees were cut down. Hopefully, the industry will use available databases to a larger extent in the future, and avoid logging activity close to known birds of prey nests (Runar Jacobsson pers. comm.).

There are unfortunately many examples of destruction of birds of prey nests due to forestry. This occurs despite the rhetoric in the Forestry Act, and new cases constantly focus on the topic. Northern goshawk nests are the most vulnerable because of the species' preference for old, mature forest, but also many other species suffer from logging activity. To conclude, the Forestry Act does not provide sufficient protection for birds of prey nesting sites.

2.5.2 Improvements of the compensation system

A report from 2003 revealed no clear relationship between the breeding population of golden eagles and reported predation on sheep (Gjershaug & Nygård 2003). The number of sheep and lambs compensated for due to predation by golden eagle has also increased in recent years, from 952 in 2008 to 2050 in 2012 (Directorate for Nature Management 2013). This has been questioned by NOF-BirdLife Norway, as no corresponding increase in the golden eagle population has been observed during the same period (Norwegian Ornithological Society 2013a). In Oppland alone, 433 sheep assumed killed by golden eagle were compensated for in 2012, out of a national total of 800 individuals reportedly killed by eagles. Only ten of these animals were documented as killed by golden eagle, with an additional eight sheep assumed killed by golden eagles (Directorate for Nature Management 2013). This leaves the remaining 415 of the compensation payments as having being made without good reason, which is in defiance of the Nature Diversity Act. Only twelve pairs of golden eagles produced chicks in Oppland that year (Norwegian Ornithological Society 2013a). Similar cases might also exist for domesticated reindeer. These data indicate weaknesses in the present Norwegian documentation system. Lack of documentation and an increasing number of compensation payments contribute to a negative reputation of the golden eagle, and a demand for population reductions. NOF have called for a better knowledge base when compensating sheep and reindeer predated by golden eagles in Norway (Norwegian Ornithological Society 2013a).

It has been suggested to change to a compensation system similar to the ones in Finland and Sweden as a solution to this problem. In these countries, Sami settlements and different reindeer regions are paid according to the number of breeding pairs of golden eagle in the area, which makes a large breeding population and low degree of damage beneficial, thereby encouraging preventive measures (Gjershaug & Nygård 2003).

2.5.3 More comprehensive requirements for environmental impact assessment

The Directorate of Cultural Heritage is supposed to evaluate conflicts related to windfarms through the "thematic conflict evaluation (TKV)", an evaluation where wind energy and national environmental goals are weighed against one another. However, the Directorate for Cultutal Heritage wishes to back out of the TKV-agreement, on the basis of the lack of consideration of the evaluation by the Norwegian Water Resources and Energy Directorate (NVE). This is illustrated by the fact that four out of eight projects categorized as being in "considerable conflict" with cultural and/or environmental values have been licensed, which is also the case for 14 out of 19 projects evaluated as being in "great conflict". The Norwegian Environment Agency has also expressed their dissatisfaction for the treatment of the TKV by Norwegian Water Resources and Energy Directorate (Norsk Telegrambyrå 2013).

NOF-BirdLife Norway raised, through BirdLife International, the problems associated with the development of Smøla windfarm at the Bern Convention annual meeting in 2009. The surveyor's report, which provided the basis for the Bern Convention handling the complaint as a case file in 2009, criticises the Norwegian Government in their considerations of environmental values, and established ten recommendations which should be considered for future assessment programmes for windfarms in Norway (Convention on the conservation of European wildlife and natural habitats 2009).

These ten recommendations highlight the need to take cumulative effects on a wider scale into account, as well as the conflict assessment for each case. The quality, independency and completeness of the risk/environmental impact assessment should be ensured before licensing windfarms, including follow-up and interpretation of recommendations and complaints. More importance should be attached to scientific reports available. Mitigation measures should be imposed to reduce detrimental effects of windfarms, including shutting down turbines during certain periods of the year, e. g. during migration or during courtship and reproduction. The positive effects of such measures should be investigated. Experience gained from research at Smøla and similar projects should be taken into account when considering new, not yet licensed, windfarm projects. Alternative sites should be investigated to reduce conflicts. More research should be carried out in relation to windfarm licensing, and comments and advice from environmental authorities and complaints from NGOs should be publicly addressed in the final decisions by the Norwegian Water Resources and Energy Directorate, explaining why complaints and advice were not taken into account, if this is the case (Convention on the conservation of European wildlife and natural habitats 2009).

Demands for preliminary and follow-up surveys should be set. Follow-up studies at Smøla have unfortunately been misused by the energy authorities. It is argued that the windfarm has had no negative effect on the white-tailed eagle population because of the growing population in the area (Kolstad 2012). This in spite of many eagles being documented killed by the wind turbines in this area, and a decreased number of breeding pairs within the windfarm area (Dahl *et al.* 2011). Field work should be carried out at relevant periods of the year and by qualified personnel. Unfortunately, field work is not always carried out at relevant periods in Norway, and not always by qualified personnel.

It is also important that the designation of internationally important sites are not affected or delayed because of the potential for future development of windfarms in those areas. Non-renewal of the license for exploiting the Smøla windfarm by 2026 should be evaluated, and restoration of the site considered. Loss of natural areas should be compensated for by establishment of new conservation areas, to protect biological diversity and landscape in Norway (Convention on the conservation of European wildlife and natural habitats 2009). Some of the Bern Convention recommendations seem to have been taken into account since 2009, but work still needs to be done (Kolstad 2012). As an example, the energy authorities have started to evaluate several applications in the same area at the same time, and have included power lines in the total evaluation. However, already licensed and existing windfarms are still not taken into cumulative consideration (Anne Kolstad pers. comm.).

The white-tailed eagle is no longer a red listed species in Norway, but Norway is the main stronghold of the species on a global scale, and has a particular international responsibility for taking care of the species. Many windfarms have already been established in important areas for white-tailed eagles. The most famous is undoubtedly the one at Smøla, where more than 51 eagles were found killed by wind turbines in the period 2005-2013 (Alv Ottar Folkestad pers. comm.; Dahl 2011). The eagle owl is still listed as "Endangered" on the Norwegian 2010 Red List, and the species is the only bird of prey with a National Single Species Action Plan (SSAP). Despite statements of the importance to take eagle owl territories into account in land planning and land use in the national SSAP, several windfarms in such areas have been licensed (Eldøy 2012, Kolstad 2012).

The energy sector was responsible for about 40% of the loss of environmental areas in Norway with no former human disturbance/intervention within 1 km distance ("inngrepsfrie naturområder") in the period 2003-2008 (2011). It is estimated that 55% of all windfarm development plans are in great conflict with national environmental values such as pristine areas. Despite this, more than half of these plans have received concession, including in areas where regional plans for wind power development recommend no such activity because of the important environmental values (Kolstad 2012).

In the treatment of applications, Norwegian Water Resources and Energy Directorate evaluates whether the measures are socially reasonable, according to § 1 of the Energy Act. If this is the case, concession may still be withheld if other interests, including environmental values, are expected to be affected (Ministry of Petroleum and Energy - Olje- og enegidepartementet 1991). However, the decision is based upon personal judgment within the Norwegian Water Resources and Energy Directorate, and not the legal framework. It is also argued that renewable energy production helps the environment and climate, and this is usually considered more important than habitat conservation. This means that the Nature Diversity Act and the Planning and Building Act have limited influence in these cases (Anne Kolstad pers. comm.).

The court of law has to a small degree importance as a policy instrument in energy cases. There are a number of demands and regulations in the legal framework, but the energy authorities still decide which considerations are the most important.

2.6 Protected areas

By 2013, the mainland of Norway has 2,757 protected areas, of which 2,048 are nature reserves, 202 are landscape protected areas and 34 are national parks (the rest have other forms of protection). These cover a total land area of 54,402.49 km^{2},, which is around 16,8% of mainland Norway (Statistics Norway - Statistisk sentralbyrå 2012). In addition 36 marine areas have been proposed by an advisory committee in a Norwegian national marine conservation plan, covering a total area of 3,450 km^{2} (Skjoldal 2005, Directorate for Nature Management 2012). Such marine protected areas could be important for birds of prey species linked to the marine ecosystems such as the white-tailed eagle.

Legislation on protection of areas is included in chapter V of the Nature Diversity Act, which replaces the former "Nature Conservation Act" (Naturvernloven) in these matters. There are five categories of protection under the Nature Diversity Act: National park, landscape protected area, nature reserve, biotope protected area and marine protected area (MD 2009). National parks are large natural areas without any interventions of significance and with natural values of special significance. In such areas, long-lasting influence on the natural environment is not to occur, unless this is necessary to protect the original purpose of protection. Landscape protected areas are areas where natural or cultural landscapes are protected for their ecological, cultural or "natural experience" values. Cultural artefacts that contribute to the character of the landscape are considered parts of the landscape. Measures that significantly change the distinctive character of the landscape are prohibited, but ongoing activities may in most cases be continued. Nature reserves are areas that contain threatened, rare or vulnerable nature, represent a special type of nature, are of special importance to biological diversity, constitute a special geological occurrence or are of special scientific value. All operations could potentially be stopped if necessary to meet the purpose of protection. Biotope protected areas are areas that have, or have the potential to be of special importance to one or several particular species. The biotope protection may be exercised for all species. Marine protected areas are established to protect marine values, including natural values that provide ecological conditions for land-dwelling species (Ministry of the Environment - Miljøverndepartementet 2009).

Most of the protected areas in Norway are made up of national parks and landscape protected areas, covering 31,000 km^2 and 17,300 km^2 of Norwegian mainland, respectively. Nature reserves cover a smaller total area, but are far more numerous than national parks and landscape protected areas. In 2010, only 5% of areas below 300 m a.s.l. were protected, whereas 35% of areas above 900 m altitude were protected. Only 6.8% of the total area of forest in Norway was protected in 2010, whilst 27% of mountain/open areas and 72% of the area covered by glaciers were protected. Of the protected forest areas, coniferous forests make up only a small part (Framstad *et al.* 2010). The situation has probably not changed much since 2010, and there is still an urgent need for more forest protection.

The Norwegian Parliament agreed in 2004 to enhance forest protection, through voluntary protection and protection of forest areas owned by the Government. Due to lack of funding, this work stopped in 2012, and forest owners who voluntarily wish to protect their forest have to wait for years before protection measures are implemented. More funds were allocated for this work in 2013, but it is still not enough to get the wheels running. In March 2013 NOF-BirdLife Norway, in alliance with organisations from industry, forest owners, outdoor pursuits and environmental protection sent a request to the Government in March 2013, asking to step up the forest protection budget (Norwegian Ornithological Society 2013b).

It is difficult to evaluate the proportion of breeding pairs of birds of prey that are found within protected areas in Norway. This is especially true for the smaller species, e. g. Eurasian sparrowhawk, merlin and common kestrel, where data on population sizes is lacking. For some of the larger species this might be possible due to more comprehensive surveying and monitoring. This is especially true for the white-tailed eagle, Northern goshawk, golden eagle and gyrfalcon, and perhaps also for the peregrine falcon. Less numerous species, such as the hen harrier and Eurasian marsh harrier, might also be possible to evaluate in this regard. Doing this properly would require a lot of resources. However, a large proportion of birds of prey nesting in Norway are undoubtedly found outside protected areas, and this is also true for many of the mountain-dwelling species. As an example, only four out of 17 known breeding sites for gyrfalcon in Buskerud are found within protected areas (Furuseth & Furuseth 2012).

For many of the forest- and lowland-dwelling species it might also be possible to evaluate the proportion of breeding pairs within protected areas. This is simply due to the very small area of protected forest in Norway. Birds of prey species found only in forest areas (primarily coniferous forest) are honey buzzard, northern goshawk, osprey, common buzzard, hobby, Ural owl, great grey owl, boreal owl and pygmy owl *Glaucidium passerinum*. Most other species of birds of prey in Norway may also be found breeding in forest habitats, but these also breed in other habitats: in mountain areas, coastal areas or in urban areas. Eurasian sparrowhawk, peregrine falcon, tawny owl *Strix aluco* and long-eared owl are in general often found breeding in rural or urban areas in addition to forest areas, and it is therefore reasonable to suggest that most pairs of these species are not found breeding within protected areas, as such habitats in general rarely are protected (Framstad *et al.* 2010).
In the case of *migrating* birds of prey, there is a general lack of conservation of important migration sites. This is probably partly due to a general lack of single important sites, often referred to as “bottlenecks”. Nevertheless, studies have revealed that such important sites may also exist in Norway (Mjølsnes 2005, 2006a, 2006b).

2.7 Internationally important bird areas (IBAs)

The BirdLife Important Bird Areas (IBA) Programme is a worldwide programme with the purpose to identify and protect a network of sites critically important for the conservation of birds all over the world. A number of regional IBA programmes exist, with the European IBA Programme being the longest running (Heath & Evans 2000). Particularly important areas for birds in Europe are:

- Sites for globally threatened species and other species of European conservation or European Union concern
- Sites where migratory species congregate in high numbers
- Sites for species unique to a small region
- Sites that support a species assemblage that is highly representative of a distinct biome

(Heath & Evans 2000)

Such sites are classified as IBAs by BirdLife International, where significant parts of species' population can be found regularly. If these sites are protected and managed in a good way by a network of countries across the world, this may contribute greatly to the conservation of species. The conservation of important sites should be managed synchronously with conservation of species and conservation of habitats (Heath & Evans 2000).

IBAs are selected through the application of a number of qualitative ornithological criteria. For the selection of IBAs in Europe, twenty criteria have been developed, and are based on a site's international importance for threatened species, congregatory species, assemblages of restricted-range species and assemblages of biome-restricted species. The international importance of a site for a species is categorised at one of three geographical levels: Global (A), European (B) and European Union (C) (Heath & Evans 2000). To identify IBAs, BirdLife International has benefited from data collected by the vast network of ornithologists, amateur birdwatchers and conservation experts across the world. This is also true for Norway (Heath & Evans 2000).

A total of 52 IBAs are identified in mainland Norway, covering a total area of 9,307 km^2 (3% of national land surface). The IBAs are situated mainly along the coast, but two large mountain areas and some wetland systems have been identified in the south. When identifying IBAs in Norway in 2000, white-tailed eagle was one of the species of global conservation concern, meeting criterion A1. Thus, there are nine Norwegian IBAs for the species (Sør-Fugløy, Skogvoll (including Skarvklakken), Saltstraumen, Svenningen-Risvær, Lovunden, Vega archipelago, Froan, Havmyran and Smøla archipelago). Species of European conservation concern with significant breeding populations at IBAs in Norway in 2000 (meeting any IBA criteria) include white-tailed eagle (3% of population breeding in IBAs), osprey (20% of population breeding in IBAs) and gyrfalcon (8% of population breeding in IBAs). IBAs are identified for rough-legged buzzard (Varangerfjord), osprey (Setesdal valley southern part, Lake Vannsjø, Aukerfjella, Nordre Øyeren and Sørumsneset), gyrfalcon (Alta-Kautokeino watercourse, Varangerfjord, Hardangervidda), peregrine falcon (Nordre Øyeren and Sørumsneset), northern hawk owl *Surnia ulula* (Øvre Pasvik) and great grey owl (Øvre Pasvik) in Norway (Lislevand *et al.* 2000).
Despite Norway holding considerable number of breeding pairs of several boreal species, e. g. raptors and owls, their distribution is highly dispersed and non-overlapping, and the identification of particular important sites is difficult in the absence of specific data. 15 of the identified Norwegian IBAs (29%) have a high overlap area (>90%) with national protected areas, while 13 IBAs (25%) have a partial overlap (10-90%) and 5 IBAs (10%) have a low

(<10%) overlap. 19 of Norwegian IBAs (36%) have no overlap with national protected areas. IBAs for birds of prey with no national protection are:

1) White-tailed eagle: Sør-Fugløy, Saltstraumen, Svenningen-Risvær, Lovunden, Smøla archipelago
2) Osprey: Setesdal valley (southern part)
3) Gyrfalcon: Alta-Kautokeino watercourse

(Heath & Evans 2000, Lislevand *et al.* 2000)

As population sizes change over time, there have probably been a great deal of changes with regard to Norwegian IBAs and the status of these during the past decade. There is probably also a number of important bird of prey areas in Norway currently not characterised as IBAs. Thus, work needs to be done in this field in the future.

2.8 Birds in Europe – Population estimates, trends and conservation status

In 2004, BirdLife International published its second comprehensive assessment of the conservation status of all wild bird species in Europe - Birds in Europe II (BirdLife International 2004). Like its 1994 predecessor, Birds in Europe (Tucker and Heath 1994), this review identifies priority species (Species of European Conservation Concern, or SPECs) in order that conservation action can be taken to improve their status. Of the 524 species assessed, 226 – or 43% of the European avifauna – are considered to have an unfavourable conservation status in Europe. This figure exceeds the 38% calculated in the 1994 review, and shows that overall the status of Europe's birds deteriorated during 1994–2004. This is also the case for many raptors and owls. However, a few species have recovered and are now classified as having a favourable status. The recovery of the white-tailed eagle and the peregrine falcon is a good example, illustrating the benefits of targeted conservation action.

The data gathered for this second review have also led to changes in the global threat status of several species, for example, red kite *Milvus milvus* (BirdLife International 2008). The aim of the assessment was to identify species of conservation concern on a European scale. In the early 1990's, no objective criteria existed for assessing a species' conservation status at a regional level. Species classifies as Secure had a Favourable conservation status, but all others had an Unfavourable conservation status, and were therefore threated as Species of European Conservation Concern (SPECs). Each species was assessed against a number of criteria, which resulted in species being classified into one of five catecories, depending on their global conservation status, their European threat status and the proportion of their global population range in Europe. In 2015, a third assessment (Birds in Europe III) will be published, and NOF-BirdLife Norway are currently working on the population assessments and trend analyses for all bird species breeding in Norway, including all species of raptors and owls.

3 THREATS

Birds of prey face many kinds of threats in their natural environment, but by far the most serious ones are anthropogenic. Many species have a history of persecution through centuries, because of superstition, or because of misbeliefs that they represent a threat to livestock, fishing industry, game populations and so on. Such opinions still exist, and there are several examples of use of poisons and illegal hunting even in Norway. Illegal hunting was still in the early 1990's actually one of the most common forms of environmental crime in Norway (Holme *et al.* 1994). Poaching for taxidermy or collecting purposes is a threat in many parts of the world including some European countries, and could be a menace to migratory birds of prey breeding in Norway. Collection of eggs and chicks has also been a problem in Norway. The major threats to these birds in Norway are nevertheless probably unintentional killing, including collisions with power lines and wind turbines, electrocution, habitat destruction and environmental contaminants.

3.1 Environmental crime

3.1.1 Examples

There are several examples of environmental crime affecting birds of prey in Norway. One of the most well-known is from Germany during summer 1992. For a long time there had been suspicion that eggs and chicks collected illegally from breeding raptors in Norway were transported to Germany for use in falconry activities. This was confirmed by the find of a long list detailing the origins of captive raptors in Germany in 1992, including 36 Norwegian gyrfalcons and some golden eagles. However, there were reasons to believe that the number of raptors collected in Norway was much higher than what was found. These birds were probably already further distributed. A highly organised and extensive smuggling activity was uncovered, with many persons involved (Holme *et al.* 1994).

Collection of eggs has been, and probably still is, a popular hobby in certain communities in Norway. According to the Nature Diversity Act, this is however illegal for all birds of prey in Norway (MD 2009). One of the problems with this activity is that the rarest eggs are the most "valuable". The same is true for collection of stuffed birds of prey – the rarest species are the most sought after. Several examples of such activity exist from Norway (Holme 1994). Even in recent years large collections, often exceeding 100 000 eggs, have been found in Europe, involving tens of thousands of eggs collected in the Nordic countries. Also nationally huge collections, with tens of thousands of eggs or more, still exist. All domestic collections shall be registered with the Norwegian Environment Agency, but no marking or tagging system has been implemented. The lack of enforcement system opens for illegal exchange, trade and renewal of collections (Øystein Størkersen, Norwegian Environment Agency pers. comm.).

Use of poisons to kill raptors has also been confirmed in Norway. This is usually carried out by poisoning of eggs or carcasses, and examples of such acts have been revealed in e. g. Stor-Elvdal in 1991, Nord-Trøndelag in the period 1990-1993 and Sunnmøre in 1994. Often, the goal of such activities is to get rid of ravens and crows, but sometimes also raptors or large carnivores (Holme *et al.* 1994).
In Telemark, in August/September 2006, wires with sheet iron, cans and rags intended to scare were found mounted in front of a golden eagle nest. The case was reported to the police, but was not solved and the case was finally dismissed. In another golden eagle territory in the same area, no successful breeding has been recorded since the start of the 1990s, despite breeding attempts on several occasions. Illegal interference is suspected, strengthened by findings of a rifle cartridge close to the breeding site, and human destruction of the nest. Suspiciously low breeding success is also observed at several other golden eagle and gyrfalcon breeding sites in

Telemark and Buskerud. Surveillance of nests has successfully been carried out on both these species in the area (Steen & Sørli 2008).

3.1.2 Penal provisions

According to the General civil penal code, § 240, serious intentional or careless environmental crime of the following character is punishable with up to fifteen years imprisonment (Ministry of Justice and Public Security 2005):

- Pollution of air, water or soil in a way that seriously damages or threatens the living environment in an area
- Storage or leaving behind of timber waste or other substances with the potential of damage to the environment similar to a)

Serious intentional or careless environmental crime of the following character is punishable with up to 6 years imprisonment (§ 240) (Ministry of Justice and Public Security 2005):

- Diminishment of a natural population of a protected organism that is threatened by extinction on a national or international level
- Infliction of significant damage on a protected area

Those who ally with someone to commit a crime as described in § 240, are liable to be punished with up to six years imprisonment (§ 241) (Ministry of Justice and Public Security 2005).

Those who with intention or carelessness violate the regulations in § 15 and § 22 of the Nature Diversity Act are liable to be punished with fines or up to one year imprisonment. This includes those who harvest or remove naturally occurring wildlife not authorised by law, and those who harm or disturb animals and cause damage to their nests, lairs or burrows (also by means of nature studies, photography and major events). Serious irregularities are punishable with fines or up to three years imprisonment, according to § 75 of the Nature Diversity Act (Miljøverndepartementet 2009). Violations of the Wildlife Act law may be punished with one year in prison, unless stricter regulations apply (§ 56). In special cases two years imprisonment may be given (Miljøverndepartementet 1982).

3.2 Collisions and electrocution – Wind turbines and power lines

The risk of collisions with wind turbines and power lines and the electrocution risk (death caused by electric shock when birds cause electrical short circuit and outages) at power pylons are no doubt major threats to birds of prey in Norway. The risk of collision with trains and cars is also probably a significant threat in certain areas.

3.2.1 Collisions

The risk of collision with power lines poses a threat to a number of birds of prey species, both diurnal and nocturnal (Lislevand 2004b). Mostly large species are reported killed by power lines (Bakken *et al.* 2003), but this may be a consequence of the fact that these are easier to find. A large number of windfarms are planned along the Norwegian coastline and in several inland mountain areas, as well as offshore along the coast (Norges Vassdrags og Energidirektorat 2013). The effect of these windfarms on natural wildlife, including birds of prey, is poorly studied in Norway (Kolstad 2012). Despite much research on the effects elsewhere, this is a general problem with the environmental impact assessments and argumentation against such projects in Norway. The exception is the BirdWind Project at Smøla in central Norway. More than 51 white-tailed eagles have been reported killed by wind turbines in the period 2005-2013, and the windfarm contributed to an extra 30% mortality for the eagles. Number of breeding eagles within the windfarm area has also been reduced during the same period (Alf Ottar Folkestad pers. comm., Dahl *et al*. 2011).

The collision risk with cars or other vehicles is well illustrated by the cause of death for 206 tawny owls collected by the Agder Museum in southern Norway: 77 of which were killed in traffic (Roar Solheim pers. comm.). This was also the most common cause of death (36%) for recovered Norwegian-ringed tawny owls, and is also a common cause of death for other species of owls (Bakken *et al.* 2006). For most species of diurnal birds of prey, the risk of being killed in traffic seems to be smaller than for owls, but this may be a potential threat also to some species of raptors (Eurasian sparrowhawk, common kestrel, peregrine falcon; Bakken *et al.* 2003). Collision with trains is sometimes reported as the cause of death for golden eagles and white-tailed eagles (Statistics Norway - Statistisk sentralbyrå 2012). However, the actual number of kills by trains is probably higher. Collision with trains is also an issue for a number of other species, such as short-eared owl and hen harrier in the Dovre mountain area, where the railway line passes through one of the most important breeding areas for these species in Norway (Ree 2005). Collision with windows is also a threat to some species, but is perhaps most evident for Eurasian sparrowhawk: this was the cause of death for 42% of recovered Norwegian-ringed Eurasian sparrowhawks analysed up until 2003 (Bakken *et al.* 2003).

3.2.2 Electrocution

Electrocution, that is death caused by electric shock when birds cause electrical short circuit and outages, has been reported as the largest threat to Norwegian eagle owls, and also poses a threat to a number of other species which use pylons and similar structures as lookout posts. As confirmed bu ringing recoveries, this is the dominating cause of death for first year white-tailed eagles (Alv Ottar Folkestad pers. comm.). The problem of electrocution increases as the distance between a phase conductor and an earthed device and/or the distance between two phase conductors gets shorter. Large birds (e. g. with long legs, wings or tail) are obviously more vulnerable to electrocution than smaller ones.

3.2.3 Solutions to the problem

The collision problem may be reduced by avoiding constructions such as power lines and windfarms in areas where there is a great risk of problems emerging. Examples of such areas are important breeding areas and migration routes. So called “bottlenecks” and leading lines for migrating raptors should be surveyed/identified prior to development of windfarms. Windfarms should also be closed down during particularly vulnerable periods, e. g. during migration periods. Power lines should also be avoided across natural leading lines, and preferably be marked if placed in such areas. Birds face the biggest risk of electrocution at open transformer poles and pylons. These should be replaced with small, closed transformers. Replacement of low voltage overhead power lines with ground cables, or isolation of open power lines at poles and pylons are also relevant measures to reduce the electrocution problem (Lislevand 2004b).

3.3 Habitat protection, land use and conflicts

3.3.1 Examples

Several excuses are used to justify persecution of birds of prey. Conflicts often arise in relation to eagle predation on sheep and domesticated reindeer. Others identify birds of prey as competitors because of their predation on small game species such as rock ptarmigan, willow ptarmigan and mountain hare *Lepus timidus*.

In Hedmark, there have been suspicions that nests and eggs of golden eagles are destroyed or removed because of conflicts with local reindeer husbandry. It has previously been noted that nests placed in trees had a tendency to fall down. Some of the nests were reconstructed by local ornithologists in the early 1990s. Breeding success for the six monitored breeding pairs is especially low in this area (0.3 chicks/pair 1992-2008) compared to other parts of Hedmark (0.59 chicks/pair 1992-2008; Knoff & Nøkleby 2009). As a result of this, some of the nests were included in the Terrestrial Monitoring Programme (TOV-programme) in 2007. Sabotage was confirmed for two of the pairs in 2008 (Knoff & Nøkleby 2009).

Another example is the conflict between forestry and breeding raptors. Nests are often destroyed by felling of nesting trees, or deserted when trees are felled very close to the nest. This happens especially when nests are unknown to land managers prior to logging. This is especially true for species bound to old (coniferous) forest as breeding habitat, such as northern goshawk and honey buzzard. Eagle owls are often also sensitive to such activities close to the nest. A good example of this is found in Hommelvik, near Trondheim in Sør-Trøndelag. Complete deforestation in a large area was carried out in January 2007, close to a well-known eagle owl breeding cliff which had been known since 1936 (Bjøru 2007). No eagle owls has been heard or seen at the locality since then. The logging company *Allskog*, who performed the logging, was aware of the eagle owl's presence in the area, but the nest was pinpointed several hundred meters away from the actual breeding spot on the map, according to them. That deforestation took place in January was in itself a bad thing, at a time when most eagle owls are preparing to breed (Bjøru 2007). Despite the consequences, there were no violations of the law in this case, which in itself underlines the need for better legislation concerning forestry near breeding localities of rare birds of prey (Bakken 2007). Old forest fragmentation and other habitat changes resulting from modern forestry influence the avian and mammalian communities of predators and prey in the boreal forest in Fennoscandia, as well as their predator-prey relationships (Sonerud 1991).

3.3.2 How to avoid conflicts?

The conflict between birds of prey, namely the white-tailed eagle and the golden eagle (and sometimes the northern goshawk), and farmers and Sami people concerning reindeer *Rangifer tarandus* husbandry is difficult to avoid. Golden eagles occasionally kill livestock or reindeer, and the conflict becomes an economic issue. Two regulations give animal keepers compensation for livestock or domesticated reindeer killed or injured by predators in Norway (Miljøverndepartementet 1999, 2001), and provided that the animal is confirmed killed by a predator this should meet the economic loss. Undoubtedly, much of the conflict is based on an obsolete way of thinking of birds of prey as vermin. To get rid of such mentality, it is important to carry out scientific investigation to confirm or disprove suspicions, and then provide information to the public in a good and understandable way, e. g. by use of media.

When it comes to the conflict between forestry and birds of prey nests, the solution lies undoubtedly within the legal framework. An agreement similar to the former Living Forest Standard should be reestablished between the forestry industry and environmental protection organisations. Guidelines concerning logging activity close to birds of prey nests similar to those proposed by the Norwegian Forest owner's Assosiation should be included in the PECF/Living Forest standards and also in the Forestry Act, and if routines are breached, sanction possibilities should be established. In association with this, it is necessary to provide resources to locate nests, and this work is currently carried out voluntarily by a small number of enthusiasts, often in cooperation with NOF-BirdLife Norway. In addition, municipalities should improve the way they follow up violations of regulations. Requirements for environmental impact assessment in association with building of roads in forest areas should also be more comprehensive.

3.4 Environmental contaminants

Many birds of prey have suffered from the use and release of environmental pollutants, bringing on alterations in reproduction, immune function, growth, development and behaviour, as reported in a number of species (e. g. Ratcliffe 1980, Newton 1986, Barron *et al.* 1995, de Swart *et al.* 1996, Verreault *et al.* 2004, Fisher *et al.* 2006). Raptors and owls are particularly relevant in this regard, because of their position at the top of natural food chains. Many environmental pollutants have high lipophilicity, and thus a high affinity for fat tissue once inside the body of an animal. As fat often function as insulation and as storage of energy, such lipophilic substances accumulate throughout an animal's lifetime, and will eventually be transferred to organisms at higher trophic levels of the food chain. This process of accumulation of pollutants in organisms at higher trophic levels is called biomagnification.

3.4.1 Relevant pollutants

One such pollutant, *p,p'*-DDE (*p,p'*-dichlorodiphenyl-dichloroethylene), the metabolite of the pesticide DDT (*p,p'*-dichlorodiphenyltrichloroethane, first used in 1947), is well known for its eggshell thinning effect in birds at higher trophic levels, and the subsequent decline in many populations during the 1960s and 1970s. Dieldrin, another persistent agricultural insecticide, was in the 1960s identified as one of the main causes of the decline in the peregrine falcon population, together with DDE. Contrary to DDE which causes reproductive failure through eggshell thinning, dieldrin leads to elevated adult mortality (Jefferies & Prestt 1966). Other examples of well-known lipophilic environmental contaminants are polychlorinated biphenyls (PCBs) and their metabolites, polybrominated diphenyl ethers (PBDEs), 2,3,7,8-tetrachlorodibenzo-p-dioxin (TCDD) and perfluorinated alkylated substances (PFAS), in addition to some endocrine disrupting chemicals, such as e. g. bisphenol A and nonylphenol.

PFAS are stable compounds made up of carbon chains and fluorine. These compounds have been used in industry and consumer products since the 1950s. Dominating forms in biota are PFOS (perfluoroctane sulfonate) and PFCA (perfluorooctanoate). Confirmed toxic effects are liver damage, adverse immune and developmental effects, and endocrine disruption (Lau *et al.* 2007). PFOS were included in the Stockholm Convention in 2007 (Stockholm Convention 2013). PCBs are another group of persistent organic pollutants included in the Stockholm Convention. Despite the ban, PCBs are still present in the environment due to their persistence. Observed adverse effects are endocrine disruption (e. g. thyroid and reproductive hormones), behavioural changes and interruption of the immune system (e. g. Barron *et al.* 1995, de Swart *et al.* 1996, Verreault *et al.* 2004, Fisher *et al.* 2006).

Other environmental contaminants, such as most heavy metals, do not biomagnify in general, but can still represent a risk. This is particularly true if the environmental concentrations are high, which it can be near effluents. In Norway, concentrations of heavy metals can locally reach high levels, especially close to local industry (Klima og forurensningsdirektoratet 2013). In addition, mercury may biomagnify in its organic form (methyl mercury). Mercury is very toxic both in its organic and inorganic form and both forms may damage the central nervous system. Mercury has been found in high levels in some birds of prey in Norway, including merlin, peregrine falcon and white-tailed eagle (Nygård & Polder 2012).

3.4.2 Needs for action

Despite most environmental contaminants proved to pose a threat to birds of prey has been banned for many years in most European countries, it is still important to be aware of new, potentially harmful pollutants. Most emerging cosmetics, drugs and synthetic substances produced today have to be tested before they are distributed. Nevertheless, it is difficult to test for potential long-term effects of a substance in a laboratory setting, and large variations often exist between different species, age groups, sexes and individuals. DDT is still in use in many

African countries in the fight against malaria, and may pose a threat to some migratory species spending the winter south of the Sahara desert. Scientific research is needed to develop new, less harmful substances that may have the same effect. In Norway, it is important to continue the ongoing monitoring programme of environmental pollutants in birds of prey, presently run by the Norwegian Institute for Nature Research (Nygård & Polder 2012).

3.5 Food depletion – Human overexploitation of food resources for raptors

If hunting mortality comes in addition to natural mortality, then hunting mortality is described as "additive mortality". If natural mortality is reduced because of hunting, hunting mortality is described as compensatory (Pedersen & Storås 2013). Studies on effects on hunting mortality on willow ptarmigan populations in Finnmark, Hedmark and Trøndelag were carried out in 1995-2000. Willow ptarmigan populations were reduced by 0-30% of autumn size and survival was investigated by radio tracking of individuals. The studies clearly show that hunting mortality, contrary to earlier suppositions, is mainly additive. In this comprehensive study, only 30% of the hunting mortality was compensatory (Pedersen *et al.* 1999, 2002).

When snowy owls regularly bred in Hardangervidda in southern Norway, both juveniles and adults wintered in elevated valleys and mountain areas around the breeding plateu (Roar Solheim upubl.), and grouse must have been the most likely prey during winter. Those snowy owls that have been marked with satellite senders as part of the Norwegian snowy owl project have all wintered in areas where grouse are likely to be important prey. Heavy shooting pressure on grouse may therefore have been a considerable threat to food availability for snowy owls durig winter and prior to breeding. Previously it was believed that one could safely harvest up to 30% of the grouse population as this would be compensated by increased survival for those individuals that survived hunting. However, a recent study of grouse fitted with radio transmitters has shown that this harvestable proportion is too high, and that only half of this can be harvested to avoid a negative effect on the following seasons grouse population. By harvesting around 15% it was shown that much of the hunting mortality was compensated by increased survival for the rest of the population, whereas a doubling of this level led to a large negative effect upon survival (Sandercock *et al.* 2011).

4 HOW TO INCREASE PUBLIC AWARENESS

Birds of prey are vulnerable to anthropogenic disturbance, habitat destruction and environmental crime. These are some of the reasons why nesting places are usually kept secret from the public. In many cases, this is probably beneficial for the population, especially when it comes to the most endangered ones, such as for instance snowy owls. In other cases, the only way to protect species is to share information with local managers. This is especially true for species vulnerable to forestry, or species threatened by building of new roads, houses, cottages or power lines and windturbines.

There are also examples of good conservation practice involving the general public in Norway. One such example is from Tydal in Sør-Trøndelag. Among a number of gyrfalcon nests monitored in the area during the 1980s, poor breeding success was observed for one of the pairs. Environmental crime was suspected, and systematic follow-up of the nesting site was carried out throughout the breeding season. Eventually, the criminals were captured on photographs. Unfortunately, the pictures were not good enough to identify the criminals. For some years, knowledge of the crime was kept secret, in the hope of catching the criminals in the act. No progress was made, and in 1993 it was decided to involve the media and the general public to monitor the nest. The nest was visible from a Trondheim electricity plant building, which made the monitoring easier. Altogether 80-90 persons were involved, including a number of competent persons, school children and a number of other volunteers to keep a watch over the nest. No chicks disappeared from the nest that year, and no signs of environmental crime have been observed in the following years. Whether this is because of the monitoring more than 20 years ago is unknown, but it may have been be a contributing factor (Ingebrikt Kirkvold pers. comm.). Similar examples exist from Fulufjellet in Sweden (east of Trysil), where gyrfalcons nesting close to a hiking trail was made publically known. This lead to increased monitoring of the birds, and four chicks were produced in the same breeding season (Jacobsen *et al.* 2014).

The Tydal case also led to the establishment of a network of contacts among local inhabitants, and valuable information concerning raptors and possible breeding sites were revealed. People also became aware of the problem of environmental crime (Ingebrikt Kirkvold pers. comm.). This breeding site has not been subject to environmental crime in recent years. However, it is evident that a similar approach would not be possible in parts of the country where raptors are not as appreciated, and also would be problematic for certain species, such as the eagles and owls. Opinions and views on environmental values might also have changed in Norway during the past 20 years. However, examples of involvement of the general public exist also in recent years. For instance, students at the Hedmark University College (Norway) and at Klarälvdalens Folkhögskola (Sweden) have been involved in the Ural owl nestbox project in Hedmark, Värmland and Dalane. This work has included making of nestboxes, but also the follow up of these (Nyhus & Solheim 2011). Such involvement of the public is a good way to increase the knowledge of these species. Birds of prey are fascinating species, and most people would probably appreciate getting to know them better.

For some species, such as white-tailed eagle, gyrfalcon and golden eagle, a large proportion of the European population is found breeding in Norway (BirdLife International 2004), and Norway therefore has a special responsibility for these. In addition, some globally and regionally threatened species breed in Norway. It is important to inform people about this to protect the species effectively. Such information may, for example, be given via the media.

It is also important to get rid of misunderstandings and superstition concerning birds of prey. Negative attitude among sheep farmers and reindeer herdsmen is suggested to be one of the major threats to golden eagles in Norway (Steen & Sørli 2008). Partly, this may be a cause of an increasing numbers of compensations for sheep and reindeer assumed to be killed by golden eagles, despite lack of documentation in most of these cases (Norwegian Ornithological Society

2013a). This probably contributes to sheep farmers and reindeer herdsmen calling for population reductions. It is also important to inform people to what extent golden eagles and white-tailed eagles actually kill reindeer *Rangifer tarandus* calves and sheep, and about the lack of evidence that white-tailed eagles are involved in such cases. Concerning the white-tailed eagle, there has not been a single case confirmed in Norway of the species attacking or killing livestock (lambs, goats or semi-domesticated reindeer), and the species seems to prefer carcasses (Alv Ottar Folkestad pers. comm.).

In addition, it is important to make people aware of the value of having birds of prey around, in predicting the state of their environment and controlling prey populations.

5 MIGRATION ROUTES IN NORWAY – IMPORTANT AREAS AND PROTECTION STATUS

5.1 Migration routes

Raptor migration in Norway is best documented along the southern coastline, but numbers of birds are small as compared to those observed at bottlenecks in Sweden and Denmark. Little is known about important migration routes further north. Many of the migrating birds seen in the south are probably breeding in southern parts of the country. It is likely that a large fraction of migrating raptors breeding in Norway use a more easterly route on their way south, passing over Falsterbo in the southernmost part of Sweden. This is supported by ringing recoveries and by satellite tracking data, e. g. of rough-legged buzzards breeding in central and northern parts Norway (Aarvak & Øien 2012; Bakken *et al*. 2003). Under favourable weather conditions good numbers of migrating raptors are sometimes also observed in Norway, but this is more an exception than a rule. Locations where good numbers of migrating raptors are observed regularly are presented in the following. Other important sites do certainly exist, and more work is needed to map migration routes and areas of particular importance for birds of prey in Norway.

5.1.1 Vestfold

Sundåsen

Vestfold is well known for being a good place to watch migrating birds of prey. Sundåsen in the municipality of Stokke is one of several good locations to observe migration in spring and autumn. Common buzzard is by far the most numerous species, while Eurasian sparrowhawk, northern goshawk and rough-legged buzzard also may be seen in some numbers (Axelsen 2013). Migrating birds of prey follow the same migration route during both spring and autumn at this locality. In autumn, birds tend to appear from the north, and then fly across Vestfjorden south or north of Sundåsen. They usually gain some height from the thermal winds over Nøtterøy or Tjøme, and then cross the Oslofjord in an eastern direction. Most of these birds reach Østfold close to Øra in the municipality of Fredrikstad in Østfold. In spring, birds migrate in the opposite direction (Axelsen 2013). At Øra, migrating raptors are usually observed migrating in a southeastern direction in autumn. It is reasonable to assume that these birds continue southwards along the western coast of Sweden.

Borrevannet

Lake Borrevannet is probably (one of) the best locations for migrating raptors *in spring* in Norway, both with regard to number of birds and number of species. The lake is situated on the "Horten peninsula", and thus close to the narrowest part of the Oslo fjord. In addition the island of Bastøya is situated in the middle of the fjord, and these are most likely the reasons why many raptors cross the fjord from Østfold to Vestfold at this site (Johansen 2005). The majority of these birds have migrated north along the western coast of Sweden. Raptors that migrate north along the eastern coast of Norway, from Telemark and southern parts of Vestfold, also pass by Lake Borrevannet in spring (Johansen 2005). Many of these birds have probably crossed the Skagerrak from Skagen in Denmark. Borrevannet is also a very nutrient-rich lake, and is well suited as a resting and hunting area for many species of raptors.

Spring numbers of raptors at Borrevannet are in general much higher than numbers of migrating raptors in autumn, when the migration is less concentrated around the lake (Johansen 2005). By far the most numerous species in spring is common buzzard, with potentially more than a hundred observed in one day, mostly in March-April. Eurasian sparrowhawk is in general the second most numerous species at the site. Honey buzzard, osprey and northern goshawk are also observed in good numbers in spring (Johansen 2005).

Mølen
Mølen Bird Observatory, situated at the southwestern tip of a promontory at the mouth of Langesundfjord inlet, west of Oslofjord, is probably the best place in Norway to watch migrating birds in autumn. Numbers of migrating raptors are also good, and eleven species were recorded as regular migrants during the 1990s (osprey, honey buzzard, hen harrier, Eurasian sparrowhawk, northern goshawk, common buzzard, rough-legged buzzard, common kestrel, merlin, gyrfalcon and peregrine falcon). Among these, Eurasian sparrowhawk is the most numerous (annual average 1991-1995: 316 individuals), while common buzzard (annual average: 146) and rough-legged buzzard (annual average: 111) were also present in good numbers (Zalles & Bildstein 2000).

Migrating raptors at Mølen continue along the coast in a southwestern direction, and the majority probably crosses the Skagerrak on their way to northern Denmark. Some birds also seem to continue westwards. Most buzzards turn east from the promontory of Mølen and fly across the Oslofjord on their way to southeastern Sweden (Zalles & Bildstein 2000).

5.1.2 Vest-Agder

Mønstremyr
Extensive observations of migrating raptors were carried out at Mønstremyr in southwestern Norway during five autumns in the period 1990-1994. These counts were compared to observations of migrating raptors from other localities in Norway, in addition to counts from Blåvandshuk in Denmark and Falsterbo in Sweden (Grimsby 1998). Results indicate a westerly displacement of migration that normally passes further east, e. g. via Falsterbo, in response to winds from the north-northeastern sector. In particular, species with southwesterly migration in autumn pass Mønstremyr in good numbers, including hen harrier, northern goshawk, Eurasian sparrowhawk and common kestrel (Grimsby 1998). The number of migrating raptors at Mønstremyr, especially numbers of Eurasian sparrowhawks, corresponds positively to the southwesterly migration at Mølen, with a delay of about four hours. This could indicate that raptors observed at Mølen continue in a southwesterly direction along the coast, and turn northwest when passing Lindesnes in the south. Possibly, these birds cross the North Sea west of Mønstremyr and the Norwegian southwestern coast (Grimsby 1998).

In a Norwegian context, the numbers of migrating raptors at Mønstremyr are rather high for some species, with average annual counts of 82, 116, 1,771, 18 and 508 individuals of hen harrier, northern goshawk, Eurasian sparrowhawk, golden eagle and common kestrel, respectively (Grimsby 1998).

5.1.3 Rogaland

Hå municipality
Similar monitoring as that on Mønstremyr have been carried out in southern parts of Rogaland, mostly in southern parts of Hå municipality, between 2004 and 2009 (Mjølsnes 2005, 2006a, 2006b, and pers. comm.). This has resulted in extensive raptor migration being documented, and the area is probably one of the most important for migrating raptors in Norway.

In 2006, the migration of raptors was recorded during 11.7% of the available hours during the migration period, with most hours of counting taking place in September (50% at Mønstremyr). The number of raptors counted from Rogaland still seems to be much higher than those reported from Mønstremyr and Lista bird observatory, with a minimum estimated 3-4,000 raptors passing in September. The most important area appears to be northern parts of

Egersund municipality, southern parts of Hå municipality and also large parts of Bjerkreim municipality.
The most numerous species in the area are Eurasian sparrowhawk, common kestrel, common buzzard and peregrine falcon. In addition, high numbers of merlin, rough-legged buzzard and hen harrier have been recorded. Numbers of honey buzzard and osprey are also high for this part of the country, while numbers of northern goshawks were lower than expected/observed at Mønstremyr ten years earlier. An average > 20 raptors passing per hour seems to be the normal in August-October. The most extensive migration probably starts during the last week of August and continues throughout September, sometimes also into the first weeks of October. Rough-legged buzzards and hen harriers are mostly observed late in the migration season, mostly in October. Most honey buzzards are observed early in the autumn, and most of common kestrels have passed by the end of September. The explanation of the migration phenomenon in southern parts of Rogaland is probably many-sided. The plains of Jæren narrow south of Vigrestad, and raptors on their way south will naturally end up in the areas around Bjårvatnet or the areas east of Bjårvatnet, between the mountains and the North Sea.

Raptor migration is far more complex than migration of passerines. Raptors seem to be less concerned about cardinal points. Many species take advantage of thermal winds, which are especially present in areas with large variations in altitude. Raptors also seem to move with the wind more than other birds. Passerines tend to follow leading lines such as valleys and coastlines on their migration, while raptors that use thermal winds follow ranges of hills, where thermal winds are present. Many such ranges of hills end up in the southern parts of Hå municipality (Matningsdalen, or further southeast towards Gravdal).

It is well known that the migration in these parts of the country is in a northwesterly direction, and this is also true for many of the raptors. Grimsby (1998) suggested that these birds continue west across the North-Sea from Jæren. This may seem to be a strange thing to do for a raptor, which in general are reluctant to cross long distances over open water. One might for instance expect these raptors to cross the ocean from the southern parts of Norway, where the oversea distance is much shorter. Mjølsnes (2006b) suggests that some of the raptors migrating towards northwest may have turned in this direction when facing the sea further south. This phenomenon is often observed at locations such as Falsterbo (SWE) and Skagen (DK), but also at Jæren and along the coast further south. The hypothesis is strengthened by the fact that many of the raptors observed from Lassaskaret (southern Hå) turn and go back the direction they came from when facing the Jæren plains further north, maybe as a consequence of the lack of thermal winds in this area. This is especially true for buzzards, which rely heavily on thermal winds. The fact that species such as honey buzzard, common buzzard and hen harrier are not regular breeders in western parts of Norway also strengthens the hypothesis. Species such as merlin, peregrine falcon, Eurasian sparrowhawk and especially common kestrel use thermal winds to a smaller extent when migrating, and are mostly observed migrating south in this area.

5.1.4 Hordaland

Kyrkjefjellet Mountain
The Kyrkjefjellet Mountain is not actually a mountain, 95 meters above sea level, but is the highest situated site in the central parts of southern Bømlo Island. Good numbers of raptors may be seen here in August and September, especially common kestrels. The highest count for this species is 43 individuals in three hours. Birds fly more or less straight south at this site, and are probably concentrated here because southern Bømlo is situated at the tip of a large triangular landmass that follows the western coastline north and the Hardangerfjord in a northeastern direction (Kjærandsen 2002).

5.1.5 Other locations
Some raptor migration is observed along the large valleys of Østerdalen and Gudbrandsdalen, primarily in autumn. These valleys are orientated in a north-south direction, and migrating birds thus use them as leading lines. No regular monitoring is carried out in these areas. Good numbers of migrating raptors are sometimes also observed along the outer coastline in Trøndelag and Møre og Romdal. In addition, Lierne in Nord-Trøndelag is a good place for migrating raptors (Artsobservasjoner 2013, Venaas 2013). Some good migration locations probably also exist further north, but data from such are lacking. However, a more eastern migration route through Finland and Russia has been documented or suggested for some species breeding in the northernmost parts of Norway, including osprey, rough-legged buzzard and merlin (Österlöf 1977, Nygård 1999, Aarvak & Øien 2012).

5.1.6 Summary
To sum up, few good raptor migration locations are known in Norway, and the spring migration pattern along the entire Norwegian coast is obviously only partly known. More comprehensive and systematic mapping of important migration sites is therefore needed, particularly in the north. In spring, raptors of several species seem to reach southern Norway on a broad front. Many of these birds are probably migrating north from Skagen in Denmark. The majority of migrating raptors in spring are observed along the Oslofjord. Some of these follow the coastline from southern parts of Norway, while others are probably following the coast from southern parts of Sweden.

In autumn, raptor migration data is also primarily limited to southern parts of the country, but good numbers of migrating raptors may also be observed further north. No clear pattern is yet found for migrating raptors in northern parts of Norway, and there is obviously a need for better and more systematicly based data. In the south, most birds seem to follow the coast of Sweden, with many of them crossing the Oslofjord on their way south. This pattern is mostly seen for buzzards. Others tend to follow the coastline south. Many of these undoubtly cross the Skagerrak when they reach the southern tip of Norway, while others continue in a westward direction. Some probably fly across the North Sea further west and north, maybe in the direction of Great Britain. Others continue north, and turn south again when they reach the flatlands of Jæren. This is especially true for those that depend on thermal winds, such as buzzards. Many raptors, primarily falcons and Eurasian sparrowhawks, follow the coastline south along western parts of Norway, and probably continue south across the sea.

5.2 Migration routes of owls
Observing migration of owls is not as simple as observing migration of other birds of prey/raptors due to their nocturnal habits. Diurnal migration exists for some species, such as short-eared owl and northern hawk owl, but in general owls migrate at night. Knowledge of important migration routes for some species is therefore more or less lacking. Some knowledge exists thanks to ringing activity, especially for boreal owl, but it is still difficult to see any clear pattern in the ringing data with regard to specific routes. Nevertheless, boreal owls tend to disperse over a large area, most of them in a southerly direction in winter (Bakken *et al.* 2006). The occurrence of this species along the western coastline in autumn is also evident (e. g. Wold *et al.* 2012), often in areas where the breeding population is low or not present at all.

5.3 Wintering grounds
Some species of birds of prey are mainly stationary within their territory in winter or roam around within the region close to the breeding area. For the migratory species of birds of prey, main wintering grounds in Norway are found in southern parts of the country, in particular at Jæren and Lista. However, there are often also quite good numbers of birds of prey in Østfold

and in other areas around the Oslofjord in winter. Some species may also be found further north and east in winter. Despite some migratory birds of prey species spending the winter in Norway, none occur in very high numbers, perhaps with the exception of the Eurasian sparrowhawk. Most migrating birds of prey thus leave Norway in winter.

Differences in migration strategy between raptors that prey on small mammals in Fennoscandian boreal zones were investigated by Sonerud (1986). It was suggested that species that are adapted to an active, energetically expensive hunting strategy migrate to snow-free areas in winter, including the hen harrier, short-eared owl and long-eared owl. Species with "sit-and-wait tactics", unable to locate prey under the snow also tend to be migratory. Examples are the common kestrel, common buzzard and rough-legged buzzard. Species that stay in snow-covered areas in winter use the "sit-and-wait strategy", which is energetically more cost-effective. These species are also able to localise concealed prey and to hunt in closed forest habitat. Primarily, this includes owl species such as boreal owl, northern hawk owl, and pygmy owl. It is suggested that the interspecific differences in prey availability, which is determined by hunting strategy and preferred hunting habitat, is more important than nest site availability in determining migration patterns of Fennoscandian owls, and also to some extent for other species of Fennoscandian birds of prey (Sonerud 1986). In fact, the main wintering grounds for migrating Norwegian species listed above are also areas with usually little or no snow cover in winter.

In this regard, species referred to as migratory birds of prey include the following species: honey buzzard, Eurasian marsh harrier, hen harrier, Eurasian sparrowhawk, osprey, common buzzard, rough-legged buzzard, common kestrel, merlin, hobby, peregrine falcon, long-eared owl and short-eared owl. Some other species of raptors and owls also migrate or move about to some extent, but no clear pattern seems evident in migration routes and migration period for most of these species. Some species travel far on their migration, and are not found in Norway in winter. These are honey buzzard, Eurasian marsh harrier, osprey and hobby. The migrating species that may be found in Norway during the winter are annotated below. Estimates of winter populations are based on the Norwegian Atlas of wintering birds (Svorkmo-Lundberg *et al.* 2006), in addition to observations published in Reinsborg *et al.* (2007), Reinsborg *et al.* (2008a), Reinsborg *et al.* (2008b), Reinsborg (2009), Reinsborg & Størkersen (2009), Reinsborg (2010) and unpublished data collected from the Norwegian "reporting system for birds"; http://www.artsobservasjoner.no/fugler.

5.3.1 Hen Harrier

The hen harrier is found in small numbers at Jæren, Lista, and in outer parts of the Oslofjord-area in winter. About 10-20 individuals may spend the winter in Norway.

5.3.2 Eurasian Sparrowhawk

The most common migratory bird of prey occurring in Norway in winter is the sparrowhawk. It is most common in southern and coastal parts of the country in winter, but may also be found far north and inland. It is difficult to estimate the winter population of the species in Norway. However, most likely more than 1,000 individuals spend the winter in Norway (Svorkmo-Lundberg *et al.* 2006).

5.3.3 Common Buzzard

A small part of the Norwegian population of common buzzard winters in Norway and the species may be found in winter in all counties where it breeds, always in lowland habitats. The most important areas are Jæren, coastal areas between Lista and Kristiansand, and coastal areas between Larvik and Tønsberg and in Østfold. About 30-50 individuals probably spend the winter in Norway.

5.3.4 Rough-legged Buzzard

The rough-legged buzzard may be seen throughout Norway in winter, including inland habitats. The majority are found around the Oslofjord (primarily in Østfold), between Mandal and Lista, at Jæren, outer parts of Sunnmøre and more rarely in areas surrounding the Trondheimfjord, where there is little snow. About 20-50 individuals may be present in Norway in winter.

5.3.5 Common Kestrel

Some common kestrels spend the winter along the coastline from Østfold to Sunnmøre, and some may also be found north to Lofoten. Nevertheless, it is only between Oslofjord and Rogaland that common kestrels winter annually. About 30-70 individuals may spend the winter in Norway.

5.3.6 Merlin

Merlin regularly winters in southwestern parts of the country, with most birds found at Lista and Jæren. Some birds are also found further north and inland in eastern parts of the country. Approximately 30-100 individuals most probably spend the winter in Norway.

5.3.7 Peregrine Falcon

Some territorial peregrine falcons in Norwegy spend the whole year in or close to their territory, but these are mostly coastal breeders in southeastern parts of the country (Vestfold, Telemark). The species is also found at other places along the southern coastline of Norway in winter. A reasonable estimate of the winter population of peregrine falcon in Norway may be 100-200 individuals.

5.3.8 Long-eared Owl

Among migratory owls, the long-eared owl is found in lowland habitats in eastern parts of Norway, and along the southern coastline in winter. Some birds may also spend the winter in inner parts of Trøndelag. Nonetheless, most long-eared owls breeding in Norway leave the country in winter (Svorkmo-Lundberg *et al.* 2006).

5.3.9 Short-eared Owl

A few short-eared owls spend the winter at Jæren and along the coast of Vest-Agder, but the species may be found in low numbers anywhere in the country wherever there are good numbers of rodents combined with sparse snow coverage during winter. About 10-50 individuals may spend the winter in Norway.

5.3.10 Other species

In addition to the species mentioned above, some other species may spend the winter outside their breeding habitats. Golden eagles and gyrfalcons are often found in coastal areas in winter, all along the Norwegian coast. A significant proportion of juvenile and immature white-tailed eagles move in a southwesterly direction in winter, and remarkably few Norwegian ringed white-tailed eagles have been found or seen in Sweden and Finland.

6 WIND TURBINES AND POWER LINES

6.1 Wind turbines

The possible conflict between wind turbines and birds has been an issue since the late 1970s, but wind turbines were at first not considered a significant threat (e. g. Rogers *et al.* 1977, Lawrence & Strojan 1980). Later studies have documented the contrary, and collisions have been shown to be one of the most detrimental effects (Kingsley & Whittam 2005, Drewitt & Langston 2006). Raptors in particular have received much attention in this regard (Carrete *et al.* 2009). Raptors and other large birds that use rising air currents and hover a lot have been shown to be especially vulnerable to collisions (Barrios & Rodriguez 2004). Other potential negative effects following establishment of windfarms might include destruction or change of habitat, and increased disturbance because of inspections and maintenance of infrastructure and turbines.

In general birds of prey are long-lived species with low annual production of chicks. This means that even low mortality rates due to collisions can have significant negative effects on populations. The fact that many of these species have low overall populations worldwide/nationwide makes this an especially important point.

6.1.1 Affected and vulnerable areas

The BirdWind project (Pre- and post-construction studies of conflicts between birds and wind turbines in coastal Norway) at Smøla and Hitra has revealed large differences in number of killed birds per turbine between different windfarms and between different species, in addition to large variations between different seasons (Bevanger *et al.* 2010). At Smøla, the number of breeding pairs of white-tailed eagles has decreased within the wind turbine complex compared with the years before establishment of the windfarm. In contrast, the density of breeding pairs just outside the area has increased. Wind turbines caused an additional mortality of 30% for adult birds at Smøla. Collisions often take place near roosting sites, and many of them within a limited period of time in spring (Dahl *et al.* 2011).

6.1.2 Ongoing and planned projects

A long list of windfarms exists, both those that have been granted concession as well as those that are planned in Norway. In January 2012, these existing and planned windfarms covered a total area of 2,000 km^2. Establishment of infrastructure and power grids are not included in this figure, so the total affected area is actually somewhat larger (Sjong 2012). Most of the windfarms are and will be situated along the coast, although several inland projects have also been planned in recent years (Norges Vassdrags- og Energidirektorat 2013). It is difficult to predict how many of these projects will be built in the future, but undoubtly the total effect will be detrimental for the environment. This includes adverse effects on birds of prey (and other species), both to breeding and migrating populations.

To evaluate all of the ongoing and planned projects of windfarm development in Norway is far beyond the scope of this report, as this includes more than a hundred different cases. Nevertheless, it is worth noting that several projects are planned in the middle of important migration routes, including the Lista wind-power station in southwestern Norway, which was granted concession in 2009 (Norges Vassdrags- og Energidirektorat 2013). Several windfarms have also been established or are planned to be developed in the middle of important white-tailed eagle breeding areas. The most famous example of the latter is the Smøla wind-power station in central Norway. Eagle owl, listed as "Endangered" on the Norwegian 2010 Red List, is also one of the species affected by such projects (Kolstad 2012). Examples of projects affecting eagle owls include Bjerkreim, Gravdal, Måkaknuten, Stigafjellet and Skinansfjellet wind-power stations, all in Rogaland, all of which have been licensed in recent years. Several of these will probably also be in conflict with migrating species (Eldøy 2012). A large complex of wind power plants in Snillfjord municipality in Sør-Trøndelag received concession in 2012, and this will affect both breeding eagle owl and other birds of prey. The best example of windfarm plans that could have serious negative impact on eagle owl populations is from Sleneset/Solværøyene in Lurøy, Nordland, an area with the highest density of nesting eagle owls in Europe. In this case, the application for concession was turned down by the NVE, but currently there is an ongoing hearing of an appeal of this case.

6.2 Power lines

The problem of power lines and birds is mainly divided into birds' risk of *collision* with overhead lines and the risk of *electrocution*, i. e. death caused by electric shock when birds cause electrical short circuit and outages. The problem of electrocution increases as the distance between a phase conductor and an earthed device and/or the distance between two phase conductors gets shorter, which means that the regional and central grid poses no electrocution threat (as the distance between phase conductors and earthed device is rather wide in these). Large birds (e. g. with long legs, wings or tail) are obviously more vulnerable to electrocution than smaller ones, and eagle owls in particular are at risk in Norway (Larsen & Stensrud 1988, Øien *et al.* 2008, Bevanger 2011). This is a result of the species' preference for high exposed places (such as pylons) as lookouts, and electrocution is therefore an issue for most species with similar habits. Moist weather conditions also increase the danger of electrocution because of the increased conductivity of wet feathers (Bevanger 2011).

The collision problem depends upon a number of different factors, including the species in question, timing, weather conditions, habitat and vegetation around a given power line, topography and other forms of disturbance. The number and length of lines per unit land area, in addition to the appearance of the line itself are also important points (Lislevand 2004b, Bevanger 2011).

All bird species may collide with power lines, but some are more vulnerable than others, as a result of differences in e. g. flying skills and behaviour. Some species spend more time airborne than others (e. g. raptors), which in itself increases the chance of collisions with power lines or wind turbines. Flying skills are much determined by the ratio of mass to the area of the wings (wing load) and the shape of the wings. Species with high wing loads are the ones most vulnerable to collisions. Examples of such species in Norway include cranes, rails, grouse and some wildfowl. Migrating birds, birds flying at high speeds and nocturnal species (such as owls and nightjars) are also at greater risk of collisions. Some raptors and owls are also especially vulnerable due to poor depth of vision and large blind zones (Lislevand 2004b).

Which species are the most vulnerable in a given area is often determined by habitat. Willow ptarmigan are, for instance, more likely to strike a power line in a forest area. Lack of vegetation makes power lines more exposed, which increases the likelihood of collisions. At the same time, exposed lines are easier to spot from a distance, which may decrease collision risk. Weather conditions could influence a bird's vision (e. g. fog or rain). Finally, topography is an important factor. Examples of so-called "leading lines" are coastlines, valleys and edges of vegetation and marshes. It is important to take this into consideration when planning a new power line at a given location. Resting and roosting areas, and important feeding areas ought to be avoided (Bevanger 2011).

6.3 Actions to avoid collisions and electrocution

6.3.1 Collisions - Wind turbines

The number of birds killed by wind turbines can be reduced in different ways. The most effective measure is to avoid wind turbines in areas where conflicts with birds might arise. This could be achieved by careful and comprehensive environmental impact assessments. The second-best measure would be to close down wind turbines at particular sensitive periods of the year, e. g. during migration movements or periods of courtship/display flights in spring.

6.3.2 Collisions – power lines

The ultimate way to eliminate the danger of collisions with power lines is undoubtedly ground cabling (Lislevand 2004b, Bevanger 2011). An alternative would be to mark the line if ground cabling is not possible, to make the line more visible. Many kinds of markings have been tested, including spirals, ribbons, marker balls, swinging plates, raptor silhouettes, coloured conductor cover and painting of conductors (Lislevand 2004b). Of these, spirals have been shown to be the cheapest and most effective, reducing the probability of collision by up to 89%. This is also the most used method of marking (APLIC 1994). Also swinging plates ("bird flappers") are effective (van Rooyen *et al.* 2003). It is also important to makes sure that the marking is concentrated at points of the line where collisions are most probable. However, little research has been done on this field in Norway, and differences might exist (Lislevand 2004b). In addition to ground cabling and marking of lines, avoiding the interruption of leading lines by power lines is of importance.

6.3.3 Electrocution

The best way to decrease the risk of electrocution is modification of electrical power lines. More work has been done to cope with electrocution than with the collision problem in Norway. As for power lines, the problem of electrocution can be reduced by avoiding placing power lines through the richest and most important bird areas, in particular breeding areas for raptors and owls. Birds face the biggest risk of electrocution at open transformer poles and towers. Lislevand (2004b) claims that these are mostly replaced with small, closed transformers at ground level in Norway in recent years. This is questioned in the Norwegian eagle owl action plan, where it is emphasised that more has been done to cope with this problem elsewhere, e. g. Sweden and Germany. In addition to the replacement of open transformers with closed transformers, effective measures are the replacement of low voltage overhead power lines with ground cables, or isolation of open power lines at poles and towers (Lislevand 2004b). Special alternative perches have been developed by scientists at the research institutions Norwegian Institute for Nature Research (NINA) and SINTEF, and test results from Sleneset in Lurøy municipality have been very promising (Abelsen 2011). NVE has been recommended to make the use of such bird-friendly constructions statutory, following the guidelines from both the Bern and Bonn conventions. These recommendations have so far been rejected (Øystein Størkersen pers. comm.).

7 MONITORING PROGRAMMES AND RINGING PROJECTS

7.1 Programme for terrestrial monitoring in Norway (TOV)

Population trends for a number of species of birds of prey are monitored in Norway. One of the most extensive monitoring programmes is the Government Programme for terrestrial monitoring in Norway (TOV), which has been conducted by the Norwegian Institute for Nature Research (NINA) since 1990. The TOV programme aims to monitor populations of golden eagle and gyrfalcon, in addition to populations of passerines, willow ptarmigan and rodents. Ground vegetation and lichens and algae growth on trees are also monitored.

The TOV data is collected from seven selected areas throughout the country (Lund, Solhomfjell, Møsvatn, Gutulia, Åmotsdalen, Børgefjell, and Dividalen). Birds of prey are monitored in all TOV areas except Dividalen. Golden eagle is monitored in the remaining six areas and gyrfalcon in Børgefjell, Åmotsdalen and Møsvatn (Framstad 2011). A minimum of 10 territories for each species is included for each area, all within an area of 50 km from the centre of the monitoring area. Both species change the borders of their territories and their nesting sites in a continuous manner, but golden eagle usually do this to a lesser extent than gyrfalcon. This is important to bear in mind when monitoring these species (Framstad 2011).

The number of breeding pairs and reproductive success, as well as level of contaminants, in the two species is monitored. It is expected that levels of contaminants will affect breeding success for these species. The breeding success is monitored by annual visits to each territory at least once in March/April and once in June/July. Visits should last for at least four hours, and all known breeding sites must be checked. If no breeding success, -attempt or –failure is confirmed, a new visit is required between the 1st of August and the 15th of September to look for fledged young (Framstad 2011). It is then determined whether the species occurs in the area, whether there are attempts at breeding and if so; how many chicks reach the age of 30 (gyrfalcon) or 50 (golden eagle) days. As the mortality of eaglets above this age is small, this number of eaglets more or less reflects the production for a given year (Framstad 2011).

The golden eagle is now included in the national predator database (*Rovdata*) programme in Norway, and the monitoring has been intensified since spring 2012. The purpose of this “intensive monitoring of the golden eagle in Norway” is to provide information about survival, proportion of subadult birds in the breeding population, and the production of eaglets, to improve estimates of population size and population trends. The monitoring is conducted in twelve areas, each including information from about 15 territories within an area with a radius of about 50 km. The six already existing TOV areas where the golden eagle is monitored are included in this programme. The intensive part of this work will ensure a broader geographical dispersion of the monitoring of golden eagles in Norway (Gjershaug *et al.* 2012; Rovdata 2013).

Comprehensive investigations of population size are important for proper management of a species. Despite this, NOF-BirdLife Norway are worried that golden eagles in the future will be managed in the same controversial way as other large carnivores in Norway. This would probably not be for the best for the golden eagle, due to the increased pressure to control populations of these animals once they are above a certain size, or if the species occurs outside predefined core areas.

7.2 Population monitoring and ringing projects

For several of the bird of prey populations in Norway, there are, or has been, systematic monitoring either at national or regional level. For some species there is also cooperation on monitoring between the Nordic countries (especially between Norway, Sweden and Finland) and on a European scale. These species are primarily golden eagle, white-tailed eagle and snowy owl and to some extent gyrfalcon. Monitoring results from the other countries are not reported here.

7.2.1 Honey Buzzard

A honey buzzard project started up in Lågendalen in Buskerud and Vestfold counties in 2011 by the birds of prey study group in Buskerud, Telemark and Vestfold, and is planned as a 5-year study. The purpose of the project is to look closer into density of pairs in selected areas to evaluate population size. Nesting sites and production of chicks are also recorded.

Work on this species is also carried out in Hedmark, where the search for breeding honey buzzards started in 2001. One nest was regularly checked before this (from 1996). In this project, search for new breeding sites has been carried out, and number of chicks is recorded annually. About 25 breeding sites have been found during the project – some of these are not in use anymore, whereas some are new ones. The densest population is found from Elverum southwards along the river Glomma. The population is evaluated as being stable, but a small decline may be the case in some areas (Roar Svenkerud pers.comm, Knoff *et al.* 2005).

7.2.2 White-tailed Eagle

The Norwegian white-tailed eagle project was initiated in 197e, with the aim to monitor population size, population trend, life history, demography, contaminants and movements of Norwegian white-tailed eagles. The project is coordinated by NOF, and includes nest visits for ringing purposes, monitoring, and surveying of new nesting sites. The present knowledge base has become more comprehensive than was initially expected, and the project has in several instances been able to follow individual eagles from hatching until adulthood. Ringing of white-tailed eagle nestlings has since 1976 been a prat of an international ringing scheme, with more than 5000 nestlings ringed in Norway until 2013. There has been a national colour code, and an additional year code to be able to read the exact age of the individual birds in the field. From 2012 onwards the yearcode ring has been replaced with an individual code ring that is possible to read from a distance (Alv Ottar Folkestad pers. comm.).

Norwegian birds move a lot during the first four to five years of age, mostly in southwesterly direction during autumn and winter and northwards during spring and summer. Remarkably few have shown uo in Sweden and Finland, but some have appeared in Dutch waters and in Scotland. Adult birds have been found in the Kola Peninsula, indicating emigration. Swedish and Finnish birds move southwest- and westwards in winter, most probably a consequence of limited food availability and cold climate in there areas in winter. Most of these birds obviously go back north in spring, although some may stay and even breed in Norway (one ringe Lapland female settled in Oslofjorden). The northern areas are in general attractive feeding areas in spring and summer, possibly due to long daylength and good availability of food (Alv Ottar Folkstad pers. comm.).

Rather large numbers of birds are regularly seen during winter along the Norwegian coast. This is mainly young birds gathering around food resources, such as fisheries. Otherwise the species is scavenging along with golden eagles and ravens on all types of carcasses and grallochs. Such gatherings of non-breeding birds seem to be most common where the breeding population is not "saturated", and tend to be moving further south as populations are "saturated" in the north (Alv Ottar Folkestad pers. comm.). In the Porsangen fjord in Finnmark, both young and adults gather in May due to easy access to lumpsuckers (Cyclopterus lumpus) in the shallow parts of the fjord (Tomas Aarvak & Ingar Jostein Øien unpublished data). This is also known from Andøya in Nordland (Karl-Otto Jacobsen pers comm.).

7.2.3 Northern Goshawk

The northern goshawk population is, or has been, monitored in several Norwegian counties, including Buskerud, Telemark, Vestfold, Troms, Sør-Trøndelag and Nord-Trøndelag. In 1998-2004 a national study was carried out by NOF-BirdLife Norway as part of the activities when the goshawk was “Bird of the year” in 1998 (Grønlien 2004a, 2004b).

In Nord-Trøndelag, population and reproduction data have been collected between 1994 and 2012. The reproduction rate for the population has been stable or slowly decreasing during the project period. Chick production shows large annual fluctuations, while the reason for this is unknown. Nevertheless, weather conditions and prey abundance are deemed to be contributing factors. The population seems to have stabilised at a low level compared to previous historical levels (early 20th century), probably mainly as a result of intensified forestry (Nygård 2013).

In Sør-Trøndelag, goshawk has been recorded at 134 breeding locations since 2000, and breeding has been confirmed at 111 of these. However, breeding has not been confirmed at more than 53 locations in any one year. Many new breeding sites have been found during the project period, but many have been destroyed, mainly because of forestry. Large variations in number of breeding pairs are also observed in Sør-Trøndelag, but no general increase is observed. The population is evaluated as stable or slowly decreasing in Sør-Trøndelag (Runar Jacobsson pers. comm., Jacobsson & Sandvik 2013).

7.2.4 Eurasian Sparrowhawk

A couple of studies have investigated breeding density, reproduction and general biology of Eurasian sparrowhawk in Norway. One of them was carried out in southern Norway some years ago, while another has investigated sparrowhawks in Oslo and Bærum municipalities in eastern Norway since 2001 (Éric Roualet pers. comm.).

The density of breeding pairs is in the range 2-10 pairs/100 km^2 in Bærum. Clutch size varies from 4-6 eggs, but usually 5 eggs are found. A higher percentage of unsuccessful breeding is recorded for birds breeding in old nests, probably because of a higher risk of predation from pine marten *Martes martes*, hooded crow *Corvus cornix* or red squirrel *Sciurus vulgaris*. Ringing of birds was initiated in 2011. A population decline was observed in the area in 2011 and 2012 (Éric Roualet pers. comm.).

7.2.5 Rough-legged Buzzard

The birds of prey study group in Buskerud, Telemark and Vestfold monitors a small number of lowland breeding sites for rough-legged buzzard in Buskerud and Telemark. The number of breeding pairs varies from year to year. Cliffs facing east, west or south seem to be preferred breeding locations, and often the nests face to the south or west. Suitable breeding cliffs are not necessarily particularly high, but usually steep/vertical, and nests are often built in the upper 1/3 part. Predation from golden eagle and eagle owl is observed, and rough-legged buzzards usually seem to avoid these species (Steen 2008a).

In the Gauldalen area in Sør-Trøndelag, lowland breeding sites for rough-legged buzzard are monitored annually. Here nests are often situated in high cliffs in coniferous forests, usually with areas of clear felling within the territory. The number of occupied territories and chick production is recorded and both parameters seem to fluctuate in a three-year cycle in this area (Ole Andreas Forseth pers. comm).

Since 2001, NOF-BirdLife Norway has monitored distribution of breeding rough-legged buzzards in Porsanger Municipality, Finnmark (Ingar J. Øien and Tomas Aarvak NOF-BirdLife Norway, unpublished data.). Number of occupied territories and egg-clutch sizes are recorded.

Here, the species is distributed both in tundra habitat and in birch forest. Preferred nesting sites in breeding cliffs are usually not very high, < 10 meters above ground. The project also maps individual migratory movements of rough-legged buzzards by use of satellite telemetry (Aarvak & Øien 2011, 2012, Aarvak *et al.* 2013).

7.2.6 Golden Eagle

The golden eagle population is carefully monitored in many parts of Norway, much due to its role as predator on sheep and domesticated reindeer. Six areas have been investigated through the NINA TOV-programme, and these areas are now included as a part of the intensive monitoring of the species in Norway. Additionally six areas are monitored in this intensive monitoring programme (Rovdata 2013).

The long-term trend (1993-2011) for chick production in the six investigated TOV-areas shows on average the highest production in Lund (0.59 per territory), followed by Børgefjell (0.55), Møsvatn (0.45), Solhomfjell (0.37), Gutulia (1997-2011: 0.36) and Åmotsdalen (0.32). No obvious regional pattern has been observed for chick production between areas (Framstad 2012). Low breeding success in some years (e. g. 2009) in Telemark (i. e. Solhomfjell and Møsvatn) can probably be contributed to low population of rock ptarmigan and especially mountain hare. Production of chicks is normally a bit higher in the areas near Hardangervidda, and could be a consequence of accessibility to thousands of wild reindeer *Rangifer tarandus* in this area.

Examples of other monitoring projects exist from Oppland, Hedmark, Buskerud, Telemark, Aust-Agder, Sør-Trøndelag, Nord-Trøndelag, Troms and Finnmark. Several of these projects have in later years become parts of the national monitoring (TOV/Rovdata). Recent investigations on population size have also been carried out in Vest-Agder, Rogaland, Hordaland and Sogn og Fjordane. Some ringing activity is also carried out in some of these projects (Jelstad *et al.* 2011).

7.2.7 Osprey

The osprey population size has been investigated in different parts of Norway. In Buskerud, a project was carried out between 2007 and 2011. Researchers at Nord-Trøndelag University College (HiNT) have investigated the population size in Nord-Trøndelag. In Østfold an ongoing project run by NOF-BirdLife Norway (Østfold branch) has monitored the population in the county since 2007 (Aae 2014). Population sizes are, or have also been, investigated in Vestfold, Buskerud, Hedmark, Aust-Agder, Vest-Agder and Oppland in recent years.

A project called «Osprey in Trøndelag» was initiated by the environmental department of the county governor in Nord-Trøndelag in 2005, and the project has been carried out by Nord-Trøndelag University College (HiNT). The goal is to localise and describe nesting sites, monitor breeding success and population development, as well as evaluate the localities in relation to disturbance (Kroglund *et al.* 2011). By 2010, twelve nesting sites were recorded, all in eastern parts of Nord-Trøndelag (Kroglund *et al.* 2011). Additionally, two probable nesting sites have been recorded since then (Øivind Spjøtvold pers. comm. to Rolf Terje Kroglund). Results suggest that the population is increasing (probably no pairs bred in the county at the start of the 1990s (Nordbakke 1994)), and reestablishment at former breeding sites are recorded (Kroglund *et al.* 2011). The population increase in Nord-Trøndelag and other parts of Norway has been suggested to be a result of application of lime (liming) to acidified watercourses, as well as reestablishment of fish populations (Østnes 1999). In Nord-Trøndelag, the increase is probably due to an increase of the population in SE-Norway (and Sweden; Kroglund *et al.* 2011). Many young have also been colour ringed throughout the project, and eight of these have been fitted with satellite transmitters (Rolf Terje Kroglund pers. comm.).

In Østfold, NOF-BirdLife Norway in cooperation with the Østfold University College have run a research project on ospreys since 2008, and 65 territories are controlled annually. A number of both adults and chicks have been fitted with satellite transmitters (Aae 2014).
In Vestfold, a group of ornithologists has monitored osprey nests annually since 1984. Osprey in this region had severe problems with nest building due to scarcity of suitable nesting trees. Construction of artificial nests was initiated in 1984. A total of 37 natural-looking nests have been erected in pines, of which 19 have been accepted by ospreys for breeding. After the construction of artificial nests, the local population of ospreys increased considerably. Production of young has fluctuated and reached a peak in 1991. The population in Vestfold reached a peak of 25 pairs in 1993, but due to decreased occurrence of key prey species it has since decreased and in 1998 it was estimated at 18-20 pairs. Overall breeding success is reported to be lower in this population than in other osprey populations in Fennoscandia (Steen & Hansen 2001).

The goal of an osprey project in Buskerud during 2007-2011 has been to map the distribution and monitor the population of ospreys in the county, in addition to in Sande and Svelvik municipalities in neighbouring Vestfold. Threats and changes in living conditions were also investigated. Results reveal that, in total, a minimum of 50 pairs are probably breeding in Buskerud, and an additional eight pairs are breeding in Sande and Svelvik municipalities. Most of the breeding sites are found in the southern and eastern parts of Buskerud.

7.2.8 Common Kestrel

In Trysil municipality in Hedmark, a project on nestbox breeding common kestrels has been in progress since 1989, following breeding records in a couple of nestboxes intended for large owls. Some breeding records of kestrels in the same sort of nestboxes were observed in subsequent years. More open-fronted nestboxes were erected, with varying results. No substantial increase in number of breeding records was observed before 1998. That year, however, was a good rodent year, and most of the breeding kestrels in the area were found in nestboxes. Some artificial nests, primarily intended for merlin, were also erected in 1991. Some kestrels bred in these, but the number decreased throughout the 1990s. Thus, it seemed as though most of the kestrel population in the area converted to nestbox breeding.

From the late 1990s, there was an increase in number of nestboxes erected. Some of the nestboxes were also re-located from the end of the 1990’s, to improve breeding conditions (height, direction, and habitat). At the start, breeding occurred in 30% of the nestboxes. This increased to 50% by 2007, perhaps as a result of more knowledge about placement and an increasing population of common kestrels. So far, the highest number of breeding birds was observed in 2011, which was a very good year for rodents. This was followed by a very poor year in 2012, when rodent populations collapsed. Nestboxes are advantageous because they are ready for use whenever birds arrive in spring. They are dry and sheltered, and do not fall down, like crow nests often do. Chicks are also protected against predators in the nestboxes, as they usually are placed on free-standing/isolated trees. In addition, there is little competition for the nestboxes, as they are designed specifically for the common kestrel. By 2012, more than 9,700 chicks have been ringed, with as many as 1,746 in 2011 alone. In 2012, breeding was recorded in 355 of the 414 kestrel nestboxes checked. A total of 384 breeding records were made in that year, including the additional 29 breeding pairs being found nesting at sites other than nestboxes (Bjørn Foyn pers. comm.).

The nestboxes are scattered throughout Trysil municipality, covering a total area of 3,100 km^2. Some are also located in Åmot and Engerdal municipalities. It is evident that the common kestrel population in the area has increased during the years the project has been running (Bjørn Foyn pers. comm.).

A nestbox project has also been initiated in Lågendalen (Buskerud), but few breeding records have been recorded to date (Steen 2013a). The birds of prey study group in Buskerud, Telemark and Vestfold has observed indications of a growing population in the lowlands, but no such increase has yet been observed in the mountains. However, no concrete figures exist to support this (Steen 2009b).

7.2.9 Eurasian Hobby

Breeding density and chick production have been investigated in restricted areas of Buskerud and Vestfold counties by the birds of prey study group in Buskerud, Telemark and Vestfold. The investigations have revealed a much larger population than earlier expected. Many of the chicks have been ringed. Colour rings were used for the first time in 2010 (Steen *et al*. 2011). Further results from these investigations are summarised in the species' section. Studies on population size were also carried out in Hedmark in the early 1990s (Hagen *et al.* 1994).

7.2.10 Gyrfalcon

The gyrfalcon is, like the golden eagle, one of the species with monitoring projects in several counties. Three areas are monitored through the TOV-programme. Monitoring has also been carried out in Oppland, Buskerud, Nord- and Sør-Trøndelag, Troms and Finnmark for many years, and a project was initiated in Hordaland in 2010 (Målsnes 2012).

When it comes to the TOV-areas, the production of chicks has fluctuated significantly between 1992 and 2011, especially in Åmotsdalen. Reproduction in the three investigated areas (Åmotsdalen, Børgefjell and Møsvatn) is quite similar, with highest average production in Åmotsdalen (0.91 chicks per year per territory) followed by Møsvatn (0.79) and Børgefjell (0.70). The lower mean production in Børgefjell is primarily the result of low production in the middle of the 1990s. In contrast to golden eagle, there are regional patterns in gyrfalcon chick production. There is a significant positive relationship between chick production in Børgefjell and Åmotsdalen ($r=0.55$, $p=0.01$), whereas the relationship is significantly negative between Møsvatn and Børgefjell ($r=-0.48$, $p=0.03$; and near-significant negative between Møsvatn and Åmotsdalen ($r=-0.37$, $p=0.11$; Framstad. 2012).

The willow ptarmigan *Lagopus lagopus* is usually an important prey for golden eagle and gyrfalcon, and a strong population of willow ptarmigan is also often indicative of good numbers of other species of prey. A clear relationship is observed between the autumn population of willow ptarmigan and production of gyrfalcon chicks the following spring (Kålås & Gjershaug 2004). There seems to be no obvious negative trends in chick production for gyrfalcons in most of the areas in the period 1992-2011 (Framstad 2012).

7.2.11 Peregrine Falcon

Extensive ringing activity has been carried out in several of the Norwegian peregrine falcon monitoring programmes. In southeastern Norway, much effort is invested in a project covering Akershus, Oslo, Buskerud, Telemark, Vestfold and Østfold, with collaborating projects in Aust-Agder, Hedmark and Oppland. Chicks have been colour ringed for future identification. The ringing effort decreased in most counties after 2011 (Steen 2012a).

A total of 118 breeding localities were known in the aforementioned counties in 2006, which is 15 times the number known two decades earlier (Steen 2008b). A further increase is observed during the following years, and a total of 141 breeding sites were found in Aust-Agder, Akershus, Buskerud, Telemark and Vestfold alone (Steen 2012a). Based on the investigations from 2006, and knowledge from other parts of Norway, there is reason to believe that the total Norwegian population could have reached 800-1000 breeding pairs already in 2007 (Steen 2008b).

The monitoring of peregrine falcons in Trøndelag is coordinated by NOF-BirdLife Norway (by Torgeir Nygård and Tore Reinsborg in Nord-Trøndelag, and Lorents Noteng in Sør-Trøndelag). In Nord-Trøndelag, search for new breeding locations started in 1976, at a time when no more than eight probable breeding sites were known in the whole of Norway (Schei 1984). Since then, populations have been steadily increasing (Nygård & Reinsborg 2012). A total of 40 breeding locations are known in Nord-Trøndelag as of 2012. Of these, breeding has been confirmed at 25, while 15 locations are potential breeding sites (Nygård & Reinsborg 2013). Some of the breeding sites have been abandoned after being used for 2-3 years, for unknown reasons (Torgeir Nygård pers. comm.). It has been documented that the production of chicks per breeding pair has decreased throughout the project period. It is possible that the increase in the population can be a result of higher adult survival due to lower levels of contaminants in the environment, in addition to more immigration because of increasing populations elsewhere (Nygård & Reinsborg 2012). Thus, decreasing reproductive success may be attributed to a higher proportion of young, newly immigrated individuals, which would be expected to have lower production of chicks in their first years as breeders. Number of breeding attempts and breeding success varies greatly, despite the general increase in the population. The reason(s) for this is uncertain (Nygård & Reinsborg 2012).

7.2.12 Eagle Owl

In association with the eagle owl project organised by NOF-BirdLife Norway in 2008-2012, the population situation in Norway has been surveyed. This work is still going on in some counties, and a final report for the project will be published in 2014. A network of contacts was established around the country, with chosen coordinators for each county. Ringing activity has not been a direct part of the project, but has been carried out in some places on a voluntary basis. From 2012, the emphasis on work on this species in Norway is on monitoring. This monitoring is a part of the national single species action plan for eagle owl in Norway, and the work is organised by NOF-BirdLife Norway and funded by the Norwegian Environment Agency and the County Governor in Nordland. Four different monitoring areas are defined in southern Norway (in Hordaland, Rogaland, Telemark and Aust-Agder). Each monitoring area consists of approximately 20 territories. Emphasis is put on monitoring breeding attempts and production of young, but also presence of eagle owls within territories is recorded. Ringing of owlets is a natural part of the monitoring. Tracking of individuals by the use of satellite transmitters as well as genetic analyses is also a part of this work (Øien *et al.* 2013). After a good breeding year in 2011, when many breeding attempts were recorded in the monitoring areas, both 2012 and 2013 were poor breeding years for eagle owls in southern Norway with only three and seven breeding attempts recorded, respectively (Øien *et al.* 2012, NOF-BirdLife Norway unpublished data).

In addition a fifth monitoring area is situated on the island group at Solværøyene in Lurøy municipality in Nordland. Here, monitoring of eagle owls started in the late 1980's by the Rana local branch of NOF-BirdLife Norway. At present, the monitoring in this area is carried out by the Hedmark University College (HIH).

7.2.13 Snowy Owl

Through the Norwegian snowy owl project, NOF-BirdLife Norway has since 2005, in cooperation with NINA and Agder Natural History Museum, searched for breeding snowy owls in Norway, and disclosed breeding areas, primarily in Finnmark. The purpose of the project is to survey population status, habitat use and movements of Fennoscandian snowy owls. Many chicks have been ringed through this project, as well as some adult birds. In addition, satellite transmitters were fitted to three adult birds in 2007 and an additional 12 individuals in 2011 (Solheim *et al.* 2008, Jacobsen *et al.* 2012a). This has revealed new knowledge concerning seasonal movements and life strategies for snowy owls breeding in Norway.

The planned national single species action plan for snowy owl in Norway will benefit from the knowledge obtained through the snowy owl project. The results from the activity of this project are essential for proper management of snowy owl in Norway and neighbouring countries. Information obtained through tracking studies are also valuable in relation to future estimates of the European and global population size. Results from the project are further described in the species' section.

7.2.14 Pygmy Owl

A couple of projects investigate the biology of pygmy owls, and one of these projects has also a monitoring component. This project has been ongoing in Nord-Trøndelag since 2009, when 50 specially-built nestboxes were put up, primarily in southern parts of the county (mostly in Stjørdal municipality and some in Meråker municipality), with a few nestboxes in the border area of Sør-Trøndelag. These have been checked for food hoarding twice each winter, in addition to breeding checks and ringing of chicks, which is carried out by volunteers from NOF-BirdLife Norway. Information from the project could give valuable insight into the life and ecology of pygmy owls in Nord-Trøndelag, and provide a picture of the state of the forest areas they live in (Øien & Aarvak 2010).

The species has also been studied in Stange and Løten municipalities in Hedmark, where hoarding habits have also been investigated. About 25 pygmy owl nestboxes were put up until 2007. These have been checked every other week from September to the end of December (Vedum & Øvergaard 2008). Some results from this study are summarised in the species' section.

7.2.15 Eurasian Tawny Owl

Nestbox projects for tawny owls are carried out in some Norwegian counties. The most comprehensive projects are probably the ones in Sør- and Nord-Trøndelag, the latter organised by the Nord-Trøndelag county branch of NOF-BirdLife Norway. In addition, smaller projects are carried out in Oppland, Hedmark, Østfold, Buskerud, Telemark, Vestfold and Aust-Agder and Vest-Agder, among others. Most of the tawny owl chicks and most of the adult breeding females are ringed in the projects in Nord-Trøndelag and Sør-Trøndelag.
Nord-Trøndelag represents the northern limit of the tawny owl distribution in Norway. As of 2013, a total of 150 nestboxes have been erected in Stjørdal, Frosta, Levanger, Meråker, Verdal, Inderøy, Steinkjer, Mosvik and Verran municipalities. Reproduction, survival, causes of death, patterns of distribution and general breeding biology are investigated through ringing of adult females and chicks. Prey selection is also studied. A total of 1,489 tawny owls were ringed in the period 1991-2012 (127 adults and 1,362 chicks). Of these, 222 individuals have been recovered (as of 1st January 2013; Øien & Frisli 2013). Some of the nestboxes have been in place since the 1980's, while expansions have been made in 1994/95, 1997/98, 2000-2005, and 2008-2010. Nestboxes are also placed between Steinkjer in Nord-Trøndelag and Mosjøen in Nordland in order to find the northern border of the distribution range for the species (current northernmost breeding pair is found in Overhalla, Nord-Trøndelag; Øien & Frisli 2013).

Although observations of single individuals are made in Nordland (Alstahaug and Leirfjord municipalities; Paul Shimmings pers. comm.), there are to date no breeding records from Nordland. The Nord-Trøndelag project is a voluntary project organised by NOF-BirdLife Norway at a regional and local level, and there is close cooperation with the Sør-Trøndelag project, that monitors the same parameteres, but is even more comprehensive. The latter project has studied a nestbox breeding population in approximately 135 nestboxes in the municipalities Malvik, Trondheim, Melhus, Midtre Gauldal, Skaun, Orkdal, Snillfjord, Hemne and Rissa. A total of 3001 tawny owls were ringed in the period 1983-2012 (271 adults and 2730 chicks). In the same period, 270 adult breeding females has been recaptured and controlled (137 ringed as adults and 133 ringed as chicks; Georg Bangjord pers. comm).

7.2.16 Ural Owl and Great Grey Owl

Monitoring and ringing of Ural owl and great grey owl is carried out in Hedmark. For Ural owl, 300 nestboxes have been erected in Hedmark, and an additional 150 nestboxes are erected on the Swedish side of the border. This has resulted in an increasing number of breeding records during the last decade (Nyhus & Solheim 2011). A large effort has been invested in locating breeding great grey owls in Hedmark during the last decade. This has involved listening for singing birds, and by checking known raptor nests (both natural and artificial), revealing an increasing population in the area (Berg *et al.* 2011). The monitoring work on these two large owls is further described in the species' section.

7.2.17 Boreal Owl

Ringing of breeding and migrating boreal owls is carried out in many parts of Norway, including Lista and Revtangen bird observatories on the southwest coast. In Hedmark, 3,551 boreal owls were captured in the period 2007-2011, 1,594 of these in 2011 alone. The breeding population fluctuates largely with rodent populations, which follow a triennial pattern. Due to peaks in the rodent populations, 2007/2008 and 2010/2011 were good breeding years for the species in Hedmark, and this is very much reflected in the ringing numbers in autumn. Nevertheless, good numbers of owls are captured even in poor breeding years, but in such years birds tend to appear later in August. In general, the ringing activity starts at the beginning of August and continues until October/November. One or two mist-nets are put up next to a sound source playing boreal owl mating calls at dusk. Two to four such "stations" are organised one kilometre apart from each other. Capturing often continues until midnight, sometimes even longer, but most owls are captured in the early hours of the night. Other species are also captured in some numbers, primarily pygmy owl, but also northern hawk owl, long-eared owl, short-eared owl, Ural owl and tawny owl (Bjørn Foyn pers. comm.). Some of the boreal owls ringed in this project have been recovered elsewhere. Following the comprehensive ringing activity in 2007/2008 and 2010/2011 some birds have been recovered both in Finland and southern Sweden. In addition, some of the owls captured in Hedmark have been ringed elsewhere, including Sweden and Finland (Bjørn Foyn pers. comm.). A good number of boreal owls have also been ringed and recovered at Dividalen bird ringing station in Troms (Karl-Otto Jacobsen pers comm.).

7.3 Monitoring of environmental pollutants

The monitoring of environmental pollutants in birds of prey in Norway has been a part of the TOV programme since 1992. Trends over four to five decades are now available for a number of species, including white-tailed eagle, golden eagle, northern goshawk, osprey, peregrine falcon, sparrowhawk, eagle owl, merlin, common kestrel and gyrfalcon (Nygård & Polder 2012). To measure environmental pollutants in birds of prey, eggs are collected and analysed. The composition of the avian egg has been shown to directly reflect that of the maternal tissue, and it has thus proved to be advantageous as a monitoring tool for exposure to environmental pollutants in a number of species (e. g. Drouillard & Nordström 2001, Verreault *et al.* 2006). The contents are analysed for pollutants, and the eggshell index is calculated. The latter is a measure of the eggshell quality. Environmental pollutants measured include chlorinated (OCs), brominated (BFR) and perfluorinated (PFAS) compounds. Mercury levels are also measured.

In general, levels of pollutants are decreasing, but levels of some compounds, including certain PCBs, have stabilised in recent years. Most pollutant levels in eggs are nevertheless well below assumed critical levels. Levels and effects of "new" contaminants, such as brominated flame retardants and perfluorinated alkylated substances (PFAS), are still uncertain because of limited amount of data and short time-series (Nygård & Polder 2012). Merlin, white-tailed eagle and peregrine falcon are the species with the highest levels of organic pollutants, with DDTs and PCBs as the dominant compounds. One of the metabolites of DDT, p,p'-DDE, is well known for its eggshell thinning effect. This compound is presently found in highest levels in merlin. White-tailed eagles and eagle owls show the highest levels of PCBs and brominated flame retardants, while mercury levels are highest in white-tailed eagle, peregrine falcon and merlin. Mercury levels have, however, stabilised in recent years, probably above pre-industrial levels (Nygård & Polder 2012).

Eggshell thickness shows clear inverse correlations with the decreasing levels of environmental contaminants in eggs, and is generally increasing for most Norwegian species. Stable or positive population trends for many raptors and owls in Norway probably reflect this, and decreased level of contaminants is clearly a key factor in the positive population trend seen for peregrine falcons during the last 30-40 years (Nygård & Polder 2012).

7.4 Migration monitoring

As earlier discussed, migration of birds of prey is in general poorly investigated in Norway. With the exceptions of Lista and Jomfruland bird observatories in southern Norway, most of the monitoring is non-standardised and insufficient for scientific use. As for Lista and Jomfruland bird observatories, migration counts and ringing numbers are shown to largely reflect trends in populations elsewhere, i. e. Falsterbo bird observatory migration counts. Examples are the positive trends for osprey, Eurasian sparrowhawk, Eurasian marsh harrier, peregrine falcon and white-tailed eagle (Wold *et al.* 2012). The positive trend for common buzzard reflects a suspected positive trend in numbers in Norway. 2011 was a very good breeding year for many raptors and owls in Fennoscandia, and this is reflected in good numbers of northern goshawk, merlin and especially Eurasian marsh harrier and peregrine falcon at both Lista and Jomfruland. Many gyrfalcons were also observed during autumn 2011 at Lista. No birds of prey species were observed in low numbers in 2011, reflecting the good breeding season (Wold *et al.* 2012).

Two methods of monitoring are carried out at Lista and Jomfruland: methodical migration monitoring and standardised mist-net capture of birds. Monitoring and ringing activity started at Lista in 1990, while monitoring at Jomfruland started in 1980. Thus, both bird observatories now provide more than 23 years of data (Wold *et al.* 2012).

Some migration routes are known, and some occasional monitoring has been carried out at Gjersdal/Lassaskaret (inland parts of coastal municipalities in Rogaland), Borrevannet (Vestfold), Mølen (Vestfold), Store Færder (Vestfold) and some other localities in Vestfold, Østfold, Telemark and Vest-Agder, as mentioned in the section on migration routes in this report. Migration data from the bird observatories are also somewhat inadequate because of limited manpower with the responsibility for both migration monitoring and ringing activities. Nevertheless, there is no doubt that a large proportion of Norwegian birds of prey migrate through Sweden, passing Falsterbo in the south, where all species are monitored throughout the year at the Falsterbo bird observatory. This is also shown by satellite telemetry studies of e. g. rough-legged buzzards and ospreys breeding in Norway (Øien & Aarvak 2013, Aae 2014). Thus, monitoring results from Falsterbo are very relevant for many populations of breeding birds of prey and owls in Norway.

8 REESTABLISHMENT

8.1 Eagle Owl

The eagle owl population in southeastern parts of Norway underwent large declines during the start of the 20th century, and was small or in some areas eliminated when the species was protected by law in 1971. Reasons for the population decline may have included persecution, disturbance, electrocution and collisions with power lines and traffic, ingestion of poisons intended for rats and crows, and shortage of food, or a combination of some or several of these factors (Grønlien 1988). In some areas, habitat change due to overgrowing of open pastures has reduced available hunting area, and thus induced a population decrease (Odd Reidar Fremming and Bjarne Oddane pers. comm.). With the goal to reestablish a vigorous population of eagle owl in this part of Norway, a reestablishment project was started up by World Wide Fund for Nature (WWF) in 1975 (Haga 1986). Eagle owls were bred in captivity, and then released in the same area as they were bred. The project was terminated in 1989 (Solheim 1994a).

The project took great advantage of experience and knowledge from the Swedish "Prosjekt Berguv" ("Project eagle owl"). The original breeding stock consisted of 28 pairs of eagle owls, which were reduced during the 1980's through release of adult birds in addition to the juvenile ones (Stokke 1989). Østfold was used as a reference area, because of the lack of eagle owls in this area before the startup of the project (Grønlien 1988). The first establishment of eagle owls bred in captivity in Norway probably took place in 1982 (Haga 1983). Breeding records of eagle owls bred in captivity were recorded for the first time in the wild in Østfold in 1988, with two nests found. Both nests were unfortunately plundered by humans (Stokke 1989).

About 20% of the released birds were found dead each year, most of them killed by collisions with power lines or by electrocution (six out of the seven eagle owls found dead in 1987). It is reasonable to believe that the actual proportion of birds killed in this way was much higher (Grønlien 1988, Stokke 1989).

The captive breeding part of the eagle owl project was discontinued in 1989, after 15 years of work. Several new establishments were recorded at the end of the project period (Grønlien 1988). A total of about 600 eagle owls were released during the entire project period between 1978 and 1989, most of them in Østfold (Stokke 1989, Solheim 1994a, Bakken *et al.* 2006). Funding was provided by WWF, with more than 1 million NOK through the project period (Stokke 1989).

By 2013, 24 years after the project ended, the eagle owl population in southeastern Norway is still low. Some pairs are now breeding in the area, but whether this is as result of the efforts of the eagle owl introduction project is uncertain. It is possible that some of the birds may have survived and established, despite the high mortality observed among the released owls. The establishment in the area might also be a result of immigration from Sweden or from other parts of Norway, based on the recovery of a Swedish ringed bird, and of eagle owls ringed in other parts of Norway in the area (Peter Sjolte Ranke pers. comm.). The breeding population of eagle owls in the counties Østfold, Vestfold, Oslo & Akershus and Hedmark is at present probably 6-8, 1-2, 5 and 5-15 pairs respectively.

8.2 White-tailed Eagle

The white-tailed eagle was a rather common bird in Britain and Ireland a couple of centuries ago, but populations started to decline during the 19th century, much as a result of persecution by shepherds, gamekeepers, fishfarm owners and skin- and egg collectors. The species became extinct in England already by 1800, but some pairs still bred in Scotland until 1916. The last known British white-tailed eagle was shot in Scotland in 1918 (The Royal Society for the Protection of Birds 1999).

Through a reintroduction programme organised by the Scottish Natural Heritage (SNH), The Scottish Forestry Commission, the Royal Society for the Protection of Birds (RSPB) in Scotland, and the Golden Eagle Trust in Ireland, supported by Norwegian authorities, and NOF-BirdLife Norway and NINA on project planning and field work in Norway, Norwegian white-tailed eagles have been translocated to Ireland and Northeast-Scotland between 2007 and 2012. Young eagles have been collected from twin broods (and triplet broods) in Norway in the period 15th-25th June, and transported by charter airplane to Kerry, Ireland and Kinloss and Edinbourgh in Scotland after being checked by a veterinarian (Folkestad 2007, Nygård *et al.* 2010, Raptor Politics 2012). During these years, 86 individuals have been introduced to Scotland, while another 100 have been brought to Ireland, where the species also became extinct in the early 20th century (Raptor Politics 2012). The first breeding in the wild in Ireland in more than 100 years was recorded in County Clare in 2012, and the first successful breeding was recorded at the same site in 2013 (Alan Mee pers. comm. to Alv Ottar Folkestad; Raptor Politics 2012).

In Scotland, the first white-tailed eagles were reintroduced already in 1975 (Folkestad 1994), when 82 Norwegian birds were imported and released on the island of Rhum over a 10 year period, from 1975-1985. An additional 58 Norwegian juveniles were released between 1993 and 1998 in Western Ross (Scottish mainland), to supplement the population (The Royal Society for the Protection of Birds 2013). By 2013, the well established and increased territorial population of the species in Western Scotland was counted to about 80 territorial pairs. The hope is that the eagles most recently introduced to Scotland will contribute to an increased genetic diversity. In 2007, Norwegian white-tailed eagles were introduced to Ireland for the first time (Alv Ottar Folkestad pers. comm.).

Despite the white-tailed eagle being a formerly extinct species in Britain and Ireland, reintroduced eagles are still being persecuted. Eggs are collected and birds are killed. Because of these threats, nests are usually guarded closely during the breeding season. Some birds have become victims of poisons illegally set for crows and foxes, but the use of poisoned baits has now been banned (Alv Ottar Folkestad pers. comm., Nygård et al. 2010). White-tailed eagles have been blamed for being a threat to livestock by Scottish sheep farmers, and this has led to some conflicts with farmers and land-owners. Measures to counteract this are already in place, and hopefully the conflict will mitigate with time (The Royal Society for the Protection of Birds 1999).

8.3 Peregrine Falcon

The Swedish Peregrine Project was undoubtly essential for the rapid increase in the peregrine falcon population in Fennoscandia during the 1980s and 1990s. In this project, peregrines were bred in captivity and wild parents were used as fosterparents in their nests in the wild. Some of the chicks were transferred to Norwegian nests, and some of the birds were also released after being raised up by the hacking method (Steen 2009a).

Eggs were also collected in Norway, and replaced with artificial eggs made of porcelain or with hen eggs. The collected eggs were incubated artificially in Sweden, and the hatched chicks were replaced back into the nests. The method of double-clutching was also carried out in Norway, for the first time in 1989 (Steen 1989). Eggs from the first clutch were collected and incubated artificially. No artificial substitutes were put out, which usually resulted in new copulations by the breeding pair, given that the first clutch was collected within 7-10 days incubation after egglaying. A new clutch is often completed at an alternative nesting site 19-20 days following collection of the first clutch. In Great Britain, pairs have been observed to produce three clutches within one breeding season (Ratcliffe 1980). When the chicks from the first clutch were 12-18 days old, they were placed back into the original nest. At the same time, the second clutch was collected. The chicks from this second clutch were used as supplements in other nests, or released following hacking (Steen 1989).

Hacking is a training method for juvenile falcons, and is used to prepare falcons to become independent hunters. The falcons are either released back into the wild, or recaptured for falconry. Four to five weeks old peregrine chicks reared in captivity were released by this method in 1989. The chicks were placed in a box in the wild, and fed through a tube to shield them from humans. The box had wire screening on one side, which was removed shortly before chicks fledged. Food was still provided for a short time (Steen 1989).

Several of the first established territories in southeastern Norway during the 1980's and 1990's contained birds from the re-establishment project, indicating that the project played a significant role in the reestablisment of peregrine falcons in Norway throughout the 1990's (Steen 2009a).

9 SPECIES SPECIFIC INFORMATION

The following section deals with every bird of prey species breeding in Norway. For each species, categorisation in the Raptors Action Plan under the Convention in Migratory Species (CMS) is listed, together with the most recent Norwegian Red List status (Kålås *et al.* 2010). If the category of a species has been downgraded on the Red List due to positive influence from neighbouring populations, this is denoted by circles ("º"). The Red List status is then annotated followed by a description of the global distribution and estimated European population size. The occurrence in Norway is described by distribution and comments on population size and population trends. Relevant studies for the species are summarised. Finally, measures to improve management of the species are suggested.

9.1 European Honey Buzzard *Pernis apivorus* (CMS Category: 3) VU

Norwegian Red List: The European honey buzzard is classified as "Vulnerable" on the most recent Norwegian Red List, largely based on migratory data from Falsterbo bird observatory, which indicates a 40-55% reduction during the past 30 years. This is based upon observations made mainly during the 1970s and 1980s. It is believed that Norwegian and Swedish birds share common migration routes and wintering grounds (Kålås *et al.* 2010).

Global status and distribution:
The European honey buzzard is distributed from Central Spain through Europe and southern parts of Siberia to Ob, possibly east to Jenisei. The distribution is scattered in the breeding season in the dry areas around the Mediterranean, and the wet areas in the West (Hansen 1994b). The European breeding population is estimated to be more than 110 000-160 000 pairs, and the population trend has been more or less stable between 1970 and 2000 (BirdLife International 2004).

Occurrence in Norway:
In Norway the species is found breeding in lowland forest areas in southeastern parts of the country, from Vest-Agder in the west to the valleys in Valdres, Gudbrandsdalen and Østerdalen (Hake *et al.* 1999, Fransson & Petterson 2001, Bakken *et al.* 2003). It is also occasionally found in the Lierne area in Nord-Trøndelag, but probably only a couple of pairs are breeding (Venås 2013). Wintering grounds are found south of the Sahara in western parts of Africa, more precisely in Ghana, Sierra Leone, Ivory Coast and neighbouring countries. Honey buzzards arrive in Norway medio May, and leave the country in August-September (Knoff *et al.* 2005).

The population fluctuates with insect availability, and large annual variations in breeding densities may be observed in accordance with climatic conditions. The honey buzzard was probably more common in Norway until around 1950, when cultivation of landscapes, which provide good conditions for many species of insects, was more commonplace (Haftorn 1971, Hansen 1994b). In lower parts of Telemark and Vestfold during the 1970s and 1980s, an average distance between pairs of 4 km was observed. Similar densities are also observed in Aust-Agder, Hedmark and Sweden and also in Vestfold and Buskerud in recent years (Hansen 1994b, Knoff *et al.* 2005, Steen 2012b). Territories can be even closer to each other in years with good food availability, and two pairs were found breeding only 1 km from each other in Lågendalen in 2010 (Hansen 1994b, Steen 2012b). The population in Norway is considered stable or slowly decreasing, and was suggested to number 500-1000 pairs in 1994 (Hansen 1994b). This estimate was adjusted to 500-1,500 breeding pairs in 1990-2002 by BirdLife International (BirdLife *et al.* 2004). However, there is a serious lack of knowledge concerning breeding density and population size in Norway, due to lack of studies on the species combined with its anonymous lifestyle (Steen 2012b). The higher number of possible breeding pairs proposed by

BirdLife International seems thus to be more in the direction of a random guess rather than based on actual investigations.

Annual numbers of honey buzzards have been decreasing at Falsterbo, with only one third of the annual numbers in the 1970s during the last two decades (Falsterbo Bird Observatory 2012). Honey buzzards are rare in spring at both Lista and Jomfruland, but at Jomfruland the autumn migration counts show a significant positive trend. The species has a stable occurrence at Lista in autumn (Ranke *et al.* 2011, Wold *et al.* 2012).

Relevant studies:
Studies on the distribution and occurrence of the species are carried out in Hedmark and in Lågendalen in Vestfold and Buskerud. Nests are hard to find because of the species' relative anonymity and quiet-mannered habits. Older pine *Pinus sylvestris* forest on nutrient-rich soil is preferred, often with elements of deciduous forest. In Hedmark, sunny, often steep, hillsides are chosen (Knoff *et al.* 2005). This seems also to be the case in the investigated area in Lågendalen (Steen 2012b). The steepness of the nesting sites could be a consequence of difficult access for forestry, and therefore better availability of mature forest in such areas, but might also be a consequence of the thermal conditions in such places (Knoff *et al.* 2005, Steen 2012b). Small felled areas near the nest do not seem to be a major problem for the honey buzzard in Hedmark, but more comprehensive logging is clearly more problematic. Alternative nests often exist within a distance of 300 meters, and nests are often used repeatedly for decades (Knoff *et al.* 2005).

Suggested measures:
Threats include deforestation, urbanisation and use of pesticides on the wintering grounds. A significant proportion of Fennoscandian honey buzzards are shot during their migration, especially in the Mediterranean area (Knoff *et al.* 2005). These problems are difficult to solve, but further mapping of migration routes and wintering areas, e. g. by the use of geolocators, transmitters or loggers, may provide the basis for further measures in this regard.

Honey buzzard on migration at Falsterbo, Sweden. More research is needed to establish a more accurate estimate of the population size for this red listed species in Norway. © Karl-Otto Jacobsen

As nests are built in mature forest and are used repeatedly, the threat from forestry (especially destruction of nests by cutting down nesting trees) is obvious, but can be reduced if nests are located and protected prior to such activities. The following measures have been suggested by Søgnen (2011) and Knoff (2005): Avoid forestry within a distance of 50 m from the nest. "Islands" of forest around the nest should be avoided, and there should be no disturbance within a distance of 200 m from the nest during the breeding season (May-August). NOF-BirdLife Norway considers this minimum distances. Protection of forests would also be of benefit for the honey buzzard. There is evidently a need for more research on the species in Norway, to establish a more scientifically based estimate of the population size for this red listed species. More investigations are also necessary to evaluate the population trend for Norwegian honey buzzards.

9.2 White-tailed Eagle *Haliaeetus albicilla* (CMS Category: 2; CITES: 1; SPEC 1) LC

Norwegian Red List: The species is evaluated as "Least Concern" on the most recent Norwegian Red List, based on a strong increase in the Norwegian population during the last 30 years (Kålås *et al.* 2010).

Global status and distribution:
The white-tailed eagle is widely distributed from Greenland and Iceland in the west to the Bering Strait and the Pacific Ocean in the east, and from Finnmark in the north to Algeria, Greece and Turkey in the South. West of Germany the species has become extinct, but it has been reintroduced to Scotland (and recently Ireland), and has settled naturally in Holland during recent years (Folkestad 1994, 2007, Raptor Politics 2012). The European population probably accounts for more than 50% of the global population of the species. There has been a large increase in the European population size since 1970 (BirdLife International 2004).

Occurrence in Norway:
White-tailed eagles breed all along the Norwegian coastline, from Sør-Varanger to Oslo, and will probably establish also in Østfold in the years to come. The strongholds are in the west and north. The population declined until the species was protected by law in 1968, and has been increasing from the middle of the 1970s onwards (Folkestad 1994, 2006). In 2000, the Norwegian population was estimated to 1 900-2 200 breeding pairs, and the population was still increasing (Folkestad 2003). In 2010, the Red List committee assumed a Norwegian population of 2 000-3 000 breeding pairs (Kålås *et al.* 2010). However, NOF-BirdLife Norway's white-tailed eagle monitoring project suggested as many as 3 500-4 000 breeding pairs in Norway in 2010 (Alv Ottar Folkestad pers. comm.). The latter was based on approximately 2 500 geographically localized, territorial pairs. About 2 000 pairs have been confirmed nesting by 2013, and additionally 500 pairs are classified as "supposed" or "probable nesting pairs" (Table 2; Alv Ottar Folkestad pers. comm.). It is quite clear that many breeding pairs are not yet localized, simply because of lacking geographical coverage. The population is still increasing in the south, but the large northern population has more or less stabilised in recent years. Nevertheless, the Norwegian population is by far the biggest in Europe (Folkestad & Probst 2013).

The territorial and reproductive part of the Norwegian white-tailed eagle population is resident all year round, even in the north. Some inland pairs may still move towards the coast in winter. Ringing recoveries confirm a rather extensive migration (500-1 000 km) among juveniles and immatures during their first four to five years. Most birds tend to move south and southwest during autumn and winter, and go north again in spring and summer. Birds from the Finnish and Swedish Lapland migrate to Norwegian coasts in winter (Folkestad 1994, Solheim 2010). Primarily these are nonbreeding birds, but even som of the terrirtorial pairs from the Lapland area may send hard winters along Norwegian coasts (Alv Ottar Folkestad pers. comm.). The reason for these movements is unknown, but might be a consequence of dense populations at the place of origin. It might also be to avoid the cold and hard winters further east and north (Solheim 2010). White-tailed eagles have become a more common sight at Falsterbo in recent years, with more than ten times as many birds seen between 2000 and 2009 compared to the average annual count during the 1970s (Falsterbo Bird Observatory 2012). The long-time trends at Lista and Jomfruland bird observatories are also significantly positive, but are based on low numbers (Ranke *et al.* 2011, Wold *et al.* 2012).

Table 2 – White-tailed eagle population size. "Territorial pairs" include number of confirmed breeding pairs as well as supposed or probable breeders (with the exception of the number from Troms, which is an estimate). Estimates are based on density of territorial pairs compared to areas which are not thoroughly investigated. Two different total estimates are calculated, one including numbers from the NOF-Birdlife Norway white-tailed eagle project (except Troms) and one including alternative numbers from Nordland and Nord-Trøndelag.

White-tailed eagle	Territorial pairs	Min est.	Max est.	Year	Referanse
Finnmark	144	200	300	2013	K.-O. Jacobsen (NINA), NOF w.-t. e. proj.
Troms	(600)	600	800	2013	K.-O. Jacobsen (NINA)
Nordland I	716	800	1200	2013	K.-O. Jacobsen (NINA)
Nordland II	716	1200	1500	2013	NOF white-tailed eagle project
Nord-Trøndelag I		175	175	2013	T. Nygård (NINA)
Nord-Trøndelag II	155	300	350	2004	NOF white-tailed eagle project
Sør-Trøndelag	131	300	350	2013	NOF white-tailed eagle project
Møre og Romsdal	387	360	400	2013	NOF white-tailed eagle project
Sogn og Fjordane	152	200	250	2013	NOF white-tailed eagle project
Hordaland	103	100	150	2012	County Governor, NOF w.-t. e. proj.
Rogaland	41	40	45	2013	K. O. Hauge, NOF w.-t. e. proj.
Vest-Agder	5	8	10	2012	R. Jåbekk, NOF w.-t. e. proj.
Aust-Agder	1	1	2	2013	R. Solheim, NOF w.-t. e. proj.
Telemark	1	0	1	2012	Artsobservasjoner, NOF w.-t. e. proj.
Vestfold	1	0	1	2012	Artsobservasjoner, NOF w.-t. e. proj.
Buskerud	1	1	1	2013	Stueflotten 2012, NOF w.-t. e. proj.
Oppland	3	1	3	2012	Artsobservasjoner, NOF w.-t. e. proj.
Hedmark	1	0	1	2012	Artsobservasjoner, NOF w.-t. e. proj.
Oslo og Akershus	2	1	2	2013	S. Dale, NOF w.-t. e. proj.
Østfold	1	0	1	2013	Artsobservasjoner, NOF w.-t. e. proj.
Total population I		**2787**	**3692**		Nordland I/Nord-Trøndelag I included
Total population II	**2445**	**3312**	**4167**		Nordland II/Nord-Trøndelag II included
Previous estimate		3500	4000	2013	Alv Ottar Folkestad,

Relevant studies:
The white-tailed eagle has received much attention in Norway due to the conflict between birds and wind turbines at the Smøla windfarm in Møre og Romsdal, and the BirdWind Project under the leadership of the Norwegian Institute for Nature Research (NINA). Several other institutions have also been involved in the project (e. g. SINTEF, Norwegian University of Science and Technology (NTNU), The Royal Society for the Protection of Birds 1999, Bevanger et al. 2010). The BirdWind Project investigated pre- and post-construction conflicts between birds and wind turbines between 2007 and 2010. The purpose of this project was to study mortality in relation to species, season and location, and to identify vulnerable species and important factors to consider in relation to windfarm developments. More than 150 individuals of more than 25 different species were documented killed by wind turbines during the project period. A total of 39 of these were white-tailed eagles, while 45 were identified as willow ptarmigan. Of the killed white-tailed eagles, 72% were found between March and May and 18% in autumn. Most of the eagles (54%) were adult birds. 28% of the killed birds were found close to five turbines in the northwestern part of the windfarm (Dahl *et al.* 2011). Young eagles fitted with satellite

transmitters (n=59) tend to leave Smøla in spring, and return in autumn. The birds seem to move along the whole Norwegian coastline, primarily in a northerly direction. The birds tend to move shorter distances away from Smøla as they grow older. The probability for survival is reduced by 10% during their first three years of life because of the wind turbines. The number of breeding pairs of white-tailed eagles has decreased within the windfarm as compared with the years before development of the windfarm. In contrast, the density of breeding pairs just outside the area has increased. The wind turbines have led to an extra mortality of 30% for adult birds at Smøla (Dahl *et al.* 2011).

Suggested measures:
As nest fidelity is very high and nests often are placed in mature trees, these should be located and protected from disturbance or forestry. Søgnen (2011) suggested the following: Forestry should be avoided within a distance of 100 m from the nest. "Islands" of forest around the nest should be avoided, and if nests are located on a cliff, forestry should be avoided within a distance of 100 m to each side and 50 m from the foot of the cliff. Forestry should be avoided even if nests have not been used for a long time. There should be no disturbance within a distance of 400 m from the nest during the breeding season (January-July; Søgnen 2011). NOF-BirdLife Norway considers this as minimum distances.

Wind turbines have been shown to pose a threat to Norwegian white-tailed eagles. To avoid mortality of eagles caused by wind turbines, it is important to carry out proper environmental impact assessments before building of windfarms, to avoid the most important breeding areas, feeding areas and roosting areas. At identified sites and when eagles are especially vulnerable during certain periods of the year, temporarily closing down of wind turbines should be considered.

Adult white-tailed eagle in Finnmark, northern Norway. The Norwegian population of this species is by far the biggest in Europe. © Tomas Aarvak

9.3 Eurasian Marsh Harrier *Circus aeruginosus* (CMS Category: 3) VU°

Norwegian Red List: The species is evaluated as "Vulnerable" on the most recent Norwegian Red List, based on a small (< 50 individuals) Norwegian population. The downgrading of the red list category in 2006 is due to the Norwegian population being a marginal population, and increasing populations in many European countries (Kålås *et al.* 2010).

Global status and distribution:
The species is widespread across Europe, but appears more scattered in the west (Olsen 1994, BirdLife International 2004). The European breeding population is estimated to number 93 000-140 000 pairs, and increased between 1970 and 1990. Some populations in southeastern Europe declined in the period 1990-2000, but populations increased or were stable elsewhere in the same period (BirdLife International 2004).

Occurrence in Norway:
The Eurasian marsh harrier is a newcomer to Norway, and still occurs in low numbers. Only two observations are known before 1950 (Haftorn 1971), and the species was found breeding for the first time in 1975, in Vest-Agder (Olsen 1976). Eurasian marsh harrier is today most common in southern parts of Norway, with the highest number of breeding pairs found in Rogaland and Østfold (Fredriksen *et al.* 2011; Tor Audun Olsen pers. comm.). The Norwegian population was suggested to number 0-5 breeding pairs in the period 1990-2003, and the population increased during this period (BirdLife International 2004). By 2013, the population is much larger; numbering 24-44 breeding pairs (Table 3). Of these, 7-8 pairs are found at Jæren in Rogaland (Tor Audun Olsen pers. comm), while 10-16 pairs are breeding in Østfold (Peter Sjolte Ranke pers. comm., Fredriksen *et al.* 2011). In 2013, Eurasian marsh harrier was confirmed breeding in Hedmark for the first time with three breeding pairs (Wernberg 2013).

Table 3 – Eurasian marsh harrier population size. No comprehensive survey has been carried out to locate breeding sites in Norway. Some of the numbers presented are thus based on personal judgment by the authors. The lower number includes documented breeding pairs, whereas the higher number includes probable and possible breeding pairs. Data presented for each county are not necessarily comparable due to different methods and years of data collection.

Eurasian marsh harrier	Min	Max	Year	Source
Finnmark	0	1	2013	Artsobservasjoner 2013
Troms	0	0	2013	Artsobservasjoner 2013
Nordland	0	0	2013	Artsobservasjoner 2013
Nord-Trøndelag	0	1	2013	Magne Myklebust
Sør-Trøndelag	0	0	2013	Magne Myklebust
Møre og Romsdal	0	0	2013	Artsobservasjoner 2013
Sogn og Fjordane	0	0	2013	Artsobservasjoner 2013
Hordaland	0	0	2012	Personal judgments
Rogaland	7	8	2012	Tor Audun Olsen
Vest-Agder	1	3	2012	Runar Jåbekk, Tor Audun Olsen
Aust-Agder	0	1	2009	Bengtson *et al.* 2009, Terje Lislevand
Telemark	0	1	2013	Øyvind Wathne Johannesen
Vestfold	1	2	2012	Per Kristian Slagsvold
Buskerud	0	1	2011	Steinar Stueflotten
Oppland	0	2	2013	Artsobservasjoner 2013
Hedmark	3	4	2013	Artsobservasjoner 2013
Oslo og Akershus	2	4	2013	Svein Dale, Simon Rix
Østfold	10	16	2013	Fredriksen *et al.* 2011, Peter S. Ranke
Total population	**24**	**44**		
Previous estimate	0	5		BirdLife International 2004

An increasing Fennoscandian population is reflected in the annual migration counts at Falsterbo, with a clear positive trend in the period 1973-2010 (Falsterbo Bird Observatory 2012). In Finland, the species is expanding northwards, and is currently breeding also north of Rovaniemi (Tuomo Ollila pers. comm to Karl-Otto Jacobsen). The trend is also significantly positive at the two Norwegian bird observatories (Lista and Jomfruland), especially in spring (Ranke *et al.* 2011, Wold, *et al.* 2012).

Relevant studies:
Fernández & Azkona (1993) studied and quantified the effects of low-level human disturbance on parental care of Eurasian marsh harriers and the nutritional status of nestlings in the Ebro Valley, Spain. They found that disturbance resulted in a lower number of food items delivered to the chicks, and a decreased amount of time spent in the nesting area by both males and females during periods of disturbance, especially during incubation. Other behaviour related to stress, specifically alarm calls, percentage flying time and chases against other intruding birds, increased during periods of disturbance. Levels of urea in blood were also found to increase in nestlings following disturbance (Fernández & Azkona 1993). Annual productivity was not affected in this study, but it is reasonable to assume that disturbance could reduce the fitness of individuals due to increased energy and time expenditure in non-reproductive activities during the breeding season.

Suggested measures:
As the Eurasian marsh harrier depends upon sedgy wetland areas and marshes as breeding locations, such areas should be protected. This habitat is not common in Norway compared to further south in Europe, and it is therefore important to protect the few areas that exist. As the study by Fernández & Azkona (1993) shows, Eurasian marsh harriers are vulnerable to even low levels of disturbance. It is therefore important to minimise or canalise outdoor activities (e. g. reduce boating, fishing and swimming) in their breeding habitats at critical periods of the year.

Juvenile Eurasian marsh harrier. The Norwegian population of this red listed species is rapidly growing. © Gunnar Gundersen

9.4 Hen Harrier *Circus cyaneus* (CMS Category: 2; SPEC 3) VU

Norwegian Red List: The species is evaluated as "Vulnerable" on the most recent Norwegian Red List, based on a small Norwegian population (Kålås *et al.* 2010).

Global status and distribution:
The hen harrier has a widespread but patchy distribution in northern and central Europe, and occurs eastwards through Siberia to the Pacific Ocean. The European breeding population accounts for about a quarter of the global population, numbering 32 000-59 000 breeding pairs. Large declines were recorded in the period 1970-1990, with populations stabilising in the period 1990-2000 (BirdLife International 2004).

Occurrence in Norway:
The species has a scattered distribution in central parts of southern Norway, and there are also some breeding records further north. By far the densest population is found in the Dovre area, with the majority of pairs breeding in Oppland (NOF-Oppland 1997). Some pairs are usually also found in the Hardangervidda area, primarily in eastern regions. In northern parts of Norway, hen harriers may be regular in suitable habitat in years with good rodent populations, especially in Finnmark. Breeding usually takes place at mountain marshes. In 1991, the Norwegian population was estimated to 50-100 breeding pairs *in good years* (Gjershaug 1991b). The BirdLife International estimate from 2004 suggests 5-50 breeding pairs in the period 1990-2003, with the population characterised as "stable" (BirdLife International 2004). This low estimate was based on the fact that only very few potential breeding observations are recorded and there are only some tens of observations on migration annually (Ingar Jostein Øien and Torborg Berge in letter to BirdLife International 2003).

In contrast, the Norwegian 2010 Red List committee assumed a much larger Norwegian population: 125-250 breeding pairs (Kålås *et al.* 2010). The latter figure seems not to be well justified. The population in Oppland is probably stable and the estimate from 1997 (10-50 pairs) is most likely still valid (Jon Opheim pers. comm.). With a smaller number of breeding pairs in Hedmark, Buskerud, Sør-Trøndelag, Nord-Trøndelag, Troms and Finnmark counties, the total population seems to be in the interval 30-125 breeding pairs (i. e. close to the 1991 estimate), fluctuating in relation to prey abundance (Table 4). A few hen harriers spend the winter in Norway, but most Norwegian birds probably migrate to continental Europe, based on recoveries from Belgium and northern France, in addition to a handful from Scotland, Denmark and southern Sweden (Bakken *et al.* 2003). This corresponds to the pattern seen for Swedish birds, which seem to migrate in a south-southwesterly direction, based on recoveries from Denmark to central France (Fransson & Petterson 2001).

Hen harrier counts at Falsterbo are stable or slowly decreasing (Falsterbo Bird Observatory 2012), while the long term trend at Lista and Jomfruland is stable or slowly increasing (not significant; Ranke *et al.* 2011, Wold *et al.* 2012). This strengthens the hypothesis of an overall stable Fennoscandian population.

Relevant studies:
The impacts of windfarms on hen harriers were reviewed by Whitfield & Madders (2006). Two main impacts of terrestrial windfarms on birds were recognised: displacement/disturbance and mortality associated with collision with rotating turbine blades. Of eight studies of hen harrier displacement reviewed, only one documented displacement. From this, it was concluded that foraging hen harriers have a low sensitivity to disturbance at windfarms. However, studies on displacement effects on nest site selection are lacking. Studies on collision fatalities from 10 windfarms were reviewed, and deaths were recorded in three of these. Two of these studies involved birds on migration, while the third involved breeding (and passage) birds. From this, it was argued that hen harriers seem to be less vulnerable to collision compared to other raptor

species. This may partly be a result of a typically low flight altitude, but the cause is presently unknown. The low expected mortality rates may suggest that studies of collisions at windfarms for this and related species have to go on for a longer period of time to provide reliable collision rate estimates (Whitfield & Madders 2006).

Table 4 – Hen harrier population size. In most of the counties no recent investigations on population size have been carried out. The numbers of breeding pairs fluctuate strongly for this species. The lower estimates include breeding pairs in poor breeding years, whereas the higher estimates include breeding pairs in good breeding years. Estimates are largely based on confirmed breeding records. Data presented for each county are not necessarily comparable due to different methods and years of data collection.

Hen harrier	Min	Max	Year	Source
Finnmark	0	30	2012	Artsobservasjoner 2013, Tomas Aarvak (NOF) Karl-Otto Jacobsen (NINA-Tromsø)
Troms	0	5	2013	Karl-Otto Jacobsen (NINA-Tromsø)
Nordland	0	2	2004	NOF Nordland 2004
Nord-Trøndelag	1	5	2012	Several reports from LRSK-NT
Sør-Trøndelag	5	15	2010	Georg Bangjord, Per Willy Bøe
Møre og Romsdal	0	1	2012	Artsobservasjoner 2013
Sogn og Fjordane	0	0	2012	
Hordaland	0	1	2012	Artsobservasjoner 2013
Rogaland	0	0	1988	Carlsson *et al.* 1988
Vest-Agder	0	1	2012	Artsobservasjoner 2013
Aust-Agder	0	1	2009	Bengtson *et al.* 2009
Telemark	0	1	2009	Steen 2009a, 2009b
Vestfold	0	0	2012	Artsobservasjoner 2013
Buskerud	5	10	2010	Steinar Stueflotten
Oppland	10	50	2012	NOF Oppland 1997, Jon Opheim
Hedmark	5	15	1998	Strøm *et al*. 1998, Artsobservasjoner 2013
Oslo og Akershus	0	0	2001	Dale *et al.* 2001
Østfold	0	0	2012	Fredriksen *et al.* 2011
Total population	**26**	**147**		
Previous estimate	125	250	2010	Kålås *et al.* 2010

Suggested measures:
Many of the marshes where the hen harrier is found breeding in Norway are already protected, but several exceptions also exist. As these rich and productive habitats are also of great importance to other species of birds and mammals, protection of the remaining breeding locations for hen harriers in Norway should be a priority. Studies on migration routes and nomadic movements between breeding seasons are needed to provide a basis for protection measures and management of the Norwegian population. More research is certainly also needed to establish a more justified population estimate.

Juvenile hen harrier. The breeding population in Norway is fluctuating with prey abundance, and the population size is therefore difficult to estimate. More investigations are needed, especially in the north, to establish a more accurate population estimate. © Gunnar Gundersen

9.5 Northern Goshawk *Accipiter gentilis* (CMS Category: 3) NT

Norwegian Red List: The species is evaluated as "Near Threatened" on the most recent Norwegian Red List, based on an assumed population decline of 5-10% during the last 18 years, in addition to a total Norwegian population of less than 10 000 reproducing individuals (Kålås *et al.* 2010).

Global status and distribution:
The species is widespread in most parts of the Western Palearctic (Bergo 1994a, BirdLife International 2004). The European population is estimated to number 160 000-210 000 pairs, and underwent a large increase in the period 1970-1990. A decline has been observed in several countries between 1990 and 2000. This is compensated for by positive trends elsewhere in the same period, and is the reason for an overall stable European population (BirdLife International 2004).

Occurrence in Norway:
The northern goshawk is found in forest areas throughout Norway, but more scarcely in the north. It prefers old, mature natural pine or Norway spruce *Picea abies* forests, but is also found breeding in deciduous forest in some places. There are indications of a much larger population size during the 19th and start of the 20th century than what is presently the situation. The Norwegian population was in 2000 estimated to 1 453-2 055 breeding pairs, with a decreasing trend (Grønlien 2004a, 2004b; Table 5). The decreasing trend is probably unchanged in 2013, although the present population size appears to be in the lower part of the estimated range. Northern goshawk has a stable annual occurrence at Falsterbo (Falsterbo Bird Observatory 2012), but data from Norwegian bird observatories is somewhat obscure, showing no clear

trends. The autumn trend at Jomfruland seems to be positive (not significant), while the autumn trend at Lista is negative (not significant; Ranke *et al.* 2011, Wold *et al.* 2012).

Table 5. Northern goshawk population size, modified from Grønlien (2004a, 2004b). The lower number includes documented breeding pairs, whereas the higher number includes probable and possible breeding pairs. A marked decline has been observed in Troms since 2000, but the number of breeding pairs is somewhat speculative. Declines are also reported from Finnmark, Aust-Agder and Oppland since 2000, and populations are probably slowly declining in Nord- and Sør-Trøndelag. Population size reported from Finnmark, Oslo & Akershus and Østfold are higher than previously suggested; however, this is probably a result of new knowledge rather than growing populations in those areas. Data presented for each county are not necessarily comparable due to different methods and years of data collection.

Northern goshawk	Min	Max	Year	Source
Finnmark	10	30	2012	Arve Østlyngen
Troms	50	130	2013	Karl-Otto Jacobsen (NINA-Tromsø)
Nordland	45	96	2000	Kristiansen 2003
Nord-Trøndelag	50	100	2000	Grønlien 2004a, 2004b
Sør-Trøndelag	120	150	2012	Grønlien 2004a, 2004b, Runar Jacobsson
Møre og Romsdal	50	100	2000	Grønlien 2004a, 2004b
Sogn og Fjordane	60	85	2000	Grønlien 2004a, 2004b
Hordaland	100	130	2012	County Governor, Hordaland
Rogaland	130	150	2000	Grønlien 2004a, 2004b
Vest-Agder	90	140	2000	Grønlien 2004a, 2004b
Aust-Agder	100	100	2009	Bengtson *et al.* 2009
Telemark	140	150	2000	Grønlien 2004a, 2004b
Vestfold	30	40	2000	Grønlien 2004a, 2004b
Buskerud	150	150	2003	Steen 2004
Oppland	50	75	2011	Jon Opheim
Hedmark	80	160	2012	Grønlien 2004a, 2004b, Carl Knoff
Oslo og Akershus	100	150	2012	Vidar Selås
Østfold	50	100	2011	Fredriksen *et al.* 2011
Total population	**1434**	**2036**		
Previous estimate	1453	2055		Grønlien 2004a, 2004b

Relevant studies:
The situation for the Norwegian northern goshawk population during the past 150 years was evaluated in a NOF-report in 2004 (Grønlien 2004a, 2004b). Northern goshawk is one of few raptor species that has not increased in numbers since it was protected by law in 1971. Early estimates of the population are based on statistics of bounties, which roughly reflects the population size during the 19th and early 20th century. The highest number of birds was shot during the first decade of the 20th century, and the Norwegian population probably numbered more than 10,000 breeding pairs at that time. A dramatic decline took place in 1916 and 1917, and this decline probably continued during the 20th century (Johnsen 1929). Later population estimates in 1992 and 2000 indicate a further decline, with 1950-2725 and 1453-2055 breeding pairs, respectively (Table 5). The decline seems to occur in most parts of Norway (Grønlien 2004a, 2004b). Yoccoz (2005) analysed this material and found indications of a further population decrease of 14% per 10-year period after 1975. In Nord-Trøndelag, 16 out of 111 breeding localities (14%) were clear-felled in the period 1994-2008 (Torgeir Nygård pers. comm.). A population decrease of over 5% has been observed in Vegårshei, Aust-Agder since 1992 (Vidar Selås pers. comm.). The fact that clear-felling of birch forest has started in later years in Troms poses a threat to northern goshawks there, and a reduction from approximately 150 pairs in Troms i 2002/2003 to approximately 120 pairs i 2009 is recently described (Johnsen *et al.* 2010). Based on the recent information from these counties, combined with Grønlien's (2004a, b) data and Yoccoz' (2005) analysis of these data until ca. 2000, a continued population decrease is assumed (Kålås *et al.* 2010).

An exception to this is Rogaland, where the population has undergone a small increase in recent years. This can probably be explained by establishment of coastal spruce forests, in addition to low overall forestry activity. The population in Buskerud is stable or slowly increasing, perhaps as a result of an increase in populations of prey, while the Finnmark population is stable (Grønlien 2004a, 2004b, Steen 2004). In Hordaland (except inland parts), Troms, Vest-Agder and Aust-Agder the decline is small, probably because of small-scale forestry in these parts of the country (Grønlien 2004a, 2004b). The remaining counties, constituting almost 80% of the total population (more than 100 pairs in Hedmark, Buskerud, Telemark and Sør-Trøndelag), have experienced large declines in the goshawk population during the 1990s (Grønlien 2004a, 2004b).

The single most important reason for the observed decline during the past 50 years is modern forestry (Grønlien 2004a, 2004b). Forestry may result in reduced abundance of prey, most importantly gallinaceous birds and red squirrel *Sciurus vulgaris*, in addition to reduced hunting grounds and nesting habitat, as suggested by Selås (1998a). Young forests will normally house smaller populations of gallinaceous birds than mature forests, partly because of the poorer growing conditions for blueberry bushes in felled areas and in young forest that can offer less shade than old forest (Selås 1998). It is shown that forestry within 50 m from the nest does not necessarily result in lower reuse the following breeding seasons compared with control nests, but nests situated in a larger area of mature forest and in forest with a high proportion of Norway Spruce are reused more often than those that are not (Saga & Selås 2012). Moreover, a higher proportion of northern goshawks breeding in spruce-dominated forest seem to lack alternative nests, probably as a result of more intensive forestry in such forests (Saga & Selås 2012). In order to preserve nest sites, it is recommended that no forestry activities take place within eight to ten decares (0.8-1 ha) of suitable mature forest around the nest, which makes this an economic issue for landowners (Steen 2004, Saga & Selås 2012). Proper agreements with landowners and compensations should therefore be mandatory.

The northern goshawk's breeding success is largely determined by availability of prey in early spring (in forests gallinaceous birds, red squirrel, and mountain hare). In cultivated areas, there are often high numbers of crows, and goshawks breeding in such habitats depend less on other species of prey. This might be the reason for a higher density of breeding pairs observed in areas with mature forest combined with cultivated land (Vidar Selås pers. comm.). In a study from Aust-Agder, southern Norway, the mean brood size for northern goshawk was higher in peak vole years than in other years. This is probably a result of reduced competition from generalist predators, but also a result of higher production of herbivorous insects and insectivorous bird prey, because high seed crops in some plant species are produced at the expense of chemical defence compounds (Selås & Steel 1998).

Suggested measures:
As nests are built in mature forest and are used repeatedly, the threat from forestry (destruction of nests by cutting down nesting trees) is obvious, but can be reduced if nests are located and protected prior to such activities. Søgnen (2011) and Saga & Selås (2012) have suggested the following: Forestry within a distance of 50 m from the nest should be avoided, without creating "islands" of forest around the nest. In addition there should be no disturbance within a distance of 200 m from the nest during the breeding season (March-August). Within these limits, there should be no forestry operation less than five years after the last breeding record (Søgnen 2011, Saga & Selås 2012). NOF-BirdLife Norway considers these measures as a minimum.

In addition to the threat from modern forestry, persecution, pesticides and reduced numbers of prey have been suggested to contribute to the population decline observed in Norway (Grønlien 2004a, 2004b). The reduced number of prey is probably often a consequence of the lack of mature forest. More protection of forest areas would benefit northern goshawk. Reduction of pesticide use is often costly, but would be of benefit for many species of birds of prey. It might be possible to do this in Norway, but many of these often volatile substances are easily transported long distances, making international regulations necessary to cope with the problem. Persecution has been, and probably still is, a threat to the northern goshawk in Norway. It might be a good idea to improve the public awareness of the species' situation in Norway to cope with this problem.

Juvenile northern goshawk. This is one of few birds of prey species with obvious population declines in Norway during the last two decades. The decline is mainly due to modern forestry. © Ingar Jostein Øien

9.6 Eurasian Sparrowhawk *Accipiter nisus* (CMS Category: 3) LC

Norwegian Red List: The species is evaluated as "Least Concern" on the most recent Norwegian Red List (Kålås *et al.* 2010).

Global status and distribution:
The Eurasian sparrowhawk is a common bird in most parts of Europe. The total European population numbers 340 000-450 000 pairs, which accounts for less than half of the global population. A large increase in the sparrowhawk population was observed during 1970-1990, mostly because of an increase in the large Russian population (which accounts for the majority of the European breeding population: 160 000-180 000 pairs; Bergo 1994b, BirdLife International 2004).

Occurrence in Norway:
The sparrowhawk is one of the most common raptors in Norway, at least in the south, and the species is probably more common than most people realise. Estimates suggest 3000-6000 breeding pairs of sparrowhawk in Norway in the period 1994-2003 (BirdLife International 2004). This is roughly the same as what was proposed in Gjershaug (1991d); 5000 pairs, but is very low compared to the most recent Swedish population estimate (44 000 pairs; Ottosson *et al.* 2012). Research is needed to provide a more accurate and updated Norwegian estimate. The population is probably fluctuating a lot, and this is reflected in the species' life strategy, with

potentially six chicks per brood (Vidar Selås pers. comm.). Migration counts indicate an increasing trend for the species in Scandinavia. Eurasian sparrowhawks are found breeding in forest areas throughout Norway, but the population is more scattered in the north, probably as a consequence of the colder climate and smaller populations of passerines (Vidar Selås pers. comm.). Breeding density of up to 12 pairs/100 km^2 and as little as 500 metres between nests are observed in southern Norway, but 1 km is probably closer to the average distance between nests (Vidar Selås pers. comm.). A density of 2-10 pairs/100 km^2 have been recorded in the Oslo area (Éric Roualet pers. comm.).

Dense young coniferous forest is the preferred breeding habitat, maybe as an adaption to avoid the northern goshawk, which is the main predator on juvenile Eurasian sparrowhawks (Selås 1996). Nests are also found in mountain birch *Betula pubescens*. Some nests are reused, generally as a function of tree density, forest age and breeding success, but not as frequently as most other raptor species (Selås 1996). Medium aged forest is often preferred hunting habitat, probably as a response to high food supply and preferable hunting opportunities. For hunting, mixed regeneration and old forests are preferred over coniferous replanting and clear-fell areas, which are seldom used (Newton 1986, Selås & Rafoss 2008). The highest density of sparrowhawks is probably found in cultivated landscape, also close to human activities, in lowland coastal areas in southern parts of Norway, there are perhaps also dense populations elsewhere (Vidar Selås pers.comm). The species suffered from hunting activities until it was protected in 1971, and from exposure to environmental contaminants during the 1950s and 1960s. Some data indicate a larger population size at the start of the 20th century (Bergo 1994b). However, at least in some areas, there are probably enough birds to fill available territories in Norway today. Most juvenile Norwegian sparrowhawks migrate to Denmark, France and Britain in winter, while many adults stay in Norway, primarily in southern parts (Bakken *et al.* 2003).

Sparrowhawk numbers at Falsterbo have increased in recent years. The positive trend was most prominent from the 1970s to the 1980s (average annual counts increased from 9 680 to 17 018), but the species is still becoming more numerous (Falsterbo Bird Observatory 2012). Trends from Norwegian bird observatories are also positive, with a significant positive trend in spring at Lista (Ranke *et al.* 2011, Wold *et al.* 2012). The positive population trend is also evident from the Ottenby bird observatory ringing data (Lindström *et al.* 2012).

Relevant studies:
A study on breeding density of sparrowhawk in relation to availability to suitable nesting sites, hatching success and weather conditions was carried out in southern Norway between 1985 and 1996. Results show that the proportion of breeding young (2nd calendar year) birds increased following hard winters with much snow, probably due to a high mortality among adult winter-resident birds. Both the number of breeding pairs and percentage of hatched clutches decreased with greater snow depth and lower mean temperature in March (Selås 1997). It was also found that many birds returned to the study area the following summer, and a positive correlation between number of breeding pairs and breeding success the previous year was observed (Vidar Selås pers. comm., Selås 1997). From this study, it is evident that the sparrrowhawk is sensitive to environmental conditions such as climate and snow cover, and that the breeding density and breeding performance fluctuates greatly between years. Warmer climate may thus be of benefit for the species in Norway.

Suggested measures:
Research on breeding density, especially in northern and central parts of Norway, would provide the basis for more accurate population estimates for this species.

Eurasian sparrowhawk on migration, Falsterbo, southern Sweden. The sparrowhawk is one of the most common birds of prey species in Norway, and the population is probably increasing. © Karl-Otto Jacobsen

9.7 Common Buzzard *Buteo buteo* (CMS Category: 3) LC

Norwegian Red List: The species is evaluated as "Least Concern" on the most recent Norwegian Red List (Kålås *et al.* 2010).

Global status and distribution:
The common buzzard has a widespread distribution in Europe (710 000-1 200 000 pairs), which accounts for less than half of the global breeding range. The European population increased between 1970 and 1990, and was stable in the period 1990-2000 (BirdLife International 2004).

Occurrence in Norway:
The Norwegian breeding population was estimated to number 1000-2000 pairs in the period 1990-2002, and seemed to be increasing during this period (BirdLife International 2004). The same number of pairs had earlier been suggested by Hansen (1994a). This was largely based on breeding densities in Buskerud, Vestfold and Aust-Agder (0.1-0.2 pairs/km^2). No recent evaluations of the Norwegian population size have been carried out. Populations in the western counties (Hordaland and Rogaland) have increased since the last estimate, but whether these populations are still increasing is an open question. Nevertheless, the western populations continue to be quite small. For the rest of the breeding range new data is limited, but at the turn of the century, breeding density of 0.15-0.3 pairs/km^2 has been reported from Aust-Agder (Selås 2001a). Despite the scarcity of breeding data, migration counts seem to indicate a positive trend. The species is common in lowland forest areas in southeastern parts of Norway, from Vest-

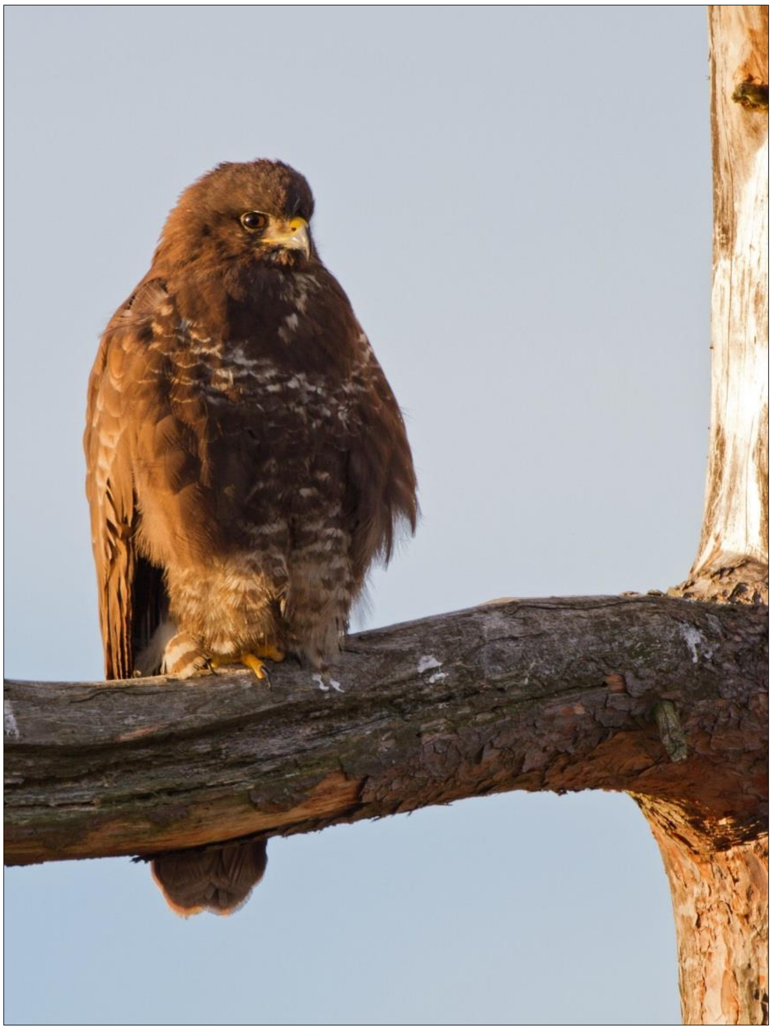
Agder to the valleys of Oppland and Hedmark, and is also patchily distributed in western parts of Norway, probably north to Sogn og Fjordane (Artsobservasjoner 2013, Hansen, 1994a). Most Norwegian common buzzards probably share a migration route with Swedish birds, moving through Sweden and in a southwesterly direction through Denmark and Germany on their way south (Hansen 1994a, Zalles & Bildstein 2000, Johansen 2005). Most Fennoscandian birds are believed to spend the winter in Western Europe, including France, Spain and northwestern parts of Africa. Some birds also stay in southern parts of Norway, Sweden and Denmark throughout the winter (Bakken *et al.* 2003).

The common buzzard is one of the most numerous migrating raptors at Falsterbo bird observatory, and the annual counts show a stable trend (Falsterbo Bird Observatory 2012). Data from both Lista and Jomfruland bird observatories show a clear positive trend, with significant increases both in spring and autumn at both locations (Ranke *et al.* 2011, Wold *et al.* 2012).

Relevant studies:
In a study from southeastern parts of Aust-Agder in southern Norway, predation on reptiles, amphibians and birds were compared in relation to changes in the main prey of the common buzzard, namely voles *Microtus agrestis* (Selås 2001b). It has been assumed that predation on other prey species is reduced when voles are abundant, and this also seems to be the case for birds (mainly trushes) and amphibians. Nevertheless, results indicate that reptiles (most importantly slow-worm *Anguis fragilis* and adder *Vipera berus*) are more common prey in peak vole years. This may be a result of the common buzzard hunting more ground-dwelling prey in peak vole years, but also of vole-hunting adders being attracted to the vole-rich common buzzard hunting grounds (clear cuts).

Another study in the same part of Norway investigated breeding density and brood size of common buzzard in relation to snow cover in spring (Selås 2001a). Snow depth in spring increased with increasing elevation in the study area. The study compared breeding density below a mean altitude of 160 m and above an altitude of 200 m. Below this altitudinal border a breeding density of 30 pairs per 100 km^2 was observed, while above the border a breeding density of 15 pairs per 100 km^2 was found. Mean brood size was highest in peak vole years, and also seemed to be negatively correlated with snow depth in April (Selås 2001a).

Suggested measures:
The common buzzard build its nests in mature forest, and these are used repeatedly. To some extent, forestry (and destruction of nests by cutting down nesting trees) may pose a threat. This threat could be minimised if nests are located and protected prior to such activities. Søgnen (2011) suggested the following: Avoide forestry within a distance of 25 m from the nest. "Islands" of forest around the nest should be avoided, and there should be no disturbance within a distance of 50 m from the nest during the breeding season (March-August). NOF-BirdLife Norway considers these distances as minimums. Forest protection would also probably be of benefit for the species. Little is known about the Norwegian population size and population trend, and efforts should be made to fill this gap in knowledge.



Common buzzard, southern Sweden. Most Norwegian common buzzards breed in the southern and eastern parts of the country. © Karl-Otto Jacobsen

9.8 Rough-legged Buzzard *Buteo lagopus* (CMS Category: 3) LC

Norwegian Red List: The species is evaluated as "Least Concern" on the most recent Norwegian Red List, but little is known about the population status in Norway. Based on migration counts at Falsterbo bird observatory there might have been a population decrease since the 1980s (Falsterbo Bird Observatory 2012).

Global status and distribution:
The species has a circumpolar distribution in the Northern Hemisphere, and is in Europe a common breeder in Fennoscandia and northern parts of Russia. 69 000-79 000 pairs make up the European population, and the population trend was reported to be stable overall between 1970 and 2000 (BirdLife International 2004).

Occurrence in Norway:
Estimates suggest that 5 000-10 000 pairs of rough-legged buzzard bred in Norway in the period 1990-2003 (BirdLife International 2004). This is the same number of pairs as proposed by Gjershaug (1991a). A limited amount of data exists to support the estimate (BirdLife International 2004), and this has been inpointed by Steen (2008a). The present population is probably smaller than what has earlier been suggested, and a similar situation might be the case in other countries as well (Aarvak *et al.* 2013). In Sweden, current mean population size is estimated to a mean of around 3000 pairs, less than half of that in the early 1980's (Ottosson *et al*. 2012). The estimate is based on a combination of local habitat-specific densities, the Breeding

Bird Surveys, the Breeding Bird Atlas and migration totals. However, the population may have been at a particularly high level in the early 1980's (Otvall *et al.* 2008). It is probable that there has been a population decrease in Norway since the early 1980's similar to that reported from Sweden (Kålås et al. 2010). Migration counts and breeding data from a larger area in southern Norway support this assumption (Odd Frydenlund Steen pers. comm.). The number of breeding pairs fluctuates widely according to prey abundance. In Sweden the amplitude between peak and bottom years is shown to be three to one (Ottosson *et al.* 2012). The rough-legged buzzard is mostly found breeding in mountain areas, but may also be found in lowland forest areas in many parts of Norway, and in coastal areas in the north. Lowland breeding often occurs in territories with good food availability, available breeding sites and open areas (e. g. felled areas (Steen 2008a). Rough-legged buzzards have a nomadic lifestyle, and it is suggested that individuals may for example breed in Norway one year and Finland the next. Most Norwegian birds probably migrate to eastern parts of Europe in winter (Bakken *et al.* 2003, Aarvak & Øien 2012).

At Falsterbo, migration counts are fluctuating, but an overall decrease seems to have been the case between 1990 and 2009. During the past three years (2010-2012), however, the numbers of migrating rough-legged buzzards have reached levels similar to the best years during the 1970s and 1980s (Falsterbo Bird Observatory 2012). In Norway, the trend seems to be marginally positive at Lista, and more or less stable at Jomfruland. Spring numbers are based on small sample sizes, and none of the trends are significant (Ranke *et al.* 2011, Wold *et al.* 2012).

Relevant studies:
The rough-legged buzzard is one of the bird of prey species most vulnerable to predicted effects of climate change (Huntley *et al.* 2007). This is enhanced by the fact that the population cycles for many rodents, in particular lemmings, seems to have collapsed in recent years (Ims *et al.* 2008). With this in mind, in addition to the fact that the species already has experienced serious declines in some areas (and disappeared in others), and also has shown decreasing migration counts at Falsterbo bird observatory (Falsterbo Bird Observatory 2012), give cause for concern. There is also good reason to believe that present population estimates are too high, because of the species' presumed nomadic lifestyle (Aarvak & Øien 2012). On the basis of the serious lack of knowledge concerning population sizes and migration routes, conservation of the species in relation to the expected population declines is impossible or extremely difficult. This underlines the need for research in this area, and is one of the reasons why NOF-BirdLife Norway has started a project to map migration routes, breeding areas and wintering grounds for the species, using satellite transmitters (Aarvak & Øien 2011, 2012).

Preliminary results from the ongoing study carried out by NOF-BirdLife Norway reveal large-scale movements during the breeding season for non-breeders or failed breeders, and more restricted ranges on the wintering grounds. However, this is based on a very small sample size (n=2). Both birds visited Finnmark and the Kola Peninsula the summer following capture (without breeding), while one of the birds (which was captured in Meråker, Nord-Trøndelag) has spent the last two winters south of Stockholm in Sweden. The other (captured in Finnmark) has spent two winters in an area near Kiev in Ukraine (Aarvak *et al.* 2013). The latter migrated through Finland and Russia, and also made some movements southwards to Bulgaria and the coast of the Black Sea during its first winter, concurrently with very cold weather conditions in Ukraine (Aarvak & Øien 2012). A more easterly migration route for birds breeding in the north compared to those in the southern regions is supported by ringing data (Bakken *et al.* 2003). However, two females breeding in Sør-Trøndelag in 2013 migrated through southern Sweden to Ukraine and Belarus during October, while a female breeding in Finnmark in 2013 on the other hand migrated along a more western route southwards through Norway to presumed wintering areas in southern Sweden (Norrköping area; Ingar Jostein Øien and Tomas Aarvak NOF-BirdLife Norway unpublished data).

Suggested measures:
As nests may be built in cliffs in forest areas, and sometimes in trees, forestry may pose a threat. Nests are usually used repeatedly. The threat can be reduced if nests are located and protected prior to such activities. Søgnen (2011) suggested the following: Avoide forestry within a distance of 50 m from the nest. If nests are located on large cliffs, forestry should be avoided within a distance of 50 m to each side and 25 m from the foot of the cliff. In addition there should be no disturbance within a distance of 200 m from the nest during the breeding season (March-August). Within these limits, there should be no forestry operation less than five years after the last breeding record. NOF-BirdLife Norway considers this as minimum measures.

Male rough-legged buzzard at nesting site in Finnmark, North-Norway. The Scandinavian population size is probably decreasing, but data is lacking in Norway. © Ingar Jostein Øien

However, the threat from forestry is minor compared to possible consequences of climate change and reduced prey abundance. In this regard, it is necessary to improve knowledge about population size, breeding areas, nomadic movements and migration routes, to provide a basis for protecting measures for the species.

9.9 Golden Eagle *Aquila chrysaetos* (CMS Category: 2; SPEC 3) LC

Norwegian Red List: The species is evaluated as "Least Concern" on the most recent Norwegian Red List, based on increasing populations in Norway and neighbouring countries. This is also the reason for the downgrading from the 2006 Red List (NT; Kålås *et al.* 2010).

Global status and distribution:
The golden eagle has a widespread global distribution. It breeds in North-America, Scotland, the Alps, from Fennoscandia through Russia and Siberia to the Pacific, and parts of Asia (Gjershaug 1994). The European breeding population is estimated to number 8 400-11 000 pairs, and was more or less stable in the period 1970-2000 (BirdLife International 2004).

Occurrence in Norway:
The species is found in mountain and forest areas in most parts of Norway, but also along the coast some places, primarily in the north. It has been protected by law since 1968. Young birds tend to seek out coastal areas in autumn and winter (Gjershaug 1994). Recent results from

Finnmark shows that young birds from the northernmost part of the population move southwards in winter, many of them wintering in southern Sweden and Finland (Jacobsen *et al.* 2012b). A small increase in the Norwegian population seems to have occurred since 1991, when the population was estimated to 700-1000 pairs (Gjershaug 1991c). In 2003 the population was estimated to 862-1042 breeding pairs (BirdLife International 2004), and in 2008 to 1176-1454 territorial pairs (Gjershaug & Kålås 2008). Some of this increase is due to a more intense mapping in the recent years. Thus, a significant part of the European population breeds in Norway (BirdLife International 2004). A further increase seems to be the case in some places since 2008 (mostly in the southern and western region), while the population seems to be stable in other areas. Based upon updated estimates from Finnmark (Jacobsen *et al.* 2011), Sogn og Fjordane, Hordaland, Rogaland, Vest-Agder (Tysse & Bergo 2011), Buskerud (Steen 2009b), Oppland (Jon Opheim pers. comm.) and Hedmark (Carl Knoff pers. comm.), the population in Norway is likely to number 1214-1555 territorial pairs (Table 6). The national predator database (Rovdata) is currently working on a new national population estimate, which will be published during 2014.

Table 6. Golden eagle population size, modified from Gjershaug & Kålås (2008). The lower number includes documented breeding pairs, whereas the higher number includes probable and possible breeding pairs. Data presented for each county are not necessarily comparable due to different methods and years of data collection. The national predator database (Rovdata) is currently working on a new national population estimate, where all numbers will be revised.

Golden eagle	Min	Max	Year	Source
Finnmark	140	160	2008	Strann 2009
Troms	202	210	2013	Karl-Otto Jacobsen (NINA-Tromsø)
Nordland	200	300	2008	Strann 2009
Nord-Trøndelag	60	63	2008	Gjershaug & Kålås 2008
Sør-Trøndelag	60	70	2008	Gjershaug & Kålås 2008, G. Bangjord
Møre og Romsdal	95	123	2008	Gjershaug and Kålås 2008
Sogn og Fjordane	66	109	2011	Tysse & Bergo 2011
Hordaland	57	86	2011	Tysse & Bergo 2011
Rogaland	46	73	2011	Tysse & Bergo 2011
Vest-Agder	26	44	2011	Tysse & Bergo 2011
Aust-Agder	35	40	2008	Gjershaug & Kålås 2008
Telemark	53	60	2008	Gjershaug & Kålås 2008
Vestfold	0	0	2008	Gjershaug & Kålås 2008
Buskerud	68	71	2009	Steen 2009a
Oppland	50	60	2012	Gjershaug & Kålås 2008
Hedmark	66	76	2012	Gjershaug & Kålås 2008
Oslo og Akershus	0	0	2008	Gjershaug & Kålås 2008
Østfold	0	0	2008	Gjershaug & Kålås 2008
Total population	**1224**	**1545**		
Previous estimate	1176	1454	2008	Gjershaug & Kålås 2008

The species is a rare visitor at both Lista and Jomfruland bird observatories (Ranke *et al.* 2011), and the same is true for Falsterbo in Sweden (Falsterbo Bird Observatory 2012). Thus, no clear trend can be drawn from migration counts for this species in Fennoscandia.

Relevant studies:
Wintering areas of golden eagles in Finnmark have been investigated by the use of radio transmitters under a golden eagle project in Finnmark carried out by the Norwegian Institute for Nature Research (NINA). Young birds show a clear pattern of moving out of the county in winter in all directions, although most of the eagles tend to move south. Most birds go back to their original home range the following spring, and tend to be more faithful to this area as they grow older. At least four different wintering areas have been recognised throughout the project: The

Swedish coast of the Baltic Sea, southern Finland, Lofoten and local spots in Finnmark. On average, young birds winter about 300-400 kilometers away from where they hatched, but extreme movements up to 1500 km have been recorded. Furthermore, satellite telemetry data also reveal that Swedish feeding sites for eagles are visited in winter. Young birds move over large areas of the ”Cap of the North” before and during the calving season for the domesticated reindeer *Rangifer tarandus*, and there is a preference for the calving areas in the period June-September (Karl-Otto Jacobsen in prep.).

The role of the golden eagle as a predator has been investigated by several scientists and institutions. NINA has carried out much of this work in Norway, and an overview of this work was presented in 2003 (Gjershaug & Nygård 2003). Results indicate no clear relation between amount of predation on sheep and the breeding population of golden eagle in a given area. Large differences in amount of reindeer calves (marked with mortality transmitters) classified as killed by golden eagle between Northern Sweden and inner parts of Nord-Trøndelag were also found. These surprising, rather unlikely results might be indicative of weaknesses in the present Norwegian documentation system for such losses. In Finnmark, most reported depredation on domesticated reindeer is from the winter months. This contrasts to what is seen elsewhere, but might be a result of difficult grazing situation and imbalance between reindeer and their natural resources (Gjershaug & Nygård 2003). It is, however, difficult to document the proportion of small reindeer calves in the diet of golden eagles, since they are not easily found in the field, but quickely consumed or transported to the nest in the breeding season (Systad *et al.* 2007). The proportion of reindeer in the diet during the breeding season seems to be quite low for golden eagles in Finnmark. Diet samples from the area indicate a diverse diet, where mountain hare *Lepus timidus* and willow ptarmigan are the most important prey species (Johnsen *et al.* 2007; Jacobsen *et al.* 2011).

Suggested measures:
There are evident weaknesses in the present compensation scheme for golden eagle depredation on sheep and reindeer. This scheme is based on damage verification, and compensations are largely based on probability and best judgment. Changing to a system similar to the ones in Finland and Sweden has been proposed as a solution to this (Gjershaug & Nygård 2003). Sami settlements and different reindeer regions in Finland and Sweden are compensated according to the number of breeding pairs of golden eagle in their area, which makes a large breeding population and low degree of damage beneficial, thereby encouraging preventive measures. Such preventive measures may help to ensure a good body condition of reindeer females prior to calving, or calving in fenced areas in poor years. Sheep should be particularly tended during the first days after they have been released in the Norwegian mountains in spring, when lambs are most vulnerable (Gjershaug & Nygård 2003).

As golden eagle nests are built in trees and cliffs in forest areas and are used repeatedly, forestry poses a threat. The threat can be reduced if nests are located and protected prior to such activities. As the species is vulnerable to disturbance, Søgnen (2011) suggested to avoide forestry within a distance of 100 m from the nest. If nests are located in large cliffs, forestry should be avoided within a distance of 100 m to each side and 50 m from the foot of the cliff. In addition there should be no disturbance within a distance of 400 m from the nest during the breeding season (January-August). Within these limits, there should be no forestry operation less than five years after the last breeding record (Søgnen 2011). NOF-BirdLife Norway considers this as minimum measures.

Young (2cy) golden eagle, southern Sweden. The Norwegian population size is slowly increasing. NOF-BirdLife Norway calls for improvements in the compensation scheme for golden eagle depredation on sheep and reindeer. © Karl-Otto Jacobsen

9.10 Osprey *Pandion haliaetus* (CMS Category: 2; SPEC 3) NT°

Norwegian Red List: The species is evaluated as "Near Threatened" on the most recent Norwegian Red List, based upon a small population (125-250 pairs). The downgrading of category is due to a strong population increase in Sweden during the past 30 years, in addition to a positive trend in Norway (Kålås *et al.* 2010).

Global status and distribution:
The osprey is globally widespread except in South America. The European population accounts for less than a quarter of the global population, and is relatively small (7 600-11 000 pairs; Nordbakke 1994, BirdLife International 2004). The European population increased between 1970 and 1990, and was stable or moderately increasing in the period 1990-2000 (BirdLife International 2004).

Occurrence in Norway:
The species was common in Norway until the end of the 19th century, but a serious decline, primarily due to hunting activity, occurred between 1850 and 1930 (Hagen 1952, Haftorn 1971). Only a few tens of pairs were known breeding in Norway when the species was protected by law in 1962 (Lislevand 2004a). The population increased until the middle of the 1970s, followed by a slow decline. Ospreys are vulnerable to acid rain, and are easily exposed to agricultural pesticides, fertilisers and heavy metals in watercourses (Nordbakke 1994). At the end of the 1980s, the species expanded its distribution in a westward direction in southern parts of Norway, and the population size again increased. This may be considered re-colonisation of former breeding areas (Lislevand 2004a). The Norwegian population was estimated to 150-200

pairs in 1991 (Nordbakke 1991), and was still considered to be within this range in 2004 (BirdLife International 2004, Lislevand 2004a). By 2012, the Norwegian population size was much larger; numbering approximately 400-600 breeding pairs (Table 7). Norwegian ospreys are mainly found in southeastern parts of the country, but the species is also found breeding west to Rogaland, in Oppland, Sør-Trøndelag, Nord-Trøndelag and Finnmark (Kroglund *et al.* 2011). The distribution corresponds to a large extent to the distribution of cyprinids *Cypriniformes sp.*, pike *Esox lucius*, perch *Perca fluviatilis*, common whitefish *Coregonus lavaretus* and grayling *Thymallus thymallus*, but also to the distribution of suitable nesting trees. Investigations have shown that cyprinids, pike and perch are the most important prey in the areas where these fish species occur (Nordbakke 1980, 1983).

Table 7. Osprey population size. Estimates from several counties are collected by Torgeir Nygård (NINA). Several of the numbers are educated guesses not based on comprehensive surveys, and a total population size of 500 breeding pairs is therefore suggested (Torgeir Nygård pers. comm.).

Osprey	Min	Max	Year	Source
Finnmark	8	30	2012	T.V. Johnsen pers. comm. to T. Nygård
Troms	0	0	2012	T.V. Johnsen pers. comm. to T. Nygård
Nordland	2	3	2012	Artsobservasjoner 2013
Nord-Trøndelag	12	15	2013	R.T. Kroglund
Sør-Trøndelag	10	15	2012	Winnem *et al.* 2013, G. Bangjord, M. Myklebust,
Møre og Romsdal	0	0	2012	A.O. Folkestad pers. comm. to T. Nygård
Sogn og Fjordane	0	1	2012	Artsobservasjoner 2013
Hordaland	0	0	2012	Personal judgments
Rogaland	5	10	2012	G. Skjærpe
Vest-Agder	50	80	2012	R. Jåbekk
Aust-Agder	30	50	2009	Bengtson *et al.* 2009, T. Lislevand
Telemark	40	60	2012	O.F. Steen pers. comm. to T. Nygård
Vestfold	35	40	2012	O.F. Steen pers. comm. to T. Nygård
Buskerud	50	50	2010	Stueflotten 2011
Oppland	20	20	2012	Jon Opheim, G. Høitomt pers. comm. to T. Nygård
Hedmark	60	70	2012	C. Knoff, O.P. Blestad pers. comm. to T. Nygård
Oslo og Akershus	30	50	2012	S. Dale
Østfold	65	100	2012	R. Aae, NOF Østfold
Total population	**417**	**594**		
Previous estimate	150	200	1991	Nordbakke 1991

At Falsterbo bird observatory, the osprey has become more common in later years, and a stable increase has been observed since 1973 (Falsterbo Bird Observatory 2012). Annual counts at Jomfruland also show a clear and significant positive trend since 1980. The autumn trend at Lista is positive, while spring counts have been decreasing, but these trends are not significant and are based on small sample sizes (Ranke *et al.* 2011, Wold *et al.* 2012).

Relevant studies:

The ospreys followed in the "Osprey in Trøndelag"-project usually nests in open coniferous forests, and all of them are found between 325 and 470 m.a.s.l. This is very close to what is observed in Buskerud, where the average altitude for all nests was calculated at 393 m.a.s.l. (std. dev.: 176 m; Stueflotten 2011). Nests are often used repeatedly (Kroglund *et al.* 2011). Nevertheless, changes in nest use were observed every year during the osprey project in Buskerud in the period 2007-2011; some nests expire because breeding ceases or nests fall down, some nests are rebuilt at old locations, reestablishment occurs at old nests and some completely new nests are built. This happened for about 22% of established nests from one year to another (Stueflotten 2011). Ospreys often have alternative nests, and can switch between years. Breeding mostly occurs close to water, with half of the nests found on islands or islets in Nord-Trøndelag (Kroglund *et al.* 2011). This is in accordance with observations from Oppland, where 11 of 19 nests were on islands, but contrasts to observations from Buskerud and Vestfold (Steen 1993, Stueflotten 2008, Kroglund *et al.* 2011). The latter observations are explained by disturbance on suitable breeding islands in association with fishing activity, in addition to the lack of proper nesting trees on suitable islands and islets (Steen 1993, Svensson *et al.* 1999). The preferred type of nesting tree in Buskerud is pine, with 91% of nests found in pine trees. Seven nests were found in spruce, while the remaining three were found on pylons (Stueflotten 2011).

Probably the most sensitive period in relation to disturbance is from late April/early May until the middle of June, during incubation and rearing of small chicks. Number of chicks produced per pair indicates good conditions for rearing chicks in the breeding areas in Nord-Trøndelag. Observations from the project reveal that birds do not necessarily breed even though they return to the breeding site (Stueflotten 2008, Kroglund *et al.* 2011). About 70% of the breeding records in Buskerud have been successful, with an average chick production of around 1.85 chicks per pair, which can be considered quite good (Stueflotten 2011). Young birds tend to establish within 100 km radius from their place of birth, but exceptions exist (Haftorn 1971, Cramp & Simmons 1980). The choice of migration route in ospreys is influenced by their place of birth (Alerstam *et al.* 2006).

None of the lakes in Nord-Trøndelag where ospreys are breeding have cyprinids, and pike are also absent at many places. Grayling and burbot *Lota lota* are found at some places, in addition to trout and charr. Observations of ospreys far from known breeding localities throughout the breeding season indicate that many birds move over large distances to find food for their chicks (Kroglund *et al.* 2011).

Eight satellite transmitters have been put on during the project period in Nord-Trøndelag. Provisional results indicate large individual differences in migration patterns. Wintering grounds are found south of Sahara, in the areas close to the River Niger (Nigeria, Guinea). Despite assumptions that birds of prey primarily migrate over land, transmitter data from these birds reveal that they have migrated both across the Baltic and Mediterranean Seas. Data indicate that the birds mostly follow the same route on their way north as they do on their way south. Some of the birds stopped for some days or weeks during their flight, one of them on Sardinia, before it moved on to Tunis, and then through Algeria, until it arrived in Nigeria at the end of November. The same bird was quite stationary throughout the winter, as well as in the following year. It took a short trip to the Mediterranean the summer two years after it hatched, and then moved back again to Nigeria. The bird moved north again during its third spring, passing Tunis, across the Mediterranean, through Germany, across the Baltic Sea and then through Sweden, arriving back in Nord-Trøndelag on 17th of May (Stene 2011). Previously, it has been concluded that ospreys breeding in northern parts of Fennoscandia (including Finnmark) make use of a more easterly migration route than those breeding in the south (Österlöf 1977). This was based on recoveries of a large number of ringed birds. In Østfold, satellite tracking of osprey families has been carried out as a joint project between Østfold University College and NOF-BirdLife Norway since 2011. Four individuals have been tracked across the Sahara. An adult female crossed Western Europe (The Netherlands, France and Spain) southwards, crossing the Mediterranean at Gibraltar, further via Morocco, Western Sahara, Mauritania and Senegal to its wintering areas near the coast in Gambia, where it remained throughout two consecutive winters. The adult male of the same family migrated via Eastern Europe (Poland, Czech Republic, Austria, Slovenia, Italy), crossing the Mediterranean to Libya and crossing the Sahara in Libya and Niger and arriving in Nigeria where it was confirmed shot on 21st October 2011 (Aae 2014). In 2013, a juvenile male followed a central European migration route (Germany, Czech Republic, Austria, Slovenia, Italy) crossing the Mediterranean from Sicily to Libya on 20th September and crossing the Sahara through Algeria, Niger and Mali to Burkina Faso where the signals ceased in October 2013. The same year, a second young male followed basically the same route through

Europe, crossing the Mediterranean as late as 2. November (Aae 2014). This male crossed Sahara in Egypt and was tracked to Tschad later that month.

Suggested measures:
In addition to the species vulnerability to environmental contaminants, shortage of favourable nesting trees, e. g. as a consequence of forestry, is one of the major threats. Ospreys in Finland have the same problem, where 46% of 951 known nests were found on artificial breeding platforms in 1995 (Saurola 1997). A solution to this problem, suggested by Pfaff (1997) and Søgnen (2011), may be to avoid forestry of significance within a radius of 200 meters from the nest, avoid forestry of any kind closer than 50 m and to preserve suitable nesting trees (i. e. large pines with flat tops). NOF-BirdLife Norway considers this as minimum distances. Another major threat in years to come is probably different forms of outdoor activities and other kinds of disturbance close to the breeding sites. This may be a problem only at some sites, but not at others. Barring of access may be a solution to this (c.f. the Planning and Building Act: Regulation of access on the basis of natural qualities), but would in general only be relevant when nests are known to the public. Lack of knowledge among the public is also a threat, especially in relation to disturbance at the breeding site, when people do not understand that birds are stressed by their presence (Lislevand 2004a). Birds are often a lot more tolerant when the eggs have hatched (Kroglund *et al.* 2011). The osprey is one of the rarest breeding birds in Norway, and as it is listed among species with an unfavourable conservation status at a regional level within a defined area in the CMS Action Plan, the authorities have a responsibility to ensure proper conservation measures for the species in Norway.

Osprey at nesting site in Finnmark. As in many other parts of Europe, the Norwegian population size is increasing. © Ingar Jostein Øien

It is also important to carry out measures to protect ospreys along migration routes and in wintering areas. As the tracking data increases, this might become easier. Improvement of public knowledge and conservation actions in the relevant countries and areas are important points in this regard.

9.11 Common Kestrel *Falco tinnunculus* (CMS Category: 2; SPEC 3) LC

Norwegian Red List: The species is evaluated as "Least Concern" on the most recent Norwegian Red List (Kålås *et al.* 2010).

Global status and distribution:
The European breeding population of common kestrel is estimated to number 330 000-500 000 pairs, with a moderate decline between 1970 and 1990, and in some countries a further decline in the period 1990-2000 (United Kingdom, France, Russia), which are the reasons for an overall declining European population (BirdLife International 2004).

Occurrence in Norway:
The common kestrel breeds in most parts of Norway, with the majority of the population in the south. Most breeding pairs are found in coastal areas, or in mountain birch forest. At the beginning of the 20th century, common kestrel was (one of) the most abundant raptors in Norway, but a general decline has been observed since then. The species suffered a major decline due to exposure to environmental pollutants in the 1950s and 1960s (Tømmeraas 1994d). The Norwegian population was suggested to number 2000-4000 breeding pairs in the period 1990-2003, and was characterised as stable by BirdLife International (2004). This population size was first suggested by Gjershaug (1991c), but a very limited amount of data existed to support the assumption. The breeding population has been described to fluctuate between years following variations in rodent populations (Tømmeraas 1994d). Nevertheless, a decline seems to be the case in some parts of Southwest-Norway in recent years, perhaps due to overgrown cultivated landscapes and agricultural changes in the region (Knut Olsen and Gunnar Skjærpe pers. comm., Steen 2013a). In Oppland, however, the population is reported to be increasing (Jon Opheim pers. comm.). The same seems to be the situation in Sør-Trøndelag (Ole A. Forseth pers. comm.), and the breeding populations in these counties have been reported to show less fluctuation between years during the first decade of this century.

Norwegian common kestrels are migratory, and are usually found in Norway from April to October. Most of these birds spend the winter in western parts of Europe, between Denmark and France, a few also further south (Tømmeraas 1994d, Bakken *et al*. 2003). Migration counts at Falsterbo were stable overall between 1973 and 1999, but have increased markedly since 2000 (Falsterbo Bird Observatory 2012). Stable or marginally positive trends (not significant) are observed at Lista and Jomfruland bird observatories (Ranke *et al.* 2011, Wold *et al.* 2012). The positive trend contrasts to the negative trend in many European countries, and an assumed negative trend in southern parts of Norway, but may reflect positive trends further north.

Relevant studies:
A number of studies have been carried out in association with a nestbox project in the municipality of Trysil in Hedmark. Primarily, these are feeding studies, focusing on issues such as prey delivery rates and prey selection in relation to nestling age, solar height and ambient temperature (Sonerud 1992, Steen *et al.* 2010, Steen *et al.* 2011a, Steen *et al.* 2011b, 2012). In many of these studies, video monitoring has been used to obtain better estimates of prey delivery. Of the 2282 prey items recorded during the 2337 hours of video monitoring in the study by Steen *et al.* (2011b), voles were most abundant, followed by birds, shrews, lizards, insects and frogs. This accounted for 60%, 13.7%, 12.4%, 9.4%, 2.9% and 0.4% of the total number of prey, respectively. It was estimated that a delivery rate of 91 items per hour was

required if parent birds had provided only insects for an average brood size of 4.3 nestlings. The corresponding number of prey items was 3.4/hr for lizards, 1.9/hr for shrews, 0.83/hr for voles and 0.52/hr for birds. On the basis of this data, it is argued that boreal forest breeding kestrels would be unable to raise an average sized brood only on insects or lizards, and unlikely to do so only on shrews. In a peak vole year, however, kestrels would be able to raise an average size brood solely on voles (Steen *et al.* 2011b). These studies underline the need for sufficient numbers of birds and rodents in kestrel breeding areas. From the results of the nestbox project in Trysil, summarised in the monitoring section of this report, it is evident that number of available breeding sites was a limiting factor for the population size. Availability of nesting sites was, however, not a factor limiting population size in Lågendalen in Vestfold and Buskerud where another nestbox project has been initiated, and where there is a good population of crows which provide alternative sites in the form of used nests. The population in Lågendalen was larger in the period 1950-1960 than it is now. Landscape and agricultural changes are suggested reasons for the probable decline in Lågendalen (Steen 2013a).

Male common kestrel. Efforts should be made to provide a better knowledge base of the population situation in Norway. © Ingar Jostein Øien

Suggested measures:
As nests may be found in trees and cliffs in forest areas, forestry sometimes poses a threat. The threat can be reduced if nests are located and protected prior to such activities. Forestry within a distance of 25 m from the nest should be avoided. In addition there should be no disturbance within a distance of 50 m from the nest during the breeding season (March-August). Efforts should be made to provide a clearer picture of the current population situation in Norway, and to confirm possible population declines or increases. Loss of suitable habitat (cultivated landscape) for the species might be a reason for an assumed decreasing population in southern Norway, but there is no data to prove this relationship. Availability of suitable nesting places is also important, as proved by the nestbox project in Hedmark. The common kestrel is one of the raptor species with the lowest levels of environmental pollutants. This might be explained by its position at a relatively low trophic level, although mercury levels in Norwegian common kestrels are more or less at a similar level as for other raptors (Nygård & Polder 2012).

9.12 Merlin *Falco columbarius* (CMS Category: 3) LC

Norwegian Red List: The species is evaluated as "Least Concern" on the most recent Norwegian Red List (Kålås *et al.* 2010).

Global status and distribution:
Merlin has a circumpolar range, but is absent from Greenland and northern parts of Canada (Cramp & Simmons, 1980). It is a widespread breeder in Northern Europe, with an estimated European population of 31 000-49 000 pairs. The population trend was stable between 1970 and 1990 (BirdLife International 2004).

Occurrence in Norway:
The Norwegian population was suggested to number 2500-6500 breeding pairs in 2002, and was then characterised as stable (BirdLife International 2004). However, the population size is difficult to estimate due to lack of monitoring programmes and studies on the species. The Swedish population is suggested to count 6200 pairs, with a density of 0.05 pairs/km^2 in mountain birch forest, and 0.02 pairs/km^2 in forested and swampy land in the northern parts of the country (Ottosson *et al.* 2012). The merlin is nevertheless probably one of the most widespread and common raptors in Norway, and breeds from coastal areas to alpine mountains (but is absent from agricultural lowland areas and larger coniferous forests in the eastern and southern parts of Norway; Tømmeraas 1994a). Population size is likely to fluctuate with crow population, because of the species' habit of using old crow nests for breeding (Tømmeraas 1990). The merlin has probably suffered from exposure to pesticides such as DDT on the wintering grounds in central and southern parts of Europe during the 1960s and 1970s (Nygård 1999).

While the migration counts at Falsterbo have increased significantly since 1973 (largest increase from the 1990s to the 2000s; Falsterbo Bird Observatory 2012), a significant negative correlation is observed in the autumn data from Lista bird observatory. However, the trend seems to be positive for the spring data and also positive overall for Jomfruland bird observatory both in spring and autumn, with significant positive correlation in spring (Ranke *et al.* 2011, Wold *et al.* 2012). Based on these trends, it is reasonable to assume a stable or increasing Norwegian population.

Relevant studies:
Migratory species such as the merlin are vulnerable to the pollution situation on the winter quarters. The long term trends in pollutant levels and shell thickness in eggs of merlin in Norway were studied by Nygård (1999). The relation to migration patterns and numbers was also investigated. Organochlorine compounds (OCs) have been reported as the probable cause of the decline in the merlin population in large parts of the species' range during the 1960s and 1970s (Temple 1972, Rebecca *et al.* 1992). Primarily, the decline was probably caused by the reproductive disrupting effects of DDE and the increased adult mortality caused by dieldrin, as for the peregrine falcon (Jefferies & Prestt 1966, Cade *et al.* 1968, Ratcliffe 1970). No comprehensive population data exist for the merlin population in Fennoscandia throughout the period of the most extensive pesticide usage. Autumn migration counts from Falsterbo bird observatory, however, indicate a decline in the population from the 1950s throughout the early 1960s. By 1973, a recovery seems to have occurred (Wallin 1984, Roos 1996). A similar pattern, though based on a smaller sample size, was observed at Revtangen bird observatory in southwestern Norway in the 1950s and 1960s (Bernhoft-Osa 1964). It is proven that some of the birds of prey species breeding in northern parts of Norway have an easterly migration route, including osprey and rough-legged buzzard (Österlöf 1977, Aarvak & Øien 2012).

Ringing recoveries of merlins breeding in northern parts of Norway also indicate a more easterly migration route and winter quarters compared to merlins breeding in central and southern parts of Norway (Bakken *et al.* 2003). This may have contributed to an observed regional variation in contaminant levels observed in this study, primarily for mercury (Nygård 1999). Significant decreases over time for sum-PCBs, HCB and DDE were observed, while chlordanes increased. Mercury levels observed in the study are generally high. Reduction in shell thickness by > 10% was observed for eggs collected in all decades following 1947, considered to be the first year of large scale use of DDT. During the 1960s and 1970s a considerable thinning (on average > 15%) took place. In the 1990s, average thinning was 8-11% (Nygård 1999). By 2012, the average thinning has declined to 5%. DDE levels have decreased, but a small increase is observed in recent years. Mercury levels are still high and recent investigations report high levels of PFAS. A higher level of DDE than PCBs contrasts to the general pattern for most other species, but might be explained by the species' terrestrial prey (Nygård & Polder 2012).

Suggested measures:
As nests may be found in trees and cliffs in forest areas, forestry sometimes poses a threat. The threat can be reduced if nests are located and protected prior to such activities. Forestry within a distance of 25 m from the nest should be avoided. In addition there should be no disturbance within a distance of 50 m from the nest during the breeding season (March-August). Another, more important, threat is exposure to contaminants. International regulations on pesticide use and release of contaminants are necessary to cope with this problem, as long-distance transport is an issue for many substances. Migratory species such as the merlin are easily exposed to pollution during migration and on their wintering grounds.

Investigations are needed to get a more precise estimate of the population size and trend in Norway. Further studies are also necessary to find out more about migration routes and winter quarters for Norwegian merlins.

Merlin. The species is vulnerable to pollution in the winter quarters, probably due to its terrestrial prey.
© Gunnar Gundersen

9.13 Eurasian Hobby *Falco subbuteo* (CMS Category: 3) VU°

Norwegian Red List: The species is evaluated as "Vulnerable" on the most recent Norwegian Red List, based on a small Norwegian population. The downgrading is due to the Norwegian population being a western branch of the Swedish population, which is strong and stable (Kålås *et al.* 2010).

Global status and distribution:
The species has a widespread distribution in the Palearctic and Oriental regions, but the European population is relatively small, numbering 71 000-120 000 pairs. No evident decline was observed between 1970 and 2000, and the European population is considered stable (Bekken 1994, BirdLife International 2004).

Occurrence in Norway:
The species is found breeding in southeastern parts of Norway, with the majority in Hedmark, Buskerud, Oppland, Oslo & Akershus, Vestfold and Østfold (Bekken 1994, Steen *et al.* 2008). It has also been found breeding in Telemark, Vest-Agder (2002) and Aust-Agder (Artsobservasjoner 2013). The Norwegian population of Eurasian hobby is small, and was dee ed to be stable, with 70-75 breeding pairs, between 1990 and 2002 (BirdLife International 2004). This is similar to the population size suggested by Steen (1994a). The Red List committee estimated the population to number 25-125 breeding pairs in 2010 (Kålås *et al.* 2010), while Steen *et al.* (2008) suggested a Norwegian population of 150-250 pairs, based on recent investigations in Buskerud. The latter seems to be better justified, as there are certainly more than 120 breeding pairs of Eurasian hobby in Norway, based on the aforementioned investigations in Buskerud, but also on existing data from Hedmark, Oppland, Oslo and Akershus and Østfold (Steen *et al.* 2008, Fredriksen *et al.* 2011; Jon Opheim, Carl Knoff, Svein Dale pers. comm.). An overview is presented in Table 8. Some data are indicative of an increasing population, but this might also be a result of greater awareness for the species, as pointed out earlier by Steen (1994a). Regular observations of adult individuals in the breeding period in Sør-Trøndelag and Nord-Trøndelag indicate breeding populations in eastern parts of these counties that could be newly established or perhaps hav been previously overlooked. Coniferous forest with marshes and/or small lakes nearby, or cultivated areas with wetlands, lakes and farmland are preferred breeding habitats (Bekken 1994, Steen *et al.* 2008).

Migration counts at Falsterbo have been stable overall since 1973 (Falsterbo Bird Observatory 2012). This also seems to be the case at Jomfruland, with a stable overall trend since the monitoring started in 1980 (based on a small sample size). The species is rare at Lista (Ranke *et al.* 2011, Wold *et al.* 2012).

Relevant studies:
Investigations on breeding density have been carried out in Buskerud, revealing a much larger population than previously assumed. Nests seem to be easiest to find in May and July, and the species usually breeds in old nests of hooded crow *Corvus cornix*. Pairs often move to a new breeding spot from one year to another. A total of 14 breeding sites were found in Buskerud in the period 2000-2007, while activity was recorded at 22 locations in 2009, 12 of which were confirmed breeding sites (Steen 2009b). The study reveals the necessity of availability to old nests of other species, and the need for available prey (insects and passerines) close to the breeding site. Often, preferable conditions are found in association with eutrophic lakes. The hobby seems to avoid large areas of dense forest (Steen *et al.* 2008). A density of three pairs/100 km^2 has been found in the investigated area, which is higher than that found in Hedmark (Hagen *et al.* 1994, Steen *et al.* 2008). When evaluating possible and probable breeding habitats for the species in Buskerud, the population is likely to be around 60 breeding pairs. With extrapolation to other possible and probable breeding habitats in eastern and southern parts of Norway, the Norwegian population is likely to number 150-250 breeding pairs. Despite this, it is impossible

to consider whether there has been an increase in the Norwegian population in recent years, due to the lack of studies. Based upon observations from present breeding sites, previous underestimation of the size of the Norwegian population is considered likely (Steen *et al.* 2008).

Table 8. Eurasian hobby population size. Numbers from Buskerud, Oppland, Hedmark, Østfold and Oslo & Akershus are suggested total population size for each county. Remaining numbers include documented ("Min") and probable and possible ("Max") breeding pairs in recent years. No surveys have been carried out in Rogaland, Vest-Agder, Aust-Agder and Telemark, but the population size is expected to be higher than indicated in all of these regions (i. e. closer to the estimate proposed by Steen *et al.* (2008).

Eurasian hobby	Min	Max	Year	Source
Finnmark	0	0	2013	Artsobservasjoner 2013
Troms	0	0	2004	Strann & Bakken 2004
Nordland	0	0	2004	NOF Nordland 2004
Nord-Trøndelag	0	1	2013	Reinsborg *et al.* 2012
Sør-Trøndelag	0	0	2013	
Møre og Romsdal	0	0	2013	
Sogn og Fjordane	0	0	2013	Artsobservasjoner 2013
Hordaland	0	0	2013	
Rogaland	0	0	2013	
Vest-Agder	2	2	2013	Artsobservasjoner 2013
Aust-Agder	1	1	2013	Artsobservasjoner 2013, Terje Lislevand
Telemark	1	1	2009	Bengtson *et al.* 2009
Vestfold	3	5	2012	Steen 2013b
Buskerud	30	60	2008	Steen *et al*. 2008
Oppland	20	25	2012	Jon Opheim
Hedmark	50	50	2012	Carl Knoff
Oslo og Akershus	10	20	2012	Svein Dale
Østfold	25	25	2012	Fredriksen *et al.* 2011, Morten Viker, Peter S. Ranke
Total population	**119**	**190**		
Previous estimate	150	250	2008	Steen *et al.* 2008

Suggested measures:
The hobby is somewhat different from other raptors in its breeding habits and choice of nesting habitat. The preference of crow nests, which often have a limited lifetime, and the switching of nests from year to year, means that considerations in relation to forestry need to be less restrictive for this species. However, if there are many crow nests within a limited area, and these are used by hobby, precautions to secure the breeding site should be taken (Steen *et al.* 2008). If nests are located, there should be no disturbance within a distance of 50 m from the nest during the breeding season (April-August).

Further investigations on breeding density in southeastern Norway will be necessary to get a better impression of the Norwegian population size and population trend. Surveys in eastern parts of Sør-Trøndelag and Nord-Trøndelag are highly desirable in order to reveal whether there are breeding populations of Eurasian hobby there, and if existence of breeding populations is proven, assess their size. This should be of priority given the species' Red List status in Norway.

Adult Eurasian hobby in Stokke, Vestfold in June 2012. Investigations of the population size of this red listed species in southern parts of Norway have revealed a larger population in the area than what was previously expected. © Gunnar Numme

9.14 Gyrfalcon *Falco rusticolus* (CMS Category: 2, CITES: 1; SPEC 3) NT

Norwegian Red List: The species is evaluated as "Near Threatened" on the most recent Norwegian Red List, based on a small but stable population. The population is evaluated to be in the IUCN-interval 500-1000 breeding pairs, which is a bit higher than previous estimates. This is explained by a probable higher population in northern Norway than previously expected. The population trend is considered stable (Kålås *et al.* 2010).

Global status and distribution:
The gyrfalcon has a circumpolar distribution, but is absent in Svalbard and Novaja Semlja. The European population is small, with no more than 1 300-2 300 breeding pairs. The population was stable in Europe between 1970 and 1990, and probably stable overall during the period 1990-2000, despite a reported decline in Russia (BirdLife International 2004).

Occurrence in Norway:
In Norway, gyrfalcons are usually found breeding in mountain areas, but coastal populations are found in some places, primarily in the north (Tømmeraas 1994b). An estimated 300-481 pairs bred in Norway in 1998 (Steen 1999). The population has been characterised as stable or slowly declining in Norway in later years, at least in some regions (Jon Opheim, Carl Knoff pers. comm. (Johansen & Østlyngen 2011). Thus, there still seems to be good reason to believe that the Norwegian population is close to the 1998-estimate, or maybe a bit higher, based on new investigations in some of the counties (Table 9). The 2010 Red List interval (500-1,000 pairs) has been criticised for being too high (Koskimies 2011), but it is important to note that the population is not assumed to potentially be as large as 1000 breeding pairs, but rather within the *IUCN-interval* of 500-1 000 breeding pairs. In Norway, the species was protected by law as late as 1971 (Holme *et al.* 1994). Young birds are more migratory than adult ones, and often move to the coast after the breeding season. Five out of seven recoveries of Swedish ringed

gyrfalcons are from Norway, four of these from coastal habitats (Fransson & Petterson 2001). Only two out of seventeen Norwegian ringed gyrfalcons were found outside Norway (in Denmark and Sweden). Those ringed as chicks in Finnmark are primarily found along the northern coastline, while several of the recoveries of birds ringed in the southern mountain regions are found along the southern coastline (Bakken *et al.* 2003). The occurrence of gyrfalcons has been stable (but low) in winter at Lista bird observatory since the startup in 1989, but numbers may have increased in recent years (Ranke *et al.* 2011, Wold *et al.* 2012).

Relevant studies:
The population trend for Fennoscandian gyrfalcons has been much debated throughout the years, and a general decline has been suggested by several authors. The strongest decline was described by Tømmeraas (1994c). In this study, 31 gyrfalcon nesting locations in a restricted area of Norwegian, Swedish and Finnish Lapland, reported in the middle of the 19th century, were re-examined in 1993. Only four of these were occupied by territorial pairs, and from this a population decline of 87% was calculated during the past 140 years (Tømmeraas 1994c). A total of 23 of the 31 nesting locations were located in Finnmark, northern Norway. In a study by Johansen & Østlyngen (2011), the distribution of these 23 nesting localities defined the 1,800 km^2 study area. Data collected during the 11-year period 2000-2010 was compared with historical data from the 11-year period 1854-1864. A total of 46 clutches were collected in the area during the 1854-1864 period, compared to 44 nesting attempts during the 2000-2010 period. The maximum number of nesting attempts for one year was eight in the latest study, compared to a maximum number of seven collected clutches in a single year 150 years earlier. Furthermore, more than 60% of the former nesting territories were still in use between 2000 and 2010. Many of the remaining territories were either disturbed by humans, or characterised by environmental change (such as birch forest expansion). An increasing population of golden eagles was also suggested to adversely affect the breeding gyrfalcons.

These results suggest that the present population in this area is of similar (or maybe even identical) size as it was two centuries ago (Johansen & Østlyngen 2011). It is not unlikely that the same is true also in other parts of Norway. Large variations between years have been documented for several of the gyrfalcon monitoring areas. However, it is important to note the general decline in many willow ptarmigan populations in Norway in later years (e. g. Furuseth & Furuseth 2012, Målsnes 2012). A clear positive correlation is observed between the autumn population of willow ptarmigan and the production of gyrfalcon chicks the following spring (Kålås & Gjershaug 2004, Selås & Kålås 2007). Available prey and nesting localities are thus essential for a strong population of gyrfalcons. Nevertheless, the study by Johansen & Østlyngen (2011) underlines the need for long time-series when evaluating population trends for the species.

Suggested measures:
Gyrfalcons largely depend on stick nests of ravens *Corvus corax*, and artificial nests have proved to be helpful where lack of suitable nest sites is an observed limiting factor determining nest density (e. g. Tømmeraas 1978, Knoff & Nøkleby 2011). Given the environmental changes (increased forestation), increasing golden eagle population and increased human activity in gyrfalcon breeding grounds in many parts of Norway, (including road building, willow ptarmigan hunting, increased stocks of domesticated reindeer, increased tourism and increased number of permanent residents), artificial nests have been suggested as a means of moving the falcons away from exposed nest sites. Studies confirm that gyrfalcons make use of such nests, and that breeding success is comparable with that at natural nests (Østlyngen *et al.* 2011).

Table 9. Gyrfalcon population size. The lower number includes documented breeding pairs, whereas the higher number includes probable and possible breeding pairs. The total population estimate is larger than earlier estimated, primarily because of more recent investigations in Finnmark, Troms and Nordland, revealing larger population sizes than earlier suggested. The population is also likely to be larger in Sogn & Fjordane than suggested here, but more research is needed to reveal this.

Gyrfalcon	Min	Max	Year	Source
Finnmark	60	120	2005	Strann *et al.* 2006, Karl-Otto Jacobsen (NINA-Tromsø)
Troms	65	130	2005	Strann *et al.* 2006, Karl-Otto Jacobsen (NINA-Tromsø)
Nordland	65	135	2005	Strann *et al*. 2006, Karl-Otto Jacobsen (NINA-Tromsø)
Nord-Trøndelag	15	20	1999	Steen 1999
Sør-Trøndelag	24	25	1999	Steen 1999
Møre og Romsdal	39	54	1999	Steen 1999
Sogn og Fjordane	2	4	2012	Agnar Målsnes
Hordaland	13	24	2012	Målsnes 2012
Rogaland	7	20	1999	Steen 1999
Vest-Agder	5	15	2009	Steen 1999, Bengtson *et al.* 2009
Aust-Agder	5	10	2009	Bengtson *et al.* 2009
Telemark	19	25	1999	Steen 1999
Vestfold	0	0	1994	Gjershaug 1994
Buskerud	17	20	2012	Furuseth & Furuseth 2013
Oppland	20	25	2007	Opheim 2007
Hedmark	16	24	2012	Steen 1999, Carl Knoff
Oslo og Akershus	0	0	2001	Dale *et al.* 2001
Østfold	0	0	2011	Fredriksen *et al.* 2011
Total population	**372**	**651**		
Previous estimate	300	500		BirdLife International 2004

Gyrfalcon at breeding site in Finnmark, northern Norway. Reducing harvest of ptarmigans from 30% to 15% of August populations would be beneficial for the species. © Karl-Otto Jacobsen

9.15 Peregrine Falcon *Falco peregrinus* (CMS Category: 3, CITES: 1) LC°

Norwegian Red List: The species is evaluated as "Least Concern" on the most recent Norwegian Red List, based on an increasing and strong Norwegian population. The downgrading since the 2006 Red List (NT°) is due to major increases in populations also in neighbouring countries (Kålås *et al.* 2010).

Global status and distribution:
The species has a cosmopolitan distribution, but is absent in some desert and arctic regions (Steen 1994b). It is patchily distributed across Europe, with a total of 12 000-25 000 breeding pairs. Large population increases have been observed across Europe during the period 1970-2000 (BirdLife International 2004).

Occurrence in Norway:
In 1998, the Norwegian population was estimated to 350-500 breeding pairs and was characterised as increasing (Steen 2002). In 2008, the population was still characterised as increasing in most parts of Norway. In 2006, the population was suggested to number 800-1,000 territorial pairs (Steen 2008b). This is similar to the presumed historical population size in Norway (500-1,000 pairs), proposed by Schei (1984). In 2013 the population is probably somewhat larger, based on a number of new establishments since 2006 (Steen 2012a, Nygård & Reinsborg 2013; for details, see Table 10). The peregrine falcon is distributed along the coastline from the Swedish border in the south to Grense Jakobselv in the north. It also occurs inland in most parts of the country (Steen 2009a). The densest population in Norway is probably found in Rogaland (Gunnar Skjærpe pers. comm.). Dramatic population declines were observed in the northern hemisphere during the 1950s, 1960s and 1970s due to eggshell thinning caused by DDE, the metabolite of the pesticide DDT (Cade *et al.* 1968, Ratcliffe, 1969, Ratcliffe 1970, Ratcliffe 1980). In 1976, no more than seven territorial pairs were documented in Norway, primarily in the south (Schei 1984). Since then, the population has been steadily increasing. In southern parts of Scandinavia a Swedish breeding programme in Bohuslän was crucial for the fast reestablishment of the species in Norway, particularly in the southeast (Steen 2009a). The majority of Norwegian peregrines winter in Western Europe, and most of the recoveries of ringed birds are from Belgium, France and Great Britain (Bakken *et al.* 2003).

The increasing population is also reflected in the Falsterbo migration counts. From an annual average of five individuals between 1973 and 1979, the mean annual number between 2000 and 2009 was 67 individuals, and an annual mean of 100 individuals in the period 2010-2012 (Falsterbo Bird Observatory 2012). Similar trends have been observed at Lista and Jomfruland bird observatories, with strong significant positive trends (Ranke *et al.* 2011, Wold *et al.* 2012).

Relevant studies:
The peregrine falcon has received much attention internationally because of the dramatic population declines all over the world between 1950 and 1980. The species was close to extinction in Norway and Sweden during the 1960s and 1970s (Lindberg *et al.* 1988). The DDT metabolite DDE was undoubtly one of the main causes of this decline. Reduction in shell thickness by > 20% was observed for eggs collected during the 1970s and the start of the 1980s (Nygård 1983). Since then, the situation has improved, probably as a direct consequence of the banning of DDT, but some eggs are still found with high levels of DDE. Mercury levels in Norwegian peregrine falcons are stable, but probably higher than pre-industrial levels. The peregrine is also one of the bird of prey species most affected by PCBs. The concentration of brominated flame retardants in peregrine eggs has decreased significantly in later years, but is still high compared to other raptor species. Levels of PFAS have been reported to be high in Norwegian peregrine falcons (Nygård & Polder 2012).

Table 10. Peregrine falcon population size. The lower number includes documented breeding pairs, whereas the higher number includes probable and possible breeding pairs. Survey and monitoring is or has been carried out in Trøndelag, Møre & Romsdal, Rogaland, Aust-Agder, Telemark, Vestfold, Buskerud, Oppland, Hedmark, Oslo & Akershus and Østfold. The remaining numbers are, however, more speculative. Populations in Troms, Nordland, Sogn & Fjordane, Hordaland and Vest-Agder are expected to be higher than indicated. Data presented for each county are not necessarily comparable due to different methods and years of data collection.

Peregrine falcon	Min	Max	Year	Source
Finnmark	100	150	2012	Arve Østlyngen
Troms	40	50	2013	NINA-Tromsø
Nordland	60	100	2013	NINA-Tromsø
Nord-Trøndelag	25	40	2012	Torgeir Nygård, Tore Reinsborg
Sør-Trøndelag	60	100	2013	Lorentz Noteng
Møre og Romsdal	60	90	2005	Stenberg 2005, County Governor
Sogn og Fjordane	8	22	2012	Artsobservasjoner 2013
Hordaland	30	40	2012	County Governor, Hordaland
Rogaland	140	190	2012	Gunnar Skjærpe
Vest-Agder	30	45	2012	Artsobservasjoner 2013
Aust-Agder	19	23	2011	Steen 2013b
Telemark	21	37	2011	Steen 2013b
Vestfold	18	18	2011	Steen 2013b
Buskerud	51	63	2011	Steen 2013b
Oppland	19	26	2009	Steen 2009a
Hedmark	6	7	2009	Steen 2013b
Oslo og Akershus	10	11	2012	Svein Dale
Østfold	3	5	2012	Steen 2009a, Fredriksen *et al*. 2011
Total population	**700**	**1017**		
Previous estimate	800	1000	2009	Steen 2008

Suggested measures:
As nests may be located in cliffs in forest areas and are used repeatedly, forestry sometimes could pose a threat. The threat can be reduced if nests are located prior to such activities. Søgnen (2011) suggested the following: Forestry should be avoided within a distance of 50 m to each side and 25 m from the foot of the cliff. In addition there should be no disturbance within a distance of 200 m from the nest during the breeding season (March-August). NOF-BirdLife Norway considers this as minimum distances. Despite the large increase in the European and Norwegian populations, it is important to keep in mind the dramatic situation for the species in Europe (and the rest of the world) just a few decades ago. To avoid similar scenarios in the future, it is important to maintain monitoring of this species in Norway, even though it is no longer on the Norwegian Red List.

Peregrine falcon at breeding site in Finnmark, northern Norway. The species suffered from the exposure to environmental pollutants between 1950 and 1980, and nearly became extinct in Norway and Sweden during the 1960s and 1970s. Now, approximately 1000 pairs are breeding in Norway. © Ingar Jostein Øien

9.16 Eagle Owl *Bubo bubo* (SPEC 3)EN

Norwegian Red List: The species is evaluated as "Endangered" on the most recent Norwegian Red List, based on indications of considerable population decrease and a small population. It is reasonable to suggest a decrease of about 20% during the past 18 years (Kålås *et al.* 2010).

Global status and distribution:
The eagle owl is distributed across the Palearctic, but is absent in southeastern Asia, Great Britain, western parts of central Europe, and in the northern tundra areas (Solheim 1994a). In Europe, the eagle owl has a patchy distribution, and the total population numbers 19 000-38 000 pairs. Large declines occurred during the 1970s and 1980s, but the population has stabilised or increased in most countries since 1990 (BirdLife International 2004).

Occurrence in Norway:
In Norway, the distribution range is mainly along the coast, from Agder to Nordland. There are also some inland populations, and eagle owls are found breeding in mountain areas as well as forest and treeless coastal habitats. The species has suffered from human persecution in Norway, and a dramatic decline in the population occurred from the early 19th century. Despite protection in 1971, the decline has continued during the last decades. Some illegal persecution probably still occurs in Norway. However, major threats today are from power lines and electrocution. The latter is a consequence of the eagle owl's habit of perching on the cross arms on pylons in open areas where there are few alternatives (Directorate for Nature Management 2008). Adult birds are often stationary, while young birds may move large distances (Solheim

1994a, Bakken *et al*. 2006). The most recent population estimate was published in 2008, and suggests a population size of 408-658 pairs in Norway; see Table 11 (Jacobsen *et al.* 2008). The situation has probably not changed much since then. This is much lower than earlier estimates, and reflects the negative population trend for the eagle owl in Norway.

Table 11. Eagle owl population size, modified from Jacobsen *et al.* (2008). The lower number includes documented breeding pairs, whereas the higher number includes probable and possible breeding pairs. Data presented for each county are not necessarily comparable due to different methods and years of data collection.

Eagle owl	Min	Max	Year	Source
Finnmark	0	2	2013	Arve Østlyngen and Karl-Otto Jacobsen
Troms	0	5	2013	Karl-Otto Jacobsen (NINA-Tromsø)
Nordland	50	80	2008	Jacobsen *et al.* 2008
Nord-Trøndelag	10	30	2008	Jacobsen *et al.* 2008
Sør-Trøndelag	62	77	2008	Jacobsen *et al.* 2008
Møre og Romsdal	65	65	2008	Jacobsen *et al.* 2008
Sogn og Fjordane	10	20	2008	Jacobsen *et al.* 2008
Hordaland	50	80	2012	Husebø & Steinsvåg, 2013
Rogaland	100	150	2008	Jacobsen *et al.* 2008
Vest-Agder	10	50	2008	Jacobsen *et al.* 2008
Aust-Agder	8	8	2008	Jacobsen *et al.* 2008
Telemark	9	13	2008	Jacobsen *et al.* 2008
Vestfold	6	10	2008	Jacobsen *et al.* 2008
Buskerud	1	2	2008	Jacobsen *et al.* 2008
Oppland	10	15	2012	Jon Opheim
Hedmark	5	15	2008	Jacobsen *et al.* 2008
Oslo og Akershus	1	3	2013	Kjetil Johannessen
Østfold	6	8	2008	Jacobsen *et al.* 2008
Total population	**403**	**633**		
Previous estimate	408	658	2008	Jacobsen *et al.* 2008

Relevant studies:
Several studies confirm the threat posed by constructions related to power transmission. In a Norwegian study from the 1980s, 27 eagle owls bred in captivity were fitted with radio transmitters and released. At least 12 of these birds were killed by electrocution due to short circuiting and earth wires. From the same project, constructions related to power transmission were identified as the cause of death for 75% of recovered ringed birds (Larsen & Stensrud 1988). However, it must be stressed that these birds were bred in captivity, and released in more urban areas than the areas where most Norwegian eagle owls breed. Nevertheless, 57% of the total amount of recovered eagle owls ringed in Norway has been killed by electrocution or collision with power lines (Bakken *et al.* 2006). The risk of electrocution is greatest when the distance between the power transmission lines or between the power-transmission lines and an earthed device is short, as eagle owls may touch both simultaneously when spreading their wings. The most hazardous constructions are those where transformers are mounted on poles and where poles provide a link to an underground or submarine cable (Directorate for Nature Management 2008).

The eagle owl is the only bird of prey in Norway with a National Single Species Action Plan (SSAP). The purpose of the SSAP is to ensure the long term survival of a breeding eagle owl population in Norway. The population should be self-sustaining and at least at the present level. It is also an objective to reestablish a breeding population of eagle owls in areas where they were previously present (Directorate for Nature Management 2008).

Suggested measures:
To meet the requests of the action plan, the most important causes of death must be removed to increase survival. Sub-populations with sufficient production of chicks must be protected, and consideration must be taken towards the eagle owl in land planning and land use. Suitable conditions must be provided to reestablish populations in former breeding areas (Directorate for Nature Management 2008). The major threats to Norwegian eagle owls are collision with power lines and electrocution (Bakken *et al*. 2006). To avoid electrocution, which actually represents a greater risk than collisions for the eagle owl, isolation of all power pylons within 2 km from known/potential nests, both old and new, should be a priority. Establishment of artificial perching sites on selected electricity poles has given good results in a pilot study in Lurøy (Nordland; Abelsen 2011). The problem of collisions is harder to resolve, but to look for alternative lines/routes is a good start. Different kinds of markings could be another measure (Lislevand 2004b). Nevertheless, the most effective measure would be to bury lines underground. However, this is also the most costly alternative (Directorate for Nature Management 2008). Several windfarms are under development in important eagle owl breeding areas in Norway (e. g. Eldøy 2012). This is not in agreement with the action plan, and must be avoided. More comprehensive environmental impact assessment in association with such developments should be a requirement, and professional and scientific advice should be taken more into consideration.

Eagle owl at nesting site in Lurøy, Nordland. The species has undergone serious population declines in Norway throughout the 20th century, which is the reason why it is listed as "Endangered" on the most recent Norwegian Red List. © Karl-Otto Jacobsen

Human disturbance, e. g. associated with holiday cabins is an increasing problem, due to the eagle owl's shyness and vulnerability at the nestsite. Cabins must be avoided within 1,000 meters from the nearest breeding location. It is also preferable to avoid logging activities within 50 meters from the foot of eagle owl breeding cliffs, and logging within 1,000 meters should be carried out only in September-January. Other relevant measures include restoration and protection of important habitats and nesting sites, and proper management of important eagle owl prey species. Monitoring of established and former breeding areas should be continued, and further surveys should be carried out to locate “new” breeding sites.

9.17 Snowy Owl *Bubo scandiacus* (CMS Category: 2; SPEC 3) EN°

Norwegian Red List: The species is evaluated as “Endangered” on the most recent Norwegian Red List, based on a small Norwegian population (< 50 individuals) and a decrease in breeding records during the past 30 years. The snowy owl was in 2006 evaluated as “Critically Endangered” (CR), but the possibility of invasions from the east is the reason for the downgrading (Kålås *et al.* 2010).

Global status and distribution:
The snowy owl has a circumpolar distribution, with European populations in Greenland, Iceland (only one-two pairs), Fennoscandia and arctic Russia (BirdLife International 2004). Breeding records have also been documented in Shetland (1967-1975) and Ireland (2001; Robinson & Becker 1986, Hillis 2004). In European parts of Russia, snowy owls are found breeding at Novaja Semlja, Vaygach, Yugorskiy peninsula, eastern parts of the Bolshezemelskaya tundra and the northern parts of Kanin peninsula (Morozov 2005). The European breeding population was estimated to 1,400-5,500 pairs, but considerable uncertainties were linked to this estimate (BirdLife International 2004). Genetic analyses reveal close relations in DNA sequence between snowy owls in North-America, Fennoscandia and Siberia, which strengthen the hypothesis that Arctic snowy owls are part of a large, panmictic population with significant gene flow (Marthinsen *et al.* 2008). Based on these DNA studies, the world population size of snowy owls was estimated at 1700-14 000 reproductive females. Potapov & Sale (2013) interpreted the snowy owls´ breeding system as made up of five to ten so-called “loose boids”, and estimated the total world population to fluctuate between 5000 and 14 000 pairs. Both studies thus point to a total world population that is less than 10% of the currently cited figures from IUCN of about 290 000-300 0000 birds These new and much better justified global population estimates should raise the awareness and concern for the future of the snowy owl, and its status on the IUCN red list should be reconsidered.

Occurrence in Norway:
The snowy owl has been protected by law since 1965 in Norway (Solheim 1994c), and the Norwegian population was suggested to be no more than 0-5 pairs in the period 1990-2003 (BirdLife International 2004). Recent investigations indicate that this number ought to be adjusted, and an estimate of 0-100 breeding pairs is probably closer to the current situation (Jacobsen *et al.* 2014). The species is found breeding on tundra and mountain plateaus, restricted to northern parts of Norway in recent years. Former breeding grounds also included southern mountain regions of the country (Dovre and especially Hardangervidda – 8-10 pairs until the beginning of 1960s), but there have been no documented breeding records here since 1974. Numbers have also been decreasing in the north. The years 1974 (13 breeding pairs), 1978 (28 br. p.) and 1985 (Børgefjell: 20 br. p.) were good for the species in Norway (Jacobsen *et al.* 2014). Snowy owls have a nomadic form of living, and invasions occur from time to time (Solheim 1994c). Some breeding records have been made in recent years, e. g. in 2001 (8 br. p.), 2004 (5 br. p.) and 2007 (7 br. p.; Jacobsen *et al.* 2014). 2011 was the first really good year in Norway since 1978, thanks to strong populations of rodents, especially Norway lemmings, and 42 breeding records were recorded in eight municipalities in Finnmark and northern Troms (Jacobsen *et al.* 2012a, 2013). Despite good numbers of rodents also in the south, breeding records were limited to northern parts of Norway (two breeding records were also made further south in Sweden). There is reason to believe that this is in part due to a small Fennoscandian/Russian population, and might give reasons to question the snowy owl’s ability to adapt to changes in climate and in the environment in general (Jacobsen *et al.* 2012a). Tracking of Norwegian snowy owls has revealed seasonal movements of Fennoscandian snowy

owls. An area on the Kola Peninsula has been recognised as an important wintering area for the species (Jacobsen *et al.* 2012a).

Relevant studies:
The Norwegian snowy owl project was initiated in 2005, and is run jointly by NOF-BirdLife Norway, NINA and Agder Natural History Museum. The aim of the project is to survey the population situation and map movements and habitat use by snowy owls. Based on this work, a report has been produced by the participants of the project, which provides a scientific foundation for a draft for a national plan of action for snowy owl, which the Norwegian Environment Agency is likely to publish within the years to come (Jacobsen *et al.* 2014).

Results from the Norwegian snowy owl project reveal that breeding in northern parts of Norway often occurs near the coast. This is in contrast to former breeding areas (and more recent breeding areas in Sweden) further south, which usually were found inland at 1 000-1 500 m above sea level (Hagen 1952, Bannermann 1957, Haftorn 1971). The best breeding areas in Fennoscandia are usually found near rich marshes and waters, often with glacial deposits nearby. Piles of glacial deposits provide good lookout posts for prey and dangers (stones are also used frequently), and are also free of snow cover early in the season, and thus provide good places to locate nests. Moist areas, such as marshes and streams, provide favourable conditions for rodents and wetland birds, and thus available prey (Jacobsen *et al.* 2012a). In years with good food availability, pairs can breed at a distance of 1-3 km apart (Hagen 1960, Parmelee 1992), unpublished data from the Norwegian snowy owl project. Whether snowy owls return to former breeding grounds is still mainly an open question. The limited amount of existing data indicates that there is much individual variation. Differences between sexes may exist, as have been documented for other species of owls (Sonerud *et al.* 1988, Hipkiss *et al.* 2002). This is a subject for future investigations for the Norwegian snowy owl project.

Availability of rodents is not a requirement outside the breeding season, and snowy owls hunt many kinds of prey, including large birds such as grouse and herring gull, and even Canada goose and grey heron (Syroechkovskiy & Lappo 1994). In Arctic and alpine regions, willow and rock ptarmigan are probably important prey species, especially outside the breeding season, and predation on sea ducks is also observed in many places in association with ice leads (Hagen 1952, Parmelee 1992, Robertson & Gilchrist 2003, Therrien *et al.* 2008, 2011, the Norwegian snowy owl project unpubl. data). Warmer climate may influence the hunting success in such habitats (Therrien *et al.* 2008, 2011). Low populations of willow and rock ptarmigan due to intensive hunting could also pose a threat. Previously, it has been suggested that seasonal quotas of 30% of the willow ptarmigan population in August each year will have no influence on the population, due to higher survival rate among the remaining birds. Recent studies have however revealed that 30% is too much to sustain a stable population, and that the hunting quotas should be set at maximum 15% of August populations in regional management plans (Sandercock *et al.* 2011).

Effects of climate change, such as changes in temperature, precipitation, vegetation limits and abundance of prey are obvious threats to the snowy owl. Lack of prey can of course have other causes than climate change, and is always a challenge for snowy owls, especially to young birds at unfamiliar wintering grounds. In addition, bad weather conditions (e. g. rain combined with low temperatures or snow), anthropogenic disturbance (e. g. tourism, recreation, reindeer husbandry, motorised traffic, dogs, photographers, ornithologists, scientists), predation (observed from eagle owl, peregrine falcon, pomarine skua, golden eagle, wolf, and probably gyrfalcon and white-tailed eagle), parasites (insects: blackflies *Simuliidae*, midges; cf. Solheim *et al.* 2013), hunting and collection of eggs (including by-catch in fox traps in Russia, illegal hunting (still legal hunting in Alaska), environmental contaminants (PCBs, POPs) and collisions (cars, aeroplanes, power lines (electrocution risk probably smaller than for eagle owl) are all potential threats. Collisions with wind turbines have not been studied much at present due to a lack of such constructions within the snowy owl distribution range. Due to behaviour and flying altitude, wind turbines are expected to pose a threat to snowy owls (Jacobsen *et al*. 2012a).

Suggested needs/measures:
The goal of a future national single species action plan (SSAP) for the species in Norway is to ensure the status of the snowy owl as a breeding bird in the country. To achieve this, it is important to improve the knowledge concerning why the snowy owl has become such a rare and irregular breeder. The Norwegian population of snowy owls is shared by Russia, Finland and Sweden, and it is therefore important to investigate potential threats and population status there. Important wintering grounds should be protected against anthropogenic disturbance, and when breeding occurs in Norway, it is important to protect the birds from disturbance and potential threats (Jacobsen *et al.* 2012a).

One relevant measure in this concern is to continue the Norwegian snowy owl project to help reveal more about migration and movements, levels of contaminants, winter diet and annual occurrence in Norway and neighbouring countries. Ongoing studies on the movements of snowy owls by satellite tracking should be given priority in order to increase the knowledge on how snowy owls distribute between Russia, Finland, Sweden and Norway throughout several rodent cycles. It is important to establish better collaboration with environmental managers and researchers in Sweden and Finland, in addition to maintaining contact with Russian researchers and environmental managers. It will also be relevant to introduce site protection under the Nature Diversity Act in some areas, as breeding locations often are smaller, limited areas that are used over and over again when conditions are favourable (Jacobsen *et al.* 2014).

Male snowy owl at breeding site in Finnmark. The Norwegian population is shared with Sweden, Finland and Russia. © Ingar Jostein Øien

One specific measure to increase adult survival could be to consider prohibition of hunting of ptarmigan in important wintering grounds in Norway. Seasonal quotas at more than 15% of the August willow and rock ptarmigan populations each autumn should be avoided. By-catch in fox traps in Russia and the use of snowy owl as a food source for indigenous people should be stopped. To increase reproductive success, requirement of permission to photograph and stay close to nests should be considered established by law, as it is in Iceland, Finland and Great Britain. Guarding of nests could be a relevant measure some places. To avoid destruction, loss and change of habitat, mapping, and then avoidance of important breeding and wintering grounds when building new roads, railroads, windfarms, power lines, cottages, reindeer husbandry, mining areas, hiking trails and ATV-trails are effective measures. It is also important to increase *public* knowledge about the species in Fennoscandia and Russia (Jacobsen *et al.* 2014).

9.18 Northern Hawk Owl *Surnia ulula* (CMS Category: 3) LC

Norwegian Red List: The species is evaluated as "Least Concern" on the most recent Norwegian Red List. Population data from the 2000-2010 period are more or less lacking, but a decrease may have occurred as a response to a tendency of lower spring populations of rodents, maybe as a consequence of climate change (Kålås *et al.* 2010).

Global status and distribution:
The northern hawk owl has a circumpolar distribution, and is in Europe widespread in the north. The European population has been estimated to number 9 200-38 000 pairs, with a stable population trend in the period 1970-2000 (BirdLife International 2004).

Occurrence in Norway:
The Norwegian population was suggested to be in the range 1 000-10 000 pairs in the period 1990-2002 (BirdLife International 2004). Data to support this guesstimate is however more or less lacking. The number of breeding pairs fluctuates due to the species' nomadic lifestyle, and in poor years the population may even number less than 100 pairs (Sonerud 1994a). The Swedish population is estimated to 2 300 pairs, with an interval of 1 125-13 510 pairs. The breeding population in Sweden is supposed to have increased in the last 30 years, both temporarily after the great invasion in autumn 1983, but also permantly because of the forestry practice of opening the coniferous forest landscape by clear-felling areas (Sonerud 1991, 2006). The reason for the low estimate is the relative scarcity of peak years (Ottosson *et al.* 2012). This is undoubtly also true for Norway. As an example of the nomadic movements of the species, northern hawk owls ringed in Norway have been recovered both in Russia and Sweden (Bakken *et al.* 2006). Northern hawk owls prefer mountain birch forest and subalpine coniferous forest as breeding habitat. The species is more common in the north and east than in the southern and western parts of Norway.

Relevant studies:
Few relevant studies have been carried out on this species in Norway in recent years. Home-range size was however investigated in Hedmark during the 1980s. This was reported to be 1.4-3.9 km^2 during the breeding season for three males, and 2.6-8.5 km^2 for two females outside the breeding season (Bækken *et al.* 1987). Another paper from the 1980s reported an average distance between breeding pairs of 2-3 km, while as little as 600 m was also recorded (Sonerud *et al.* 1987). The same study also highlights a case of bigyny from northern Norway.

Suggested measures:
More research is needed to get a clearer picture of the population size and population trend for the northern hawk owl in Norway. Investigations on the species' movements between breeding seasons are needed to provide more accurate estimates on the total Fennoscandian and European population. A wide selection of tracking devices is currently available or under development that could help provide such data. Information on population dynamics and

distribution according to prey abundance and variations in climate are also needed to predict future prospects.

Adult northern hawk owl at Røst archipelago, Nordland, during irruption in autumn 2013. Investigations of regional movements are needed to better estimate the Fennoscandian population of this species.
© Tomas Aarvak

9.19 Eurasian Pygmy Owl *Glaucidium passerinum* LC

Norwegian Red List: The species is evaluated as "Least Concern" on the most recent Norwegian Red List (Kålås *et al.* 2010).

Global status and distribution:
The Eurasian pygmy owl has a global occurrence in the boreal zone across Eurasia, and is in Europe a widespread resident in northern and parts of central Europe. The European population is estimated to number 47 000-110 000 pairs, with a stable population trend during the 1970s and 1980s. Some decline in the Russian population was recorded in the period 1990-2000, but populations were stable or increasing elsewhere, and the European population is therefore probably stable overall (BirdLife International 2004).

Occurrence in Norway:
The Norwegian population is mainly limited to the eastern region. The species is found north to Nord-Trøndelag, and patchily further north. In recent years, a population has also been discovered in Alta, Finnmark, and in 2011 four pairs were confirmed breeding there (Arve Østlyngen pers. comm.). In southern and western regions, the population is also more scattered. The number of breeding pairs fluctuates between years, and was suggested to be in the interval 5 000-10 000 in the period 1990-2003. The amount of data to support this is, however, somewhat limited (BirdLife International 2004).

Eurasian pygmy owls breed in old nesting holes made by great spotted woodpecker *Dendrocopos major*, three-toed woodpecker *Picoides tridactylus* and occasionally green woodpecker *Picus viridis* in coniferous forest mixed with deciduous trees. Pygmy owls prefer old, relatively open forests of spruce or pine as nesting habitat, usually with old aspen *Populus tremula* trees (Vedum & Øvergaard 2004).

Northern populations of pygmy owl migrate more than southern populations, and populations in Northern Europe may appear during invasions, maybe as a consequence of cold weather and food scarcity. Individuals might also move closer to cities and towns in winter. Pygmy owls ringed in Hedmark have been recovered at Mølen in Vestfold and in Akershus (Bakken *et al.* 2006).

Relevant studies:
Hoarding habits have been investigated in Stange and Løten municipalities in Hedmark, where about 25 special built pygmy owl nestboxes were erected by 2007 (Vedum & Øvergaard 2004, Vedum & Øvergaard 2008). These have been followed up every other week from September to the end of December. Hoarding seems to start earlier in the areas situated at a higher altitude (280 meters above sea level) compared to those at lower altitudes (150 meters above sea level). This is suggested to be a result of low temperatures and thereby snow cover earlier in autumn. The hoarding in the area usually starts in October and ceases from the middle of November, first at high altitude. New prey items are rarely found in December, and hoarding is usually at a low level in January and February. However, there have been cases of hoarding starting in January. Number of stored prey items in a nesting box may change rapidly. For instance, 71 new items of prey were found at one site after nine days, while 122 prey items disappeared from a nesting box in one month. Such storages provide a good picture of prey abundance in an area, and also of which species are the most common at a given time. The number of birds tends to increase when the availability of small mammals is low. Species of prey recorded in this area include a number of rodents (yellow-necked mouse *Apodemus flavicollis,* wood mouse *Apodemus sylvaticus*, field vole *Microtus agrestis* and bank vole *Myodes glareolus*), shrews (common shrew *Sorex araneus*, pygmy shrew *Sorex minutus* and water shrew *Neomys fodiens*), and birds (mostly goldcrest *Regulus regulus*, great tit *Parus major*, blue tit *Cyanistes caeruleus*, willow tit *Poecile montanus*, coal tit *Periparus ater*, nuthatch *Sitta europaea,* common redpoll *Carduelis flammea*, siskin *Carduelis spinus* and bullfinch *Pyrrhula pyrrhula*, but also larger prey such as great spotted woodpecker *Dendrocopos major* and fieldfare *Turdus pilaris*). Prey items are often temporarily stored at tree branches during the day, and transported to the storage at dawn (Vedum & Øvergaard 2004, 2008). In Nord-Trøndelag and bordering areas of Sør-Trøndelag a similar nestbox project was initiated in 2008, when 50 special built pygmy owl nestboxes were erected for registration of breeding and hoarding in pygmy owls (Øien & Aarvak 2010). The first breeding records (3) were recorded in these nestboxes in 2011. Three species of small mammals are regularly hoarded in the nestboxes in this region: field vole, bank vole and common shrew. Birds were less numerous, and usually single individuals of tit species (coal-, willow-, blue- and great tit) and common redpoll. During winter 2011-2012, after the Norway lemming population peak in summer 2011, Norwegian lemming was the predominant hoarded prey species even in lowland areas (Ingar Jostein Øien and Tomas Aarvak unpublished data).

Home range and habitat selection of eight adult pygmy owls (six males and two females) were assessed by radio-tracking in a fragmented forest farmland landscape in Hedmark during January-September 1993, when small mammal populations were in their low phase. Minimum convex polygon home range size ranged 0.4-6.0 km^2, with a median of 2.3 km^2. The habitat composition in the pygmy owls' home ranges differed from that in the study area. Mature forest ranked highest, followed by young thinning stands, edge between forest and open areas, clear-cut areas, advanced thinning stands and finally agricultural crop land where the pygmy owls were never observed (Strøm & Sonerud 2001).

Adult male pygmy owl near nest site in Nord-Trøndelag Mid-Norway. The species' hoarding habits have been investigated both in Hedmark and Trøndelag. © Ingar Jostein Øien

Suggested measures:
Investigations on breeding density in Norway will be necessary to improve the accuracy of the Norwegian population estimate, and to get a better impression of population trends for the species. Existing nestbox projects with a monitoring component should be continued and such projects should also be established in other parts of the distribution range in Norway. Forestry may be harmful to pygmy owl populations by harvesting old forest, but also beneficial by creating more edges between the old forest and stands of younger successional stages. In order to counteract negative influence from modern forestry on pygmy owls, mature stands of aspens which are usually rich in woodpecker nestholes that provide suitable breeding sites for pygmy owls should be left standing.

9.20 Eurasian Tawny Owl *Strix aluco* LC

Norwegian Red List: The species is evaluated as "Least Concern" on the most recent Norwegian Red List (Kålås *et al.* 2010).

Global status and distribution:
The European range constitutes more than half of the global range of this species, but it is also distributed further southeast in Asia, China and Korea (Sonerud 1994d, BirdLife International 2004). Overall, the tawny owl had a stable European population between 1970 and 2000, numbering 480 000-1 000,000 pairs (BirdLife International 2004).

Occurrence in Norway:
Approximately 2 500-6 000 breeding pairs were estimated in Norway in 2002-2003, largely based on quantitative data (BirdLife International 2004). Eurasian tawny owls have a predilection for cultivated landscapes and deciduous forests, but the species also breeds in larger gardens and parks. The Norwegian population is mainly restricted to coastal areas and lowland valleys, and the species can be found from Østfold to Nord-Trøndelag. Despite this it is also found inland, often in association with rural and urban areas (Sonerud 1994d). The tawny owl is the most stationary of Norwegian breeding owl species. The population is stable overall, but the species is probably vulnerable to agricultural rationalisation (Sonerud 1994d, BirdLife International 2004).

Spring counts of tawny owl from Jomfruland bird observatory show a positive but not significant trend, while autumn counts are significantly increasing. The trend also seems to be positive at Lista in autumn, but this is based on a very small number of observations (Ranke *et al.* 2011, Wold *et al.* 2012). It is however important to note that tawny owls in Norway do not have any regular seasonal migration. They might move about to some extent, but many adult birds are found in their territory throughout the year (Bakken *et al.* 2006).

Relevant studies:
Breeding tawny owls have been studied since the late 1980s in Nord-Trøndelag by NOF-BirdLife Norway, with 150 nestboxes put up in Stjørdal, Frosta, Levanger, Meråker, Verdal and Inderøy (in later years also in Mosvik, Verran and Steinkjer) municipalities (inner and southern parts of the county; Øien & Frisli 2013). A similar project has been running in Sør-Trøndelag since the early 1980's with more than 200 nestboxes (Georg Bangjord pers. comm). Incubating adult females and chicks are ringed annually, and each nestbox is visited twice each year. Data from these projects provides valuable information on the state of cultivated landscape via this key species found at a high trophic level. Number of breeding pairs varies between years and is usually between 40-60 in Nord-Trøndelag and 70-100 in Sør-Trøndelag. Onset of breeding and annual chick production varies according to the rodent situation (Øien & Frisli 2013).

Dispersal and mortality of fledglings have been studied in Nord-Trøndelag by telemetry, and mortality before dispersal was 61% due to starvation and predation by red fox *Vulpes vulpes*, pine marten *Martes martes*, and *Corvus* spp. Mortality was highest during the first 10 days after leaving the nestbox, when fledglings were small and had poorly developed locomotion. The average area used by fledglings that survived to dispersal was 26 ha (n = 15), which is a figure larger than reported elsewhere for this species (Overskaug *et al.* 1999). Solheim (2006) studied mortality of 79 tawny owls found dead in southern Norway during winter and spring 2006. Most of these birds died because of starvation, due to low food availability caused by heavy snowfall.

Home range sizes of adult females have also been studied in Nord-Trøndelag and Sør-Trøndelag, and the winter home ranges were, on average, 54% larger than those in summer. In the summer, range size was negatively correlated with the proportion of mixed deciduous/coniferous forest within 1 km of the nest. In some cases, females left the nesting area for prolonged periods during the non-breeding season, which indicates that even a species known to be notoriously residential can express a high degree of plasticity in its ranging behaviour when population densities are low (Sunde *et al.* 2001). In two cases adult females died (predation by Northern goshawk and collision with electricity wires) 4-5 and 11-12 days after their fledglings had left the nestbox. Even if both parens are presumed to be important for successful rearing of chicks in this species, the widowed males successfully reared the broods of respectively two and three owlets (Overskaug & Øien 2002).

Female tawny owl at nesting site in Nord-Trøndelag. By 2013, more than 350 nestboxes have been erected for the species in the Trøndelag counties. © Ingar Jostein Øien

Suggested measures:
The cause of death for many Norwegian tawny owls is anthropogenic. Collisions with vehicles, power lines or similar constructions are most common, while many birds get stuck in chimneys (Bakken 2006). Collisions are difficult to avoid, especially for nocturnal species. The best way to avoid collisions with power lines would probably be to avoid disrupting natural leading lines (or to use ground cabling). Providing nesting sites for tawny owl by putting out nestboxes could be an effective measure many places. Population sizes are well established for some counties, but not for others. As the species usually is easy to find, this situation could easily be improved.

9.21 Ural Owl *Strix uralensis* (CMS Category: 3) VU°

Norwegian Red List: The species is evaluated as "Vulnerable" on the most recent Norwegian Red List, based on a small population. The downgrading is because the Norwegian population is a marginal population, and the westernmost part of a strong Swedish population (Kålås *et al.* 2010).

Global status and distribution:
The species is associated with the northerly belt of coniferous forest that extends across Eurasia, and is found from Japan to Norway. It is also distributed in southeastern Europe, with large populations in Romania and Russia (Solheim 1994b, BirdLife International 2004). The European population was stable between years 1970 to 2000, and is estimated to number 53 000-140 000 pairs (BirdLife International 2004).

Occurrence in Norway:
Ural owls prefer coniferous forests and vigorous swamp and marsh forests in eastern part of the country, more specifically in southeastern parts of Hedmark. The species has also been found breeding in Lierne in Nord-Trøndelag, most recently in 2011 (Hagen 1968, Mysterud 1969,

Solheim & Bjørnstad 1987, Solheim 1994b, Reinsborg *et al.* 2012), and has been observed in Pasvik in Finnmark during the breeding season on several occasions (Artsobservasjoner 2013). In 2002, the total Norwegian population was evaluated to number 1-12 breeding pairs and was characterised as stable (BirdLife International 2004). About 450 nestboxes have been put up in some of the eastern municipalities of Hedmark (Trysil, Elverum, Åsnes, Grue, Våler and Kongsvinger) and in Värmland and Dalarne in Sweden. Almost 300 of the nestboxes are on the Norwegian side of the border. This has resulted in an increasing number of breeding records during the past decade, and a new record of nine breeding pairs were found in 2011, most of them in Åsnes and Trysil municipalities (Nyhus & Solheim 2011). Including bordering areas in Sweden, a total of 50 breeding pairs were recorded within the nestbox area in 2011. In 2013, Ural owls were recorded breeding in 10 nestboxes in Hedmark (Roar Solheim pers. comm.).

Relevant studies:
Systematic nestbox studies were started in Hedmark in 1979, and extended in 1982 and 1985 (Solheim & Bjørnstad 1987), with the aim to study breeding biology of the species at its western population border (Solheim *et al.* 2009). From 2000 onwards, more nestboxes were established on the Norwegian/Swedish border to secure the Värmland breeding population, but also to connect this population with the old nesting sites in Hedmark (Nyhus *et al.* 2005). Nestboxes have been made by students at the Hedmark University College and at Klarälvdalens Folkhögskola, and the students have also been involved in further work. Nothing seemed to happen during the first years of this new project, but this changed in 2006-2010, followed by the all-time high in 2011. Three of the breeding females in Hedmark have been birds ringed in Sweden. One of these has moved in a similar direction and distance as two of the great grey owls found breeding in Hedmark. In addition to these, seven ringed Ural owls have been found dead in Norway between 1969 and 2009 (Nyhus & Solheim 2011). These birds have moved an average distance of 208 km from where they hatched, which contrasts to the mean 29.4 km reported for young Finnish birds (Saurola 2002, Nyhus & Solheim 2011). Thus, most birds found in Norway are long distance travelers compared to the situation in Finland. Such birds often move as a consequence of collapsing rodent populations, and are often in poor condition. This might have limited the increase in the Norwegian Ural owl population. With an increasing breeding population in Hedmark and good production of chicks in recent years, this problem might now have been overcome (Nyhus & Solheim 2011).

Suggested measures:
The Ural owl breeds in mature forest, and as breeding sites may be used repeatedly, forestry (and cutting of nesting trees) may pose a threat. If nests are located and protected prior to such activities, for example by avoiding forestry within a distance of 50 m from the nest, this threat could be minimised. “Islands” of forest around the nest should be avoided, and there should be no disturbance within a distance of 200 m from the nest during the breeding season (February-August; Søgnen 2011). A large number of nestboxes have been provided for the species in its core distribution area in eastern Hedmark, and this could also be a relevant measure elsewhere.

Ural owl at breeding site in Hedmark. More than 450 nestboxes have been erected for the species in the border areas between Hedmark in Norway, and Värmland and Dalarne in Sweden. Ten Ural owls were breeding in Hedmark in 2013. © Roar Solheim

9.22 Great Grey Owl *Strix nebulosa* (CMS Category: 3) VU°

Norwegian Red List: The species is evaluated as "Vulnerable" on the most recent Norwegian Red List, based on a small Norwegian population. The downgrading is because the Norwegian population is a marginal one, and the westernmost part of strong Swedish and Finnish populations (Kålås *et al.* 2010).

Global status and distribution:
The great grey owl has a circumpolar distribution, and is in Europe resident in the boreal zone (Sonerud 1994e, BirdLife International 2004). The European breeding population is estimated to number 2 100-6 700 pairs, and was fairly stable between years 1970 and 2000 (BirdLife International 2004). In Fennoscandia, the highest density of great grey owl is found in moist coniferous forests, often overgrown grasslands and dense forests in the vicinity of the Gulf of Bothnia. Further north the distribution is more scattered, but more suitable conditions in areas around Pasvik in Finnmark are probably the reason for more frequent breeding records in this area (Roar Solheim pers. comm.).

Occurrence in Norway:
The species breeds in abandoned or old raptor nests (often northern goshawk, rough-legged buzzard or common buzzard nests) in old, tall forests, but may also use man-made nests or nestboxes (Sonerud 1994e, Berg *et al.* 2011). 0-10 breeding pairs were found annually between years 1990 and 2003, and the population is fluctuating (BirdLife International 2004). Previously, great grey owl had only been found breeding in Pasvik in Finnmark on a regular basis. As many as 14 nests were found in 1904 (Haftorn 1971). The species was also found breeding in Målselv

in Troms in 1979 (Johnsen & Rolstad 1979, Strann *et al.* 1985) and has been found breeding in Trysil in Hedmark since 1989 (Foyn & Blestad 1989, Bækken & Bjørkeli 1990). In recent years there have been indications of an increasing population in southern parts of Norway. Simultaneously, the number of breeding pairs has increased in southern Sweden. The Great Grey owl has expanded its distribution southwetwards in northern Europe on a large scale (Lawicki et al. 2013). Thus, the increasing Norwegian population is likely to be a result of the population moving south rather than nomadic migrations (Solheim 2009). A total of 22 breeding pairs were recorded in Hedmark in 2011 alone, and this was at that time a new record for Norway. Among these, 10 were found in Elverum municipality, five in Åsnes and the rest in Stange, Løten, Åmot and Trysil (Berg *et al.* 2011). Following the good year of 2011, the rodent population collapsed, and only two breeding pairs where recorded in southern parts of Scandinavia in 2012 (as far south as Småland; Roar Solheim pers. comm.). In 2013, however, the number of great grey owls in Hedmark reached a new record of 30 breeding attempts, and one pair in Oppland. The mean production of nestlings was much lower this year, with typical brood sizes of 1-3 owlets (Roar Solheim pers. comm.), as compared to typical brood sizes of 4-6 owlets in 2011 (Berg *et al.* 2011). As regards the occurrence in Pasvik, there have been few breeding records in recent years. One of the reasons for this may be the limited availability of suitable nests in the area. Limited research could be another reason. This may improve, as 20 breeding platforms were erected in Pasvik in March 2012 (Roar Solheim pers. comm.).

Relevant studies:
A large effort has been invested in locating breeding great grey owls in Hedmark during the past decade. This has been carried out by listening for hooting individuals and by checking known raptor nests (both natural and artificial). Altogether 36% of breeding pairs in 2011 were found in northern goshawk nests, while 18% were found in common buzzard nests. Together with artificial nests, this makes up 72% of the total (Berg *et al*. 2011). One great grey owl was found breeding in a nestbox intended for Ural owl, while several breeding records are from artificial platforms. Others have been found "by chance" when searching more or less "suitable habitat". A couple of nests have even been found on the ground, which is very rarely described in the literature. However, these were unsuccessful, probably due to predation. In the good vole year of 2011, most of the breeding owls were young (2nd calender year) birds, which is uncommon. Two of the 17 birds captured were ringed as chicks in Elverum municipality the year before, while one was ringed as chick at Siljan in Sweden the year before (120 km away). A first year bird bred in the same nest as an 11-years old female was found breeding the year before. Three males were fitted with radio transmitters for home-range studies in 2011, but the results have not been published (Berg *et al.* 2011). In 2013 the old female from Sweden renested in the same twig nest as she used in 2011 (Roar Solheim pers. comm.)

Suggested measures:
The great grey owl breeds in mature forest, often in old raptor nests. As nests are reused to some extent, forestry (and cutting of nesting trees) may pose a threat. If nests are located and protected prior to such activities, for example by avoiding forestry within a distance of 50 m from the nest, this threat could be minimised. "Islands" of forest around the nest should be avoided, and there should be no disturbance within a distance of 200 m from the nest during the breeding season (March-August; Søgnen 2011). The habit of breeding in raptor nests underlines the need to protect such nests from forestry. Establishment of artificial nests or breeding platforms would probably also help the species establish a stable breeding population in Norway.

Female great grey owl attacking at nest in Hedmark when owlets are ringed. Protecting raptor nests and erection of artificial nests would help the species establish in Norway. © Roar Solheim

9.23 Long-eared Owl *Asio otus* (CMS Category: 3) LC

Norwegian Red List: The species is evaluated as "Least Concern" on the most recent Norwegian Red List (Kålås *et al.* 2010).

Global status and distribution:
The long-eared owl is found in temperate regions in both Eurasia and North America, and is distributed in most parts of Europe. The European population is large with 380,000-810,000 pairs, and was stable in the period 1970-2000. The bulk of the European population is found in Romania and Russia (BirdLife International 2004).

Occurrence in Norway:
There are breeding records of long-eared owls from all Norwegian counties, although the species is found more scattered and in low numbers in the northern parts of the country. Also in the west the long-eared owl is more patchily distributed (Sonerud 1994b). The total Norwegian population is fluctuating, and was considered to be in the range of 1000-10 000 breeding pairs both by Sonerud (1994b) and in the period 1990-2003 (BirdLife International 2004). Quantitative data from Norway to support this guesstimate is lacking. In comparison, the Swedish population numbers 8 600 pairs, with an interval of 2 605-14 565 pairs (Ottosson *et al.* 2012). The species breeds in agricultural and cultivated landscape with patches of coniferous forest. It often rests during daytime in social gatherings outside the breeding season. Most Norwegian long-eared owls are migratory and move to central and southern Europe (Great Britain, Denmark, Sweden and Germany) and have a nomadic lifestyle (Sonerud 1994b, Bakken *et al.* 2006). There is a significant negative correlation between year and the number of spring observations of long-eared owl at Jomfruland bird observatory after the startup in 1980, but the

sample size is small. Numbers from Lista are too small to analyse (Ranke *et al.* 2011, Wold *et al.* 2012).

Long-eared owl at daytime roost in winter. Satellite tracking would be beneficial to track nomadic movements of Norwegian long-eared owls. © Ingar Jostein Øien

Relevant studies:
The long-eared owl usually uses an energetically expensive, active hunting strategy. Sonerud *et al.* (1986) suggested that species that are adapted to this hunting strategy migrate to snow-free areas in winter, while species that stay in snow-covered areas in winter use the “sit-and-wait strategy”, which is energetically more cost-effective. These species are generally also able to localise concealed prey and to hunt in closed forest habitat (Sonerud 1986). This is likely to be one of the reasons why most long-eared owl leave Norway in winter, with some exceptions in the southwestern region, where a few birds usually try their luck in the snow-free coastal areas.

Suggested measures:
Satellite tracking data would be beneficial to reveal nomadic movements. Such investigations are needed to provide quantitative data on population size and fluctuations.

9.24 Short-eared Owl *Asio flammeus* (CMS Category: 2; SPEC 3) LC

Norwegian Red List: The species is evaluated as “Least Concern” on the most recent Norwegian Red List (Kålås *et al.* 2010).

Global status and distribution:
The short-eared owl has a wide circumpolar distribution in northern parts of Eurasia and North America, and is patchily distributed throughout most of Europe (BirdLife International 2004). The European population numbers 58 000-180 000 pairs, but has decreased during the 1970s and 1980s. The population stabilised during the 1990s (BirdLife International 2004).

Occurrence in Norway:
The Norwegian population was suggested to number 1 000-10 000 breeding pairs in the period 1990-2003, and fluctuates according to rodent populations (BirdLife International 2004). The same population estimate was published in Gjershaug *et al.* (1994). However, there is no quantitative data to support this, and the upper limit of this estimate is likely to be too high. This is supported by a smaller Swedish population, estimated to 1,700 pairs in 2012, with an interval of 755-4 702 pairs. The Swedish population has declined during the past 30 years (Ottosson *et al.* 2012). The species can be found breeding in most parts of Norway, but is generally most numerous in mountain areas in the northern and middle parts of the country. Short-eared owls are rarely found breeding in Hordaland, Oslo & Akershus, Østfold and Vestfold (Sonerud 1994c).

Short-eared owl in Finnmark, northern Norway. Tracking data would be beneficial to map nomadic movements of this species, and to establish more accurate estimates of the Fennoscandian population size. © Oddvar Heggøy

The species has a nomadic lifestyle, and breeds only if the availability of rodents is sufficient. It winters in North-Africa and southern and eastern parts of Europe, but some birds might also spend the winter in Norway (Sonerud 1994c, Bakken *et al.* 2006). NOF–BirdLife Norway's Atlas of wintering birds showed that short eared owls may winter in small numbers in most counties (Svorkmo-Lundberg *et al.* 2006). The species is recorded in low numbers at Jomfruland, but is more common at Lista, where there is a stable trend both in numbers of spring and autumn observations in recent years (Ranke *et al.* 2011, Wold *et al.* 2012).

Relevant studies:
Short-eared owls are poorly studied in Norway. The species' high degree of mobility, and ability to track population fluctuations of rodents without time lags, is however, well demonstrated in a study of numerical and functional responses of common kestrels, long-eared owls and short-eared owls in relation to vole density in a 47 km^2 farmland area in western Finland in the period 1977-1987 (Korpimäki & Norrdahl 1991). Between 0-49 pairs of short-eared owls nested in the

area during the study period, with the mean annual number of fledglings produced ranging from 0.4-3.8. A positive correlation was found between spring density of *Microtus* voles and number of fledglings. Increase in population of microtines caused a rapid immigration to the study area, while the opposite was true when microtine densities decreased (Korpimäki & Norrdahl 1991).

Suggested measures:
Tracking data would be beneficial to find out more about nomadic movements and migration. There are also large uncertainties associated with the Norwegian population size, and efforts should be made to establish a more accurate estimate.

9.25 Boreal Owl *Aegolius funereus* (CMS Category: 3) LC

Norwegian Red List: The species is evaluated as "Least Concern" on the most recent Norwegian Red List (Kålås *et al.* 2010).

Global status and distribution:
Boreal owl has a circumpolar distribution, and in Europe is resident in the north and more patchily distributed further south. The European population is relatively large, numbering 110 000-350 000 pairs, and was considered stable in the period 1970-2000 (BirdLife International 2004).

Occurrence in Norway:
The BirdLife International estimate from 2004 suggested that 2,000-20,000 pairs bred in Norway between years 1990-2003 (BirdLife International 2004). This is considerably higher than the estimate from Gjershaug *et al.* (1994; 1 000-10 000). The latter estimate is based on the area of the northern boreal zone (minus 2/3 of the "birch belt" and the western part of Norway; 100 000 km^2) divided by the known size of home ranges (3-6 km^2): 18000-36000 pairs in an optimal year for the whole country. Taken into consideration that the entire country does not have optimal conditions in any given year, as well as fluctuations, the estimate was changed to 2000-20000 pairs (Geir Sonerud pers. comm. to Ingar J. Øien and Torborg Berge in 2003). None of these estimates are, however, based on specific survey data, so quantitative data on population size is in Norway is limited. An overall decline has been observed in the Swedish population during the past 30 years. The reported breeding density in Sweden is 0.03-0.15 pairs/km^2 in coniferous and mixed coniferous forest, and the population was estimated to 32,000 pairs in 2012 (Ottosson *et al.* 2012). A significant population decrease is also well documented from Finland, where there was an evident negative growth rate of 2.1-2.3% per annum during the 1980s to 2000s (Korpimäki & Hakkarainen 2012).

The main reason for the decline of the boreal owl population in Finland is the decreasing area of old-growth forests, but also increasing populations of Ural owl may explain some of the decline (Korpimäki & Hakkarainen 2012). Despite the lack of data from Norway, there is no reason to believe that the trend for the species in Norway differs radically from these countries. The species prefers old coniferous forest, but can also use logged areas as hunting grounds in spring (Sonerud *et al.* 1986, Sonerud 1986, Jacobsen 1989, Bye 1990). It breeds in old nest holes made by black woodpecker *Dryocopus martius* and in nestboxes. Boreal owl is (one of) the most common owls in most parts of Norway, but is absent (or breeds in low numbers) in the west. Males are often stationary, but females live a nomadic life (Sonerud 1994f). Young birds also tend to move over large distances, especially when numbers of rodents are low (Sonerud *et al.* 1988).

The trend seems to be stable for the species at Lista bird observatory, based on ringing numbers (not statistically significant), while the trend is significantly negative in autumn at Jomfruland. Nevertheless, it is worth noting that ringing activity is not standardised for owls at Lista. Despite this, it is easy to observe a triennial cycle in the ringing data, with high number of owls ringed every third year (Ranke *et al.* 2011, Wold *et al.* 2012). The triennial cycles observed at Lista partly reflects the cycles observed in Hedmark and Trøndelag. A new record annual total of 204 boreal owls were ringed at Lista in 2011 (Wold *et al.* 2012).

Relevant studies:
A long-term data set on small mammal cycles and boreal owl dynamics from north Norway was analysed and compared with related Fennoscandian studies by Strann *et al.* (2002). A significant positive correlation was found between number of breeding boreal owls and the abundance of *Clethrionomys* spp. (grey-sided vole and red vole) the following autumn, but not for shrew abundance. Number of fledged chicks and clutch size was also dependent on *Clethrionomys* spp. abundance. No significant correlation between number of breeding boreal owls and *Clethrionomys* spp. abundance the previous autumn was found. This may indicate that high autumn densities of small rodents always lead to a collapse the following winter, and low densities the following spring. This contrasts to the situation reported elsewhere. The three-year cycles reported from the Norwegian study also contrast to the 4-5 year cycles reported from Finland at the same latitude (Hansen *et al.* 1999). From this, the authors argue that dynamics may be different over short distances, and may be correlated with continentality, as well as latitude. It is also stressed that "cyclic dynamics with large amplitude still persist at least locally in Fennoscandia", despite less cyclicity observed elsewhere, and that "the gradient cyclicity and cycle period cannot be simply interpreted as a latitudinal gradient", as previously suggested (Strann *et al.* 2002).

Adult female boreal owl at nesting site in Nord-Trøndelag. Research on movements outside the breeding season would help in the establishment of a Fennoscandian population estimate.
© Ingar Jostein Øien

Nest predation in boreal owls using nestboxes was studied for 13 years in Hedmark. Forty-eight per cent of the clutches were preyed upon, and of these at least 70%, and possibly all, were taken by pine martens *Martens martens*. Frequency of predation increased with nestbox age. Boreal owl clutches had a higher probability of being preyed upon in nestboxes where the previous clutch had been taken than in boxes where there had been a successful nesting the previous year.

These results indicate that pine martens did not encounter nestboxes randomly, but revisited those that they had found previously. Boreal owls preferred to nest in new boxes, and a majority of the females shifted nest hole between successful nestings (Sonerud 1985). Bye *et al.* (1992) studied the nocturnal hunting and diurnal roosting behaviour of 17 radio-equipped boreal owls in Hedmark during their nesting season. The owls perched lower when hunting than when roosting, probably because hunting perches were selected to minimize the predator-prey distance or to obtain unobstructed access to the ground-dwelling small mammal prey, whereas roosting perches were selected to minimise the probability of being detected by an avian predator.

Suggested measures:
Tracking data would reveal more about boreal owl movements outside the breeding season, and would help in the assessment of the total Fennoscandian population size. In the case of the Norwegian population size, more research on population densities in different parts of Norway is needed to provide a more accurate estimate.

10 PRIORITY ACTIONS

In this chapter, we identify needs for capacity building, plans of action, studies and monitoring and the need for taking considerations to birds of prey in land planning within all sectors.

Priority actions listed in § 4 of the action plan are:

- Protection of all species of birds of prey from illegal killing (poisoning, shooting, persecution, unsustainable exploitation)
- Promotion of high environmental standards in the planning and construction of structures (e. g. wind turbines, power lines) to reduce negative impact on species, in addition to improving existing structures.
- Conservation of important bird of prey habitats (ecosystem approach)
- Protection and good management of important localities, especially for important migration bottlenecks and breeding sites for category 1 species.
- Ensure that the needs of bird of prey conservation are taken into account in agriculture, fisheries, forestry, industry, tourism, energy production and in the use of chemicals and pesticides.
- Increase public awareness and knowledge of birds of prey, including current plights, threats and what needs to be done to conserve them.
- Monitor populations to ensure and establish reliable population trends, in addition to conducting research on the impacts of current threats and elucidate what measures need to be taken to mitigate them.
- Investigate and map migration routes and conduct research on species ecology.
- Building of capacity for conservation actions in institutions and communities, by increasing knowledge and monitoring.

(CMS 2012)

10.1 Priorities

Priorities are to prevent global extinction of species and then prevent and reverse population declines in globally threatened and near threatened species and as many species with an unfavourable conservation status as possible. On a longer time scale, these populations should be restored, in addition to the populations of all species with an unfavourable conservation status. Declines in populations in all species with a favourable conservation status should finally be prevented.

10.2 Prioritized species and red list evaluation

Eight Norwegian birds of prey species are listed as having an unfavourable conservation status at a regional level within a defined area (common kestrel, gyrfalcon, osprey, white-tailed eagle, hen harrier, golden eagle, snowy owl and short-eared owl) and another 11 species of birds of prey are currently found on the Norwegian Red List (northern goshawk (NT), eagle owl (EN), snowy owl (EN), Eurasian marsh harrier (VU), hen harrier (VU), gyrfalcon (NT), Eurasian hobby (VU), osprey (NT), European honey buzzard (VU), great grey owl (VU) and Ural owl (VU). No justification is made for those species evaluated as “Least Concern” on the Red List. This should, however, be a priority. For many birds of prey species, there are large uncertainties associated with population size and population trend. This is especially true for honey buzzard, Eurasian sparrowhawk, rough-legged buzzard, merlin, common kestrel, northern hawk owl, long-eared owl and short-eared owl. There are also uncertainties associated with the population size for the hen harrier, common buzzard and pygmy owl. There is thus undoubtedly an urgent need for further studies and monitoring of many of the Norwegian birds of prey species. Measures should also be taken to stop the decline in the northern goshawk and eagle owl populations, and to increase the snowy owl breeding population. Reliable population trends for honey buzzard and rough-legged buzzard should be established.

10.3 Migration routes

Much information is lacking with regard to migration routes for birds of prey in Norway. This is important primarily to prevent development of windfarms and power lines in sensitive areas. Work still needs to be done to prevent collisions and electrocution with wind turbines and power lines. Measures could include mapping of important roosting and resting areas, breeding sites and leading lines prior to building, and to improve existing constructions to prevent electrocution. Such improvements should be a priority close to nesting sites of breeding birds of prey. Wind turbines should also be shut down during periods when the risk of collisions is especially prominent, e. g. during migration, courtship etc. In addition to the threat from wind turbines, power lines and electrocution, major threats to birds of prey in Norway are changes in land use, forestry, environmental pollutants and environmental crime. To cope with pollutants and environmental crime, international agreements and regulations are essential.

10.4 Legal framework

Within the framework of the Nature Diversity Act, not only species themselves, but also the areas on which the species depend are to be maintained, to achieve maintenance of the species and their genetic diversity. Other important points in relation to constructions and changes in land use are the requirements for sufficient knowledge base in each case, the precautionary principle, the ecosystem approach and cumulative environmental effects, the user-pays principle and environmentally sound methods of operation. Clearly, these points are not always taken into account. One of the most evident examples is found in the forestry sector in relation to nesting sites for birds of prey. The guidelines for logging activity in the vicinity of birds of prey nests should therefore also be legally integrated in the Forestry Act. Also, the requirements for environmental impact assessment and follow-up related to windfarm development should be far more comprehensive than is the case today. Cumulative effects must be considered, and compensation and mitigating measures carried out. Professional advice and scientific research must also be taken more into consideration in these cases. Only red listed species are considered in Norwegian risk evaluations today. Environmental impact assessments should, however, include all birds of prey species du to the low numbers of most species and importance to conserve their breeding sites. Other examples are found in the practice of hunters' harvest of prey species utilised by birds of prey. This is especially true regarding the harvest of ptarmigans, where significant population declines and non-sustainable management have been identified in many areas.

10.5 Compensation system

The compensation system for sheep and reindeer killed by golden eagle should be improved, either by improvement of the documentation system, or by revising the legal framework, e. g. to a system equivalent to the ones in Finland and Sweden.

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