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Grouse Status Survey and Conservation Action Plan, 2006-2010

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IUCN Species Survival Commission, Grouse Specialist Group

World Pheasant Association

Grouse

Status Survey and Conservation Action Plan 2006-2010

Compiled by Ilse Storch

IUCN Species Survival Commission

IUCN/SSC
Grouse
Specialist
Group

SSC
Species Survival Commission

IUCN—International Union for Conservation of Nature

Founded in 1948, IUCN brings together States, government agencies and a diverse range of non-governmental organizations in a unique world partnership: over 1,000 members in all, spread across some 140 countries. As a Union, IUCN seeks to influence, encourage and assist societies throughout the world to conserve the integrity and diversity of nature and to ensure that any use of natural resources is equitable and ecologically sustainable. IUCN builds on the strengths of its members, networks and partners to enhance their capacity and to support global alliances to safeguard natural resources at local, regional and global levels.

IUCN Species Programme

The IUCN Species Programme supports the activities of the IUCN Species Survival Commission and individual Specialist Groups, as well as implementing global species conservation initiatives. It is an integral part of the IUCN Secretariat and is managed from IUCN's international headquarters in Gland, Switzerland. The Species Programme includes a number of technical units covering Wildlife Trade, the Red List, Freshwater Biodiversity Assessments (all located in Cambridge, UK), and the Global Biodiversity Assessment Initiative (located in Washington DC, USA).

IUCN Species Survival Commission

The Species Survival Commission (SSC) is the largest of IUCN's six volunteer commissions with a global membership of 8,000 experts. SSC advises IUCN and its members on the wide range of technical and scientific aspects of species conservation and is dedicated to securing a future for biodiversity. SSC has significant input into the international agreements dealing with biodiversity conservation. Web: www.iucn.org/themes/ssc

IUCN SSC Grouse Specialist Group

The Grouse Specialist Group (GSG) is a global voluntary network of persons professionally involved in the study, conservation, and sustainable management of grouse. The GSG is committed to understanding and securing viable populations of all species and subspecies of grouse seeking ways to maintain them in their natural habitats and is particularly concerned with the conservation of threatened grouse. The GSG operates under the joint authority of the Species Survival Commission of IUCN—International Union for Conservation of Nature, BirdLife International, and the World Pheasant Association. The GSG was officially founded in 1993, however, a WPA-tied network of grouse specialists has existed much longer. By late 2007, the GSG had about 130 members from 30 countries in Eurasia and North America. Web: www.gct.org.uk/gsg

World Pheasant Association

The World Pheasant Association (WPA) is a registered charity 271203, founded in 1975, which aims to develop and promote the conservation of all the species within the order of the Galliformes, which are, broadly speaking, the gamebirds of the world. This group, including pheasants, grouse, partridges, quail, francolins, megapodes and cracids, contains some of the most beautiful and threatened birds in the world. WPA is the umbrella organisation for Galliformes Specialist Groups which operate under the joint parentage of WPA and the Species Survival Commission (SSC) of IUCN International Union for Conservation of Nature.

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Grouse
Specialist
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IUCN Species Survival Commission

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Foreword

By Phil McGowan, Director of WPA, and Holly Dublin, Chair of IUCN-SSC

At a time when the challenges facing those engaged in biodiversity conservation have never seemed greater, there is an ever more urgent search for new ways of halting population declines and even reversing them. The potential for innovative management approaches to meet these needs is nowhere greater than amongst the grouse. They comprise a group of high profile species that are amongst the most well known species in the countries where they occur and indeed, they are often considered the embodiment of the landscapes in which they live. They have been entwined with human societies throughout recorded time and are embedded in many cultures and traditions. The extinction of a population is the loss of far more than a single species from a single place, but the loss of a centuries old connection with our natural surroundings.

The Grouse Specialist Group contains a wonderfully diverse array of talented members. Some are dedicated to understanding the nature of genetic diversity and how it is affected by human activities and are pioneers in the application of these approaches and techniques to conservation issues. Others are gathering fundamental data on species ecology and population status, again developing field methods and applying analyses that are innovative and immensely insightful. Yet others are working at the interface of science and management and are leaders in the application of science to the development of practical measures to safeguard populations. All in all the expertise contained within this technically-skilled group is a powerful demonstration of the important contributions made by the Specialist Groups of the IUCN Species Survival Commission.

This Action Plan is their distillation of the current status of the world's grouse and an assessment of the key issues facing these species. Four of the 18 species covered here (the American Ornithologists' Union has recently proposed a split that would make 19 species) are included on the IUCN Red List and are thus of global conservation concern. Many of the remaining species have large geographic distributions and are not considered globally threatened, but alarmingly they feature on the national red lists or in legislation for their protection in many of the countries where they occur. This plan shows that our biological knowledge of what is needed to safeguard and even restore populations of grouse is very advanced. These magnificent birds deserve that this knowledge is translated into action so that their stunning displays remain a vibrant and evocative part of our relationship with nature.

Acknowledgements

This online-publication is based on the 2000-2004 Grouse Action Plan (Storch 2000; http://www.iucn.org/themes/ssc/actionplans/grouse/contents.pdf) and is a product of the joint expertise of the WPA/BirdLife/IUCN/SSC Grouse Specialist Group (GSG; http://www.gct.org.uk/gsg/) and many other grouse biologists, conservationists, and managers worldwide. I thank the many individuals and institutions who provided contacts, information and photographs, completed questionnaires and reviewed parts of the manuscript. They were too many to name them all. I am particularly grateful to those colleagues who were supportive and reliable correspondents throughout the process of compiling, drafting and reviewing this update of the Grouse Action Plan. Juan Pablo Nieto prepared some of the figures. Michèle Loneux prepared the manuscript for online publication with financial support from the World Pheasant Association (WPA), the major parent organisation of the Grouse Specialist Group.

This revised version of the Grouse Action Plan (Storch 2000; http://www.iucn.org/themes/ssc/actionplans/grouse/contents.pdf) is meant as a working document. Readers are invited to report relevant changes and related documentation to the GSG webmaster.

Executive Summary

Grouse have long attracted and fascinated people. Their display behaviour, and particularly their traditional communal mating grounds or "leks", have inspired poetry and folklore as well as scientific theories on sexual selection and the evolution of mating systems. In many parts of their range, grouse hunting still plays a major role in the culture, economy, and subsistence of local communities.

The 2006-2010 Grouse Action Plan provides an overview to the distribution, status and threats to all 18 grouse species worldwide and identifies the most immediate conservation needs. It is a product of the joint expertise of the Grouse Specialist Group (GSG), a voluntary network of grouse professionals, and other grouse experts worldwide. The Grouse Action Plan was primarily written as a reference guide for decision makers, agency officials, resource managers and funding organisations, but also scientists and students who share the GSG´s goal of securing viable population of all species and subspecies of grouse in the wild. The Action Plan also aims to underline the importance of grouse conservation in a broader sense: as typical representatives of a wide spectrum of natural habitats, grouse are indicators of ecosystem health.
Their indicator function and their attractiveness to people make grouse suitable flagship species to promote the conservation of ecosystems and biodiversity.

At the time of compiling the 2000-2004 Grouse Action Plan (Storch 2000) in 1999, none of the grouse species were considered to be threatened following IUCN criteria, but three species with limited geographic distribution were listed as Near Threatened (IUCN 1996): Caucasian black grouse *(Tetrao mlokosiewiczi)*, Chinese grouse *(Bonasa sewerzowi)*, and Siberian grouse *(Dendragapus falcipennis)*. In 2000, the newly recognized Gunnison sage-grouse (*Centrocercus minimus)* was listed as Endangered and the Caucasian black grouse was re-classified to Data Deficient. Shortly after, both the lesser prairie-chicken (*Tympanuchus pallidinctus)* and the greater prairie-chicken (*Tympanuchus cupido)* were added to the Red List as Vulnerable owing to rapid population declines, and the greater sage-grouse (*Centrocercus urophasianus)* was listed as Near Threatened (IUCN 2004). At a national level, 14 of the 18 species are red-listed in at least one country. Populations at the southern edge of a species´ range and in densely populated regions are most often red-listed.

Healthy grouse populations require large areas of natural or semi-natural habitat. Thus they compete with increasing human populations and economic development. Based on questionnaire results from 47 countries, deterioration of habitats has been identified as the major threat to grouse worldwide. Habitat degradation, loss and fragmentation due to human land use are considered the most important threats. Other frequently named pressures are small population size, predation, direct exploitation and human disturbance. Current approaches to grouse conservation include legislation, protected areas, surveys and monitoring, habitat management, captive breeding, re-introduction and re-enforcement, predator control, reduction of human disturbance and education. Integrating habitat preservation and human land use practices remain to be the major challenge to grouse conservationists world-wide.

After a short introduction to grouse and the Action Plan, the history of the Action Plan and the scientific basis of grouse conservation are outlined in Chapter 1. Chapter 2 provides an overview to the conservation biology of grouse and summarises major threats and current conservation measures. Brief accounts for each species are provided in Chapter 3, compiling information on status, taxonomy, distribution, population, ecology, cultural importance, threats, research needs and current and recommended conservation measures. In Chapter 4, conservation and research priorities are proposed for the most threatened taxa (Gunnison sage-grouse, greater and lesser prairie-chicken, greater sage-grouse, Chinese grouse, Caucasian black grouse, Siberian grouse, Attwater´s prairie-chicken, Cantabrian capercaillie, and Gunnison sage-grouse). The recommendations were sketched by leading specialists on the different taxa and provide preliminary outlines that may be used to develop detailed project proposals. Proposed measures span from population surveys, research into the effects of human land use on grouse habitats and populations and integration of land use practices and grouse conservation needs to population recovery programmes. Readers interested in the implementation of any part of the plan are requested to contact the chairman of the GSG or the relevant local correspondents (see http://www.gct.org.uk/gsg/). We hope that the Action Plan will find a wide distribution as a tool to promote and implement grouse conservation.

1. Introduction

Grouse occur throughout the northern hemisphere. From a global perspective, and compared with other galliformes taxa, the status of most grouse species at the beginning of the 21st century is not critical. So far, their extended distribution ranges and often remote habitats have effectively protected most grouse species. None of the 18 species has been extirpated. However, they are also far from being safe. At the time of compiling the 1ast Grouse Action Plan (Storch 2000) in 1999, none of the grouse species were considered to be threatened according to IUCN criteria (IUCN 1996), and three species with limited geographic distribution (the Caucasian black grouse *(Tetrao mlokosiewiczi)*, the Chinese grouse *(Bonasa sewerzowi)*, and the Siberian grouse *(Dendragapus falcipennis*) were listed as Near Threatened (IUCN 1996). The overall situation has not improved since the turn of the century. In the 2000 IUCN Red List of Threatened Species (Hilton-Taylor 2000), the newly recognized Gunnison sage-grouse (*Centrocercus minimus)* became listed as Endangered and the Caucasian black grouse was re-classified to Data Deficient. Shortly after, both the lesser prairie-chicken and the greater prairie-chicken were added to the Red List as Vulnerable owing to rapid population declines, and the greater sage-grouse (*Centrocercus urophasianus)* became listed as near threatened (http://www.redlist.org/).

Several subspecies of grouse are considered to be threatened, but the intraspecific taxonomy of the widely distributed species is still uncertain. On local and regional scales, many populations of grouse are declining and threatened with extinction. This is particularly true in landscapes which are densely populated and intensively used by humans. But even in remote northern areas of both North America and Eurasia, grouse numbers have been declining in relation to increasing development and exploitation of their habitats. Fourteen of the 18 species of grouse are included in the National Red Data books of at least one country.

Since the mid 1980s, a series of more than 70 Action Plans has been published by the Species Survival Commission (SSC) of the IUCN (Gimenez-Dixon and Stuart 1993; http://www.iucn.org/themes/ssc/pubs/sscaps.htm). The aim of these Action Plans is to assess the nature and scale of threat to particular groups of species and to propose conservation action that should lead to a safer future for the species of concern (McGowan et al. 1998, Fuller et al. 2003). Accordingly, the Grouse Action Plan is primarily a tool for promoting grouse conservation. As well as providing an up-to-date reference to the distribution, status and threats to all grouse species, the major objective is to identify conservation priorities from a global perspective. The Action Plan is not, however, a comprehensive account of the biology and ecology of grouse. Johnsgard (1983) has published a monograph on grouse and an extended summary on grouse is also provided in del Hoyo et al. (1994). See also the GSG website http://www.gct.org.uk/gsg/ for other books on grouse.

The 2000-2004 Grouse Action Plan (Storch 2000) and its present 2005-2009 update were primarily written as a guide for decision makers, agency officials, resource managers and funding organisations, but also scientists and students who share our goal of maintaining viable populations of all species and subspecies of grouse in the wild. In particular, it is hoped that this Action Plan will help to implement the most immediate conservation needs to improve the survival chances of the near threatened and threatened species and subspecies. They are the primary concern of the Grouse Specialist Group. The Action Plan, however, also underlines the importance of grouse conservation in a broader sense: as typical representatives of a wide spectrum of natural tundra, grassland, and forest habitats of the northern hemisphere, grouse are indicators of ecosystem health. Their indicator function and their attractiveness to people make grouse suitable flagship species to promote the conservation of biodiversity.

1.1. History and Evolution of the Grouse Action Plan

The 2000-2004 Grouse Action Plan (Storch 2000, http://www.iucn.org/themes/ssc/pubs/sscaps.htm#Grouse2000) and this present 2005-2009 update, are products of the joint expertise and efforts of the Grouse Specialist Group (GSG) and many other grouse researchers and conservationists worldwide. The GSG (http://www.gct.org.uk/gsg/) is a voluntary network of grouse professionals, having as joint parent organisations the Species Survival Commission (SSC, http://www.iucn.org/themes/ssc/) of IUCN - The World Conservation Union, BirdLife International http://www.birdlife.net/, and the World Pheasant Association (WPA, http://www.pheasant.org.uk/).
The GSG´s tasks are to provide and assess information, to identify conservation priorities, to promote research and conservation and to give advice on grouse and their habitats. Since 1978, the triennial International Grouse Symposia initiated by WPA have been a major forum for people concerned with grouse, either as a scientist, conservationist, or aviculturist. The symposia led to an extensive network of contacts among grouse specialists long before the GSG was formally founded in 1993. This network provides the major information base of the Grouse Action Plan.

Before publication of the 2000-2004 Grouse Action Plan (Storch 2000), three Action Plans, all for the period 1995-1999, had addressed galliformes: The megapodes (Dekker and McGowan 1995), the partridges, quails, francolins, snowcocks and guineafowl (McGowan et al. 1995), and the pheasants (McGowan and Garson 1995). In preparation of the Grouse Action Plan, the experience from the making of these plans (McGowan et al. 1998) was particularly valuable, although the Grouse Specialist Group followed somewhat different approaches to data collection and compilation. For the period 2000-2004, parallel to the preparation of the 2000-2004 Action Plan for the grouse, an Action Plan for curassows, guans and chachalacas was prepared (Brooks and Strahl 2000), and those for megapodes (Dekker et al. 2000), partridges (Fuller et al. 2002) and pheasants (Fuller and Garson 2000) were revised.

In preparation of this 2005-2009 Grouse Action Plan, the questionnaire results from 1999 (Storch 2000) were sent for revision to one or several persons and organisations per country and species during 2004 and 2005. A total of 168 country-by-species questionnaires regarding the conservation of the 18 grouse species were received from researchers, state agencies and NGOs in 45 countries. For seven countries (Albania, Bosnia-Herzegovina, Bulgaria,

Greece, Mongolia, North Korea and Tadjikistan) no contacts could be established nor information obtained despite repeated attempts. For three of these (Bulgaria, Greece and Mongolia), questionnaires from 1999 obtained for the 2000-2004 Action Plan (Storch 2000) were used. The global conservation status of grouse was assessed following the IUCN Red List of Threatened Animals (IUCN 2004-2006; http://www.redlist.org/) and the IUCN Red List categories (http://www.iucn.org/themes/ssc/redlists/RLcategories2000.html IUCN 2001). Additional information and professional assessments were collected from recent literature, the Internet and colleagues worldwide involved in research and conservation of grouse.

These sources were analysed and synthesised to provide a global overview of the status, threats and conservation of the grouse, and to revise the 2000-2004 Action Plan's (Storch 2000) summary accounts for each species. Leading experts on the taxa at risk were asked to recommend priority conservation measures. All parts of the Action Plan were reviewed by specialists from different parts of the world. Although many individuals were involved in the compilation and review, this 2006-2010 Action Plan may not necessarily represent the situation of all grouse populations and the opinions of all grouse specialists worldwide. Most species have a wide distribution and their status may vary greatly among and within the range countries. From a local perspective, a particular problem may be seen in a different light than from the global perspective applied in the Action Plan. Consequently, the Grouse Action Plan should be seen as a basis for review and refinement.

1.2. The Scientific Basis of Grouse Conservation

Grouse are among the most intensively studied birds in the world. Much of their early attractiveness to researchers can be explained by their role as game species. Their broad spectrum of mating behaviours make grouse a favourite group of animals for studies of sexual selection, evolution and sociobiology. As specialists with fairly narrow habitat needs but large spatial requirements, grouse are well suited for studies of wildlife-habitat relationships, spatial population structure and dynamics and landscape ecology.

The number of scientific and semi-scientific grouse publications has steadily increased during the past decades. Since the 1980s, ten times more publications on grouse have annually been published than in the 1930s (Storch 2000). This trend reflects a general development in the wildlife literature. After a slow increase between the 1930s and 1960s, the number of wildlife publications exploded in the 1970s and remained on a high level in the 1980s and 90s. In the 1930s, more than 4% of all wildlife publications dealt with grouse and grouse hunting (Storch 2000). Since then, the field of wildlife research and conservation has become much broader. The proportion of grouse-related papers, however, remained as high as 1% after 1980 (Storch 2000). Grouse are still among the taxa particularly interesting to researchers.

The species of grouse are not evenly represented in the literature. Based on the CD Wildlife Worldwide (NISC 1999), that covers scientific papers, and also theses, agency reports and other "grey" literature from the 1930s to the 1990s, the majority has been written about ruffed grouse,

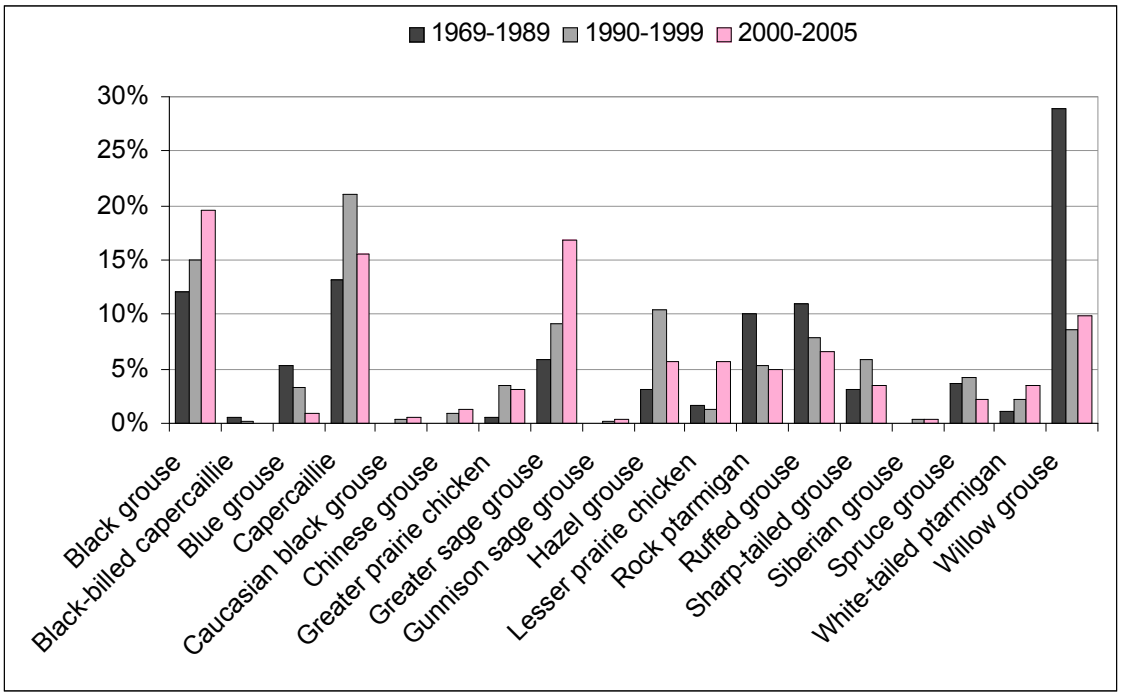

Figure 1.1 Representation of all 18 species of grouse in the international scientific literature (N=1024 papers on grouse, 1969-mid 2006). Of a total of 322 papers published on grouse between 1999 and mid 2006, most dealt with black grouse, sage-grouse, or capercaillie. In the 1970s and 80s, however, the willow grouse was the major study species. ***(Source: Web of Science; analysis based on keywords and title; Search statements listed below).***

Search statements for figure 1.1: ("Siberian grouse" or "*Falcipennis falcipennis*"); ("Spruce grouse" or "*Falcipennis canadensis*"); ("Blue grouse" or "*Dendragapus obscurus*"); ("Willow grouse" or "*Lagopus lagopus*"); ("Rock ptarmigan" or "*Lagopus mutus*"); ("White-tailed ptarmigan" or "*Lagopus leucurus*"); ("Black grouse" or "*Tetrao tetrix*"); ("Caucasian black grouse" or "*Tetrao mlokosiewiczi*"); (Capercaillie or "*Tetrao urogallus*"); ("Black-billed capercaillie" or "*Tetrao urogalloides*"); ("Hazel grouse" or "*Bonasa bonasia*"); ("Chinese grouse" or "*Bonasa sewerzowi*"); ("Ruffed grouse" or "*Bonasa umbellus*"); ("Sage-grouse" or "*Centrocercus urophasia*nus"); ("Gunnison sage-grouse" or "*Centrocercus minimus*"); ("Sharp-tailed grouse" or "*Tympanuchus phasianellus*"); ("Greater prairie-chicken" or "*Tympanuchus cupido*"); ("Lesser prairie-chicken" or "*Tympanuchus pallidicinctus*").

capercaillie, willow ptarmigan and black grouse, while four species are clearly under-represented: Only a few studies on black-billed capercaillie, Caucasian back grouse, Chinese grouse and Siberian grouse have been published. It should be noted, however, that the Russian and Chinese literature is not fully represented in the NISC data base used for this analysis. Nevertheless, these four species are certainly the least intensively studied (Storch 2000). A similar picture results from a literature search in the Web of Science database that only covers peer-reviewed scientific journals (Fig. 1.1): In the 1970s and 1980s, the willow grouse, including the Scottish red grouse, played the dominant role in grouse science, closely followed by capercaillie and black grouse. In the 1990s, the capercaillie was the best-studied species, closely followed by the black grouse that took over the lead role after 2000, when also the greater sage grouse received increasing attention from scientists.

The grouse literature covers a wide range of topics (Fig. 1.2). In the 1970s and 1980s, based on the Web of science database, the predominating themes were behaviour, diet and release programmes. Thereafter, studies into grouse habitat gained importance, whereas the interest in diet and releases dropped. In the 1990s, the majority of scientific papers discussed grouse behaviour and habitat; and conservation issues, landscape ecology and genetics started to gain importance. Grouse researchers were among the first to point out the effects of habitat alterations at the landscape scale on wildlife. Therefore, the proportion of papers published between 1990 and mid 1998 dealing with landscape ecological topics such as habitat fragmentation, was higher (5%) in the grouse literature than among all wildlife publications (2%) (Storch 2000). Population genetic and landscape ecological studies on grouse also continued to increase after the year 2000.

Although many questions remain to be answered, our understanding of the biology and ecology of grouse is better than that for most other bird families. In general, the conditions under which grouse can persist in high numbers have been described reliably and the major factors that may threaten grouse populations have been identified. Therefore, the recommendations for grouse conservation given in this Action Plan are built on a comparably firm scientific basis.

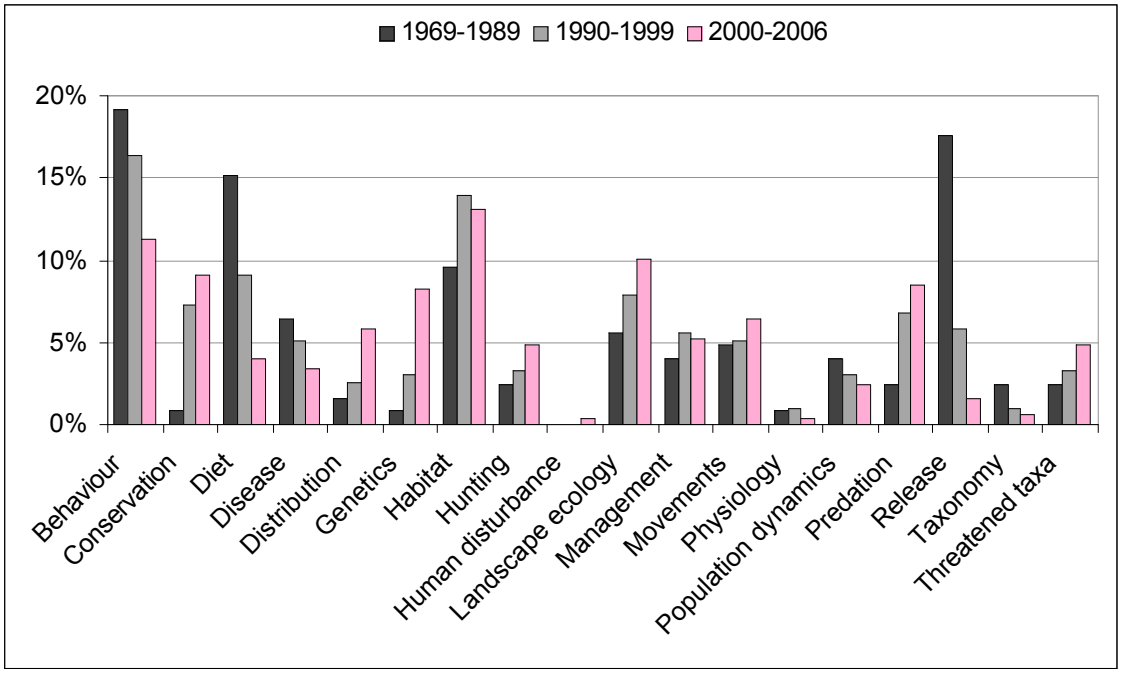

Figure 1.2 Frequency of various topics in grouse publications in 1969-89, 1990-99 and in 2000-mid 2006. In the 1970s and 80s, predominating themes in grouse papers were diet, behaviour and reintroduction. In the 1990s, habitat became the major topic, with landscape ecology and genetics still increasing in importance. ***(Source: Web of Science; analysis based on keywords and title).***

Search statements for figure 1.2:

Grouse:	***behavio* or etholog* or mating or lek* or social or socio****
Conservation:	***conserva* or protect* or preserv****
Diet:	***diet or nutrition or food or feed****
Disease:	***disease or parasit****
Genetics:	***genetic* or DNA***
Habitat:	***habitat***
Hunting:	***hunt* or harvest or shoot* or bag or exploit* or poach****
Human disturbance:	***disturb*and (recreatio* or sport or ski* or hunt* or leisure or human or tourism)***
Landscape ecology:	***landscape or metapop* or spatial or connectiv* or fragment* or patch****
Management:	***manag****
Movements:	***movement* or home range or dispersal or migration***
Physiology:	***physiol****
Population dynamics	***:(population and dynamic*) or cycle***
Predation:	***predat****
Release:	***releas* or captiv* or restock* or introduc* or transloc****
Taxonomy:	***taxonom* or systemat* or morpholo* or anatom****
Threatened taxa:	***threat* or endanger* or declin* or extirpat* or extinct****

2. Conservation Biology of Grouse

2.1 Taxonomy

At present (2006), 18 species of grouse are recognised worldwide. Although the grouse form a distinct and homogeneous group within the order Galliformes and the suborder Phasiani, authors disagree whether grouse should be considered a family Tetraonidae (e.g. Potapov and Flint 1989, del Hoyo et al. 1994) or a subfamily Tetraoninae within the pheasant family Phasianidae (e.g. Short 1967, Johnsgard 1983, Sibley and Monroe 1991, 1993, American Ornithologists´ Union 1998). Subfamily status has recently been supported by genetic studies (Dimcheff et al. 2002). However, with regard to conservation, the decision between family and subfamily is of minor significance. In this Action Plan, we follow BirdLife International in accepting Tetraonidae family status for the grouse.

Recent genetic studies into grouse phylogeny suggest a North American origin of the grouse and the genus *Bonasa* as basal of all the Tetraonidae (Lucchini et al. 2001). Currently, there seems to be little doubt regarding the status of the 18 taxa presently recognised as distinct species (see Lucchini et al. 2001, Drovetski 2002, Dimcheff et al. 2002 for recent molecular phylogenetic studies), although the generic treatment of some species remains to be variable. In this Action Plan, the scientific names for the grouse species are used in accordance with Sibley and Monroe (1990), Monroe and Sibley (1993), Cramp and Simmons (1977-1994), del Hoyo et al. (1994), and the American Ornithologists´ Union (1998 + supplements). In the case of disagreement between these authors we follow the taxonomy used by BirdLife International in spring 2006 (http://www.birdlife.org).

Most grouse species are widely distributed and show a considerable degree of geographic variation in life-history traits and ecology. Numerous subspecies have been described, mostly based on differences in various parts of a range; for most, however, their validity is doubtful. Some described subspecies might not be justified, others may not have been recognised. The intraspecific taxonomy of the grouse merits careful evaluation. According to del Hoyo et al. (1994), 129 subspecies are currently recognised**.** However, present grouse taxonomy below the species level is still based on morphological, behavioural, ecological and biogeographical features. Recent genetic studies suggest that some currently recognized subspecies may not be justified, whereas other subspecies and perhaps even species have not been identified (e.g. Barrowclough et al. 2004). Molecular techniques will further help to clarify the status of and the phylogenetic relationships among the grouse taxa (e.g. Gyllesten et al. 1985, Ellsworth 1991, Randi et al. 1991, and Ellsworth et al. 1994, 1995, 1996, Lucchini et al. 2001, Drovetski 2002, Dimcheff et al. 2002, Barrowclough et al. 2004).

Genetic studies are also highly relevant for conservation, as they will identify units of variation of evolutionary significance. They will provide more objective criteria to identify priorities for conservation. Only recently, in 2000, genetic analyses significantly contributed to the recognition of a new species of grouse, the Gunnison sage grouse, as distinct from the greater sage grouse (Kahn et al. 1999, Oyler-McCance et al. 1999, Young et al. 2000). Also, in blue grouse, the recognized subspecies sooty (*Dendragapus obscurus fuliginosus)* and dusky (*D. o. obscurus)* grouse may deserve species status (Barrowclough et al. 2004); in mid 2006, the AOU has officially split the blue grouse into two species: the dusky grouse (*Dendragapus obscurus*) and the sooty grouse (*Dendragapus fuliginosus*) (Banks et al. 2006).

2.2. Biology and Ecology

Grouse occur throughout the temperate, boreal and Arctic biogeographical zones of the Northern Hemisphere. The four species of the genus *Tetrao* exclusively inhabit Eurasia, and the five species within the genera *Centrocercus* and *Tympanuchus* are exclusively American. The genera *Dendragapus* and *Bonasa* occur with at least one species on each continent. Two species, both of the genus *Lagopus*, inhabit both Eurasia and North America, a third *Lagopus* species occurs only in North America. Table 2.1 summarises the worldwide distribution of grouse.

A number of features distinguish a grouse from other Galliform birds: Grouse have feathered feet (tarsi) and nostrils, no spurs and during the winter their toes are feathered or have small scales along the sides that help them to walk on top of the snow (Photo 2.1).

Photo 2.1. Grouse wear 'snowshoes': their toes have feathers or small scales along the sides. *(Capercaillie. Photo I. Storch).*

Adaptations to a cold climate, such as these "snowshoes", are a major ecological feature of grouse. A series of morphological, physiological and behavioural characteristics allow them to live in environments of enormous seasonal change without migrating south in the winter as other birds do. Grouse roost in snow-burrows to stay warm, survive on low-energy but abundant winter foods such as buds and conifer needles (Photo 2.2) and have particularly long intestines with well-developed caecae that enable them to digest cellulose with the help of bacteria. Because all species share these adaptations to cold climates, the evolutionary origin of the grouse was probably in northern latitudes (Johnsgard 1983, del Hoyo et al. 1994).
Grouse occupy a wide variety of habitats. They inhabit alpine and Arctic regions (genus *Lagopus*), are found on the North American prairies (*Centrocercus*, *Tympanuchus)* and occupy various types of forest habitats (*Tetrao, Bonasa, Dendragapus*). Whereas tundra and forest grouse occur both in Eurasia and North America, the prairie grouse are restricted to North America, paralleling the bustards *Otidae* in the Old World.

Photo 2.2. Grouse survive the winter on poor but abundant food such as buds or conifer needles. ***(Fir needles cut off by capercaillie. Photo I. Storch.)***

Most grouse are habitat specialists, tending to show relatively narrow habitat preferences and a susceptibility to habitat changes. Generally, each species is adapted to one or a few particular habitat types, although some species may occupy a range of habitats. Together, the grouse family utilises a wide range of natural habitats of the northern Palaearctic.

Their adaptations match different successional stages as well as different altitudinal and latitudinal zones: There are grouse specialised to tundra habitats, to open grasslands, to forest edges and to the various stages of forest succession from young regeneration to dense deciduous and open, old conifer forests (Figure 2.1). At least one grouse species is adapted to each of these habitat types in the temperate, boreal and Arctic zones of the northern hemisphere (see Johnsgard 1983, Swenson and Angelstam 1993, del Hoyo et al. 1994).

The sociability of grouse is variable. Forest grouse tend to be solitary but do not strictly avoid each other and may form flocks in autumn and winter. The prairie grouse tend to be more social. The tundra grouse (ptarmigan) may form winter flocks of more than one hundred birds. In many areas, several grouse species are sympatric; i.e. they share the same or at least use overlapping habitats. Hybrids between sympatric species are common, but they are usually infertile (Johnsgard 1983).

Grouse show a variety of different mating systems ranging from monogamous pair bonds to traditional communal display grounds, or leks. The five species of prairie grouse (*Centrocercus*, *Tympanuchus* spp.) and the forest edge species (*Tetrao tetrix, T. mlokosiewiczi*) form typical leks with small male territories used only for display. Among the forest grouse, however, two species form leks with permanent territories (*Tetrao urogallus, T. parvirostris*), two are largely monogamous (*Bonasa bonasia, B. sewerzowi*), and four are considered intermediate with dispersed male territories (*B. umbellus, Dendragapus* spp.). The three tundra species (*Lagopus* spp.) are essentially monogamous (see Johnsgard 1983, Höglund and Alatalo 1995 for reviews of grouse mating systems).

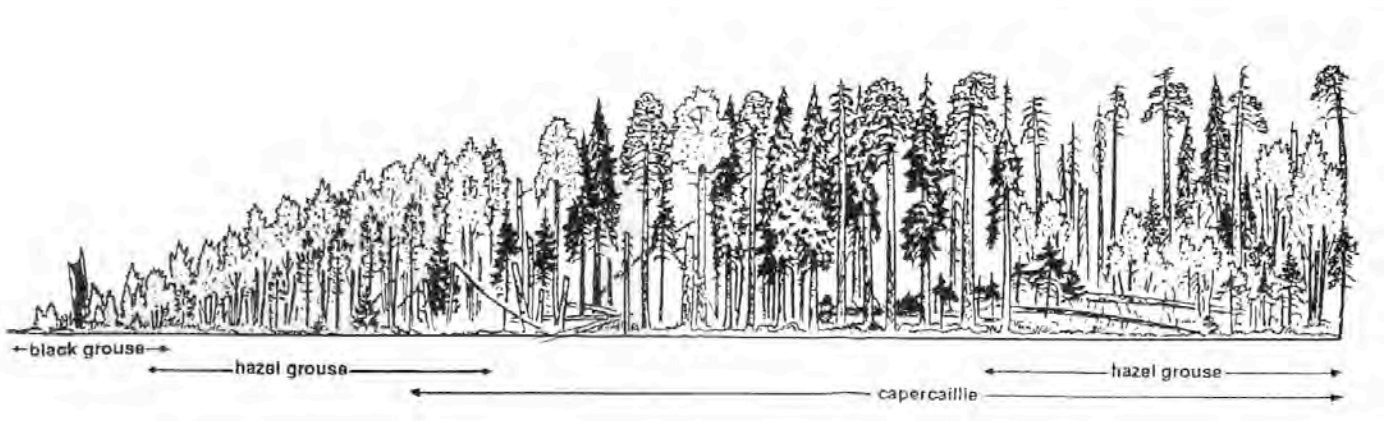

Fig. 2.1. Grouse are indicators to a whole spectrum of habitats. The adaptations of the three forest grouse species of Europe, for example, match the different stages as well as the different altitudinal zones: the black grouse occupies young stages of forest succession and treeline habitats, the hazel grouse lives in dense regenerating forest, and the capercaillie represents mature forest stages. (*from Swenson and Angelstam 1983, with permission*).

Table 2.1 Worldwide distribution of the 18 species of grouse by country (species present: 1, absent: 0, unclear: ?)

Species / Country	Siberian grouse *Dendragapus falcipennis*	Spruce grouse *Dendragapus canadensis*	Blue grouse *Dendragapus obscurus*	Willow grouse *Lagopus lagopus*	Rock ptarmigan *Lagopus muta*	White-tailed ptarmigan *Lagopus leucura*	Black grouse *Tetrao tetrix*	Caucasian grouse *Tetrao mlokosiewiczi*	Western capercaillie *Tetrao urogallus*	Black-billed capercaillie *Tetrao parvirostris*	Hazel grouse *Bonasa bonasia*	Chinese grouse *Bonasa sewerzowi*	Ruffed grouse *Bonasa umbellus*	Greater sage grouse *Centrocercus urophasianus*	Gunnison sage grouse *Centrocercus minimus*	Sharp-tailed grouse *Tympanuchus phasianellus*	Greater prairiechicken *Tympanuchus cupido*	Lesser prairie chi *Tympanuch pallidicinc*
Albania	0	0	0	0	0	0	0	0	1	0	1	0	0	0	0	0	0	0
Andorra	0	0	0	0	1	0	0	0	1	0	0	0	0	0	0	0	0	0
Armenia	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0
Austria	0	0	0	0	1	0	1	0	1	0	1	0	0	0	0	0	0	0
Azerbaidjan	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0
Belgium	0	0	0	0	0	0	1	0	0	0	1	0	0	0	0	0	0	0
Beloussia	0	0	0	0	0	0	1	0	1	0	1	0	0	0	0	0	0	0
Bosnia-Herzegovina	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0
Bulgaria	0	0	0	0	?	0	0	0	1	0	1	0	0	0	0	0	0	0
Canada	0	1	1	1	1	1	0	0	0	0	0	0	1	1	0	1	0	0
China	?	0	0	1	1	0	1	0	1	1	1	1	0	0	0	0	0	0
Croatia	0	0	0	0	0	0	0	0	1	0	1	0	0	0	0	0	0	0
Czechia	0	0	0	0	0	0	1	0	1	0	1	0	0	0	0	0	0	0
Estonia	0	0	0	1	0	0	1	0	1	0	1	0	0	0	0	0	0	0
Finland	0	0	0	1	1	0	1	0	1	0	1	0	0	0	0	0	0	0
France	0	0	0	0	1	0	1	0	1	0	1	0	0	0	0	0	0	0
Georgia	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0
Germany	0	0	0	0	1	0	1	0	1	0	1	0	0	0	0	0	0	0
Greece	0	0	0	0	0	0	1	0	1	0	1	0	0	0	0	0	0	0
Greenland (DK)	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0
Hungary	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0
Iceland	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0
Iran	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0
Ireland	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Italy	0	0	0	0	1	0	1	0	1	0	1	0	0	0	0	0	0	0
Japan	0	0	0	0	1	0	0	0	0	0	1	0	0	0	0	0	0	0
Kazakhstan	0	0	0	0	0	0	1	0	1	0	1	0	0	0	0	0	0	0
Kyrgystan	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0
Latvia	0	0	0	1	0	0	1	0	1	0	1	0	0	0	0	0	0	0
Liechtenstein	0	0	0	0	1	0	1	0	1	0	1	0	0	0	0	0	0	0
Lithuania	0	0	0	1	0	0	1	0	1	0	1	0	0	0	0	0	0	0
Luxemburg	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0
Macedonia	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0
Mongolia	0	0	0	1	1	0	1	0	1	1	1	0	0	0	0	0	0	0
Netherlands	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0
Norway	0	0	0	1	1	0	1	0	1	0	1	0	0	0	0	0	0	0
Noth Korea	0	0	0	0	0	0	1	0	0	0	1	0	0	0	0	0	0	0
Poland	0	0	0	0	0	0	1	0	1	0	1	0	0	0	0	0	0	0
Romania	0	0	0	0	0	0	1	0	1	0	1	0	0	0	0	0	0	0
Russia	1	0	0	1	1	0	1	1	1	1	1	0	0	0	0	0	0	0
Serbia-Montenegro	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0
Slovakia	0	0	0	0	0	0	1	0	1	0	1	0	0	0	0	0	0	0
Slovenia	0	0	0	0	1	0	1	0	1	0	1	0	0	0	0	0	0	0
South Korea	0	0	0	0	0	0	1	0	0	0	1	0	0	0	0	0	0	0
Spain	0	0	0	0	1	0	0	0	1	0	?	0	0	0	0	0	0	0
Sweden	0	0	0	1	1	0	1	0	1	0	1	0	0	0	0	0	0	0
Switzerland	0	0	0	0	1	0	1	0	1	0	1	0	0	0	0	0	0	0
Tadjikistan	0	0	0	0	?	0	0	0	0	0	0	0	0	0	0	0	0	0
Turkey	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0
UK	0	0	0	1	1	0	1	0	1	0	0	0	0	0	0	0	0	0
Ukraine	0	0	0	0	0	0	1	0	1	0	1	0	0	0	0	0	0	0
USA	0	1	1	0	0	1	0	0	0	0	0	0	1	1	1	1	1	1
No. of countries (total 52)	1	2	2	12	20	2	30	6	30	3	36	1	2	2	2	1	1	1

In some of the lek-breeding species, especially capercaillie, black grouse and sage grouse, but also in the non-lekking blue grouse, the sexes look very different. In some languages, there are even different popular names for males and females, as if they were different species. The males have a more conspicuous plumage and may be up to twice the size of the smaller and cryptic females. Male grouse show bright yellow or red combs above their eyes and may have coloured patches of skin on their necks that can be inflated during courtship. In the monogamous species, the differences are least pronounced and the sexes look alike to an untrained observer.

Grouse mate in April or May around the time of snowmelt. They are ground-nesting birds and only the females incubate. Grouse produce a single brood each year, but hens may re-nest if they loose their clutch during the laying period or an early stage of incubation. Mean clutch sizes of grouse are between five and 12 eggs (see Johnsgard 1983). Incubation begins with the last egg laid and chicks hatch after approximately 3-4 weeks. Chicks are precocious, that is they leave the nest shortly after hatching. Only in the willow ptarmigan do both sexes accompany and protect the brood; in all other species this is the exclusive task of the female. During their first weeks of life, grouse chicks depend on high-energy food and invertebrates comprise the major part of their diet. Broods stay together with the female until autumn.

2.3 Grouse and Biodiversity

All species of grouse have their strongholds in natural or semi-natural ecosystems. Maintaining healthy grouse populations requires large areas of suitable, that is natural or semi-natural, habitat. Because of these specialised habitat needs, grouse are susceptible to habitat changes. Although grouse can tolerate a moderate degree of habitat disturbance and some human land-use practices can favour certain grouse species, the opposite is more often true. There are many examples for all species and from throughout the distribution range where anthropogenic habitat alterations have had bad effects on grouse populations. Healthy populations of grouse are most likely to be found in extensive landscapes with natural vegetation and natural disturbance regimes (but see heather-moorland management for red grouse in the Willow Ptarmigan Species Account).

As a result of their sensitivity, grouse have often been considered to be indicators of the health of the ecosystems they inhabit. The presence of an indicator species is believed to suggest suitable habitats for other species as well (e.g. Verner et al. 1986, Landres et al. 1988). Thus conservation efforts to preserve grouse habitat are also likely to benefit other species associated with the same habitat. This argument is frequently used to support grouse conservation measures in central (e.g. Müller 1978, Scherzinger 1989, Fischer 1999, Suter et al. 2000) and Northern Europe (e.g., Pakkala et al. 2003; http://www.capercaillie-life.info/htm/bird_importance.php) and grouse are among the designated management indicator species of the US Fish and Wildlife Service.

The often assumed indicator function of grouse has explicitly been tested for the capercaillie: In Switzerland, species richness and abundance of red-listed subalpine forest birds was considerably higher in plots with capercaillie than in those without (Suter et al. 2002), and capercaillie, mountain birds, and carabid beetles all responded positively to near-natural forest structure (Suter et al. 2002, Debrunner 2004). Similarly, forest stands good for capercaillie in the German Alps correlated with high woodpecker densities and bird species richness (Fischer & Storch 2001). Also in the forests of Finland, capercaillie display grounds had greater bird species richness and old forest specialists were more common than elsewhere (Pakkala et al. 2003). All these studies support the use of the capercaillie as an indicator of ecosystem health and an umbrella for species biodiversity conservation. In general, the species composition and diversity of bird communities in landscapes managed for grouse is related to the diversity of habitat types and successional stages provided (Yahner 1997), and thus bird diversity is not necessarily greatest in habitats optimal for grouse. However, because grouse often represent rare and threatened habitat types, habitat conservation measures for grouse are likely to favour rare and threatened species.

Because of their popularity, grouse are also suitable to serve as flagship species to promote ecosystem and biodiversity conservation measures, particularly where habitat preservation conflicts with human land-use interests.

2.4 Grouse and People

Grouse are popular birds. Some, such as the black grouse in central Europe, or the red grouse in Scotland, are traditional elements of regional folklore. The display behaviour of lekking male grouse is mimicked in folk dances both in Europe and North America, and there are numerous examples of local stories, sayings, beliefs and superstitions relating to grouse.

Their popularity is largely explained by the cultural and economic importance of grouse hunting. Grouse have long been valued as a good source of protein and in many northern cultures, grouse hunting plays a major role in the subsistence of local communities. The willow ptarmigan, hazel grouse, and black grouse are the most numerous grouse species in the bags of Eurasian hunters, and the ruffed grouse is the most intensively hunted species in America. In total, the annual harvest of grouse may exceed 10 million birds worldwide (Johnsgard 1983, del Hoyo et al. 1994, Gabuzov 1995). A variety of hunting methods have evolved, including specialised breeds of dogs, whistles to imitate grouse calls, dummies to attract flocks and different kinds of snares and traps.
There are at least three different interests behind grouse hunting: food, sport and trophies. Meat is probably still

the major motivation of grouse hunters in eastern Europe, Russia, most of Asia and North American indigenous people. In northern Europe and most of North America, grouse are hunted for both sport and food, however, without major importance for subsistence. Elsewhere, e.g. in Britain, sport is the dominating interest. The habitats of the British subspecies of the willow ptarmigan *L. l. scoticus*, the "red grouse", are intensively managed to produce high population densities, and the red grouse shoot is a major social event and an important cultural and economic factor. Expensive London restaurants pay high prices for the first birds shot on August 12th ("the glorious 12th") when the grouse shooting season begins. In parts of Europe, the males of the black grouse and particularly the capercaillie are considered highly prestigious trophies. In the Alps and elsewhere, countless stuffed birds, mounted in display posture, decorate traditional homes and inns. Already in the Middle Age and earlier, the capercaillie received particular attention. At times, e.g. in the 18th and 19th century, the capercaillie hunt was reserved for aristocrats and today the species is still accounted as "high game" (Photo 2.3).

Photo 2.3. High ranking hunting guests at an Austrian estate and their prestigious prey: capercaillie males shot at the lek in spring. The photo by an unknown photographer was probably taken in the late 1880s or early 1900s. *(Photographer unknown; courtesy T. Huber).*

Despite its great cultural importance, black grouse and capercaillie hunting have generally played a minor economic role in central Europe. In recent times, since the hunting of capercaillie and black grouse has been banned in most western and central European countries, trophy hunting by westerners is gaining increasing economic importance in Eastern Europe.
Other kinds of direct exploitation of grouse have probably never played a significant role. Occasional egg collection may have occurred in many areas and is still reported from some parts of Asia; however, grouse nests are sparse and too difficult to find to be an attractive food source for people. In parts of Siberia, grouse are used as bait in mustelid traps. Interestingly, there is no evidence that people have ever tried to domesticate any grouse species.

Non-consumptive uses of grouse have only been increasing in recent years. The spectacular display of the lekking species has attracted the attention of naturalists, wildlife photographers and bird-watchers, and in North America, grouse-watching has become a locally important economic factor. Because the presence of people at leks involves a great risk of disturbance with negative consequences for reproduction, the potential of grouse-watching for ecotourism to support habitat conservation needs careful and critical consideration.

2.5 Conservation Status

Related to their extended distribution ranges and often remote habitats, the conservation status of grouse is less critical than that of other galliform taxa. No species of grouse has been extirpated and none are Critically Endangered. However, they are also far from being safe. At the time of compiling the first Grouse Action Plan (Storch 2000) in 1999, none of the then 17 grouse species were considered to be globally threatened according to IUCN criteria (IUCN 1996), but three species with limited geographic distribution; the Caucasian black grouse *Tetrao mlokosiewiczi*, the Chinese grouse *Bonasa sewerzowi* and the Siberian grouse *Dendragapus falcipennis*, were listed as Near Threatened (IUCN 1996). The overall situation has not improved since the turn of the century. In the 2000 IUCN Red List of Threatened Species, the newly recognized Gunnison sage grouse *Centrocercus minimus* became listed as Endangered and the Caucasian black grouse was re-classified to Data Deficient. Shortly after, both the lesser and the greater? prairie chicken were added to the Red List as Vulnerable owing to rapid population declines (IUCN 2002).
At least two recognised subspecies appear to be threatened according to IUCN Red List Categories (IUCN 2001, http://www.iucn.org/themes/ssc/redlists/RLcategories2000.html): Attwater´s prairie chicken (*Tympanuchus cupido attwateri)* should be designated as Critically Endangered (see Greater Prairie Chicken Species Account and Recommended Conservation and Research Priorities for Attwater's Prairie Chicken) and the Cantabrian capercaillie (*Tetrao urogallus cantabricus*) appears to be Endangered (see Capercaillie Species Account and Recommended Conservation and Research Priorities for the Cantabrian Capercaillie).

At regional, national and local scales, many populations of grouse are declining and threatened with extinction. This is particularly true of grouse inhabiting landscapes in temperate regions that are densely populated and intensively used by humans; e.g. western and central Europe, eastern and central North America, and parts of eastern Asia. 14 of the 18 species of grouse (78%) are included in the national red-data books of at least one country (Table 2.2).

Table 2.2. Conservation status of grouse by continent.

	World	North America	Europe[1]	Asia[1]
Number of species	18	11	5	9
Number of range countries	52	2	37	13
Globally red-listed species (IUCN 2006)	3 NT 1 DD 1 EN 2 VU	1 NT 1 EN 2 VU		2 NT 1 DD
Nationally red-listed species (in at least one country)	13 (72%)	4 (36%)	5 (100%)	8 (89%)
		Greater prairie -chicken Lesser prairie -chicken Gunnison sage grouse	Black grouse Capercaillie Hazel grouse Rock ptarmigan Willow ptarmigan	Black grouse Black-billed capercaillie Caucasian black grouse Chinese grouse Hazel grouse Rock ptarmigan Siberian grouse Willow ptarmigan

[1] ***Continents according to geographic borders (west of Urals and Caucasus).***
[2] ***Federal listing (Endangered Species act) of the species under consideration in the USA.***

2.6 Threats

Numerous factors are thought to influence the population dynamics of grouse and to threaten their survival. Below, the most important threats are described in their order of relative significance as based on the 2004-2005 questionnaire results. All 133 questionnaires (per species and country) that reported on threats to grouse on a national level were included in the analysis; all 18 species were represented (Figure 2.2).

Questionnaire of 1999

In 1999 (Storch 2000), the most frequently named threat categories at the national scale were habitat degradation (73% of the questionnaires; reported from at least one country for 15 of the then 17 species) and habitat loss and fragmentation (71%; 16 species). Degradation is here understood as a decline in species-specific habitat quality that leads to reduced survival and/or reproductive success in a population e.g. related to changes in food availability, cover or climate. Habitat loss means that an area completely loses its habitat suitability for a particular species. Habitat fragmentation is a likely consequence of habitat loss; e.g. clearcuts result in habitat loss, but also fragment the remaining forest.

Small population size was considered an important threat by 51% of the correspondents and reported from at least one country as a threat for 15 of the 17 species of grouse. In most cases, small population size is a threat that follows habitat loss and fragmentation. Without doubt, deterioration of habitats is the major threat to grouse populations worldwide. In almost all cases, these habitat changes are man-made. Habitat change has also been identified as the main cause of the extinction of the heath hen (*Tympanuchus cupido cupido)* in Massachusetts (Schroeder and Robb 1993), the black grouse in parts of central Europe (Loneux and Ruwet 1997), and the decline and extinction of some prairie chicken populations in the USA (Schroeder and Robb 1993, Westemeier 1998).

Predation (28%; 8 species), direct exploitation (29%; 10 species) and human disturbance (26%; 5 species) were less commonly named but may be critical regionally. These three threats also show the greatest geographic variation of all pressures. Whereas predation and human disturbance were mostly reported from Europe, exploitation seemed to be a predominantly Asian problem. It should be pointed out, however, that worldwide most of the threats to grouse and other wildlife are a direct result of increasing human populations and economic development.

Questionnaire of 2004-2005

Five years later, the situation had not significantly changed (see Figure 2.2). Still, the most frequently named threat categories at the national scale were habitat degradation (71% of the questionnaires) and habitat loss and fragmentation (60%). Small population size was considered an important threat by 53% of the correspondents. Again, deterioration of habitats continues to be the major threat to grouse populations worldwide. Predation (40%), direct exploitation (28%) and human disturbance (35%) showed the greatest geographic variation of all pressures. As before, predation and human disturbance were mostly reported from Europe, while exploitation seemed to be a predominantly Asian problem. The awareness of climate change and the potential threats it poses to grouse have increased significantly since 1999, with 23% of the national grouse populations considered potentially affected in 2004.

2.6.1 Habitat Degradation, Loss and Fragmentation

Degradation, loss and fragmentation of habitats are the major threats to grouse populations worldwide. Most grouse species reach their highest population densities in landscapes with natural vegetation and natural disturbance regimes. Grouse can tolerate a certain degree of human disturbance of the habitat. However, where industrialised farmland, timber production forests and urban areas dominate the landscape, grouse populations are likely to decline and disappear. In almost all cases, the habitat

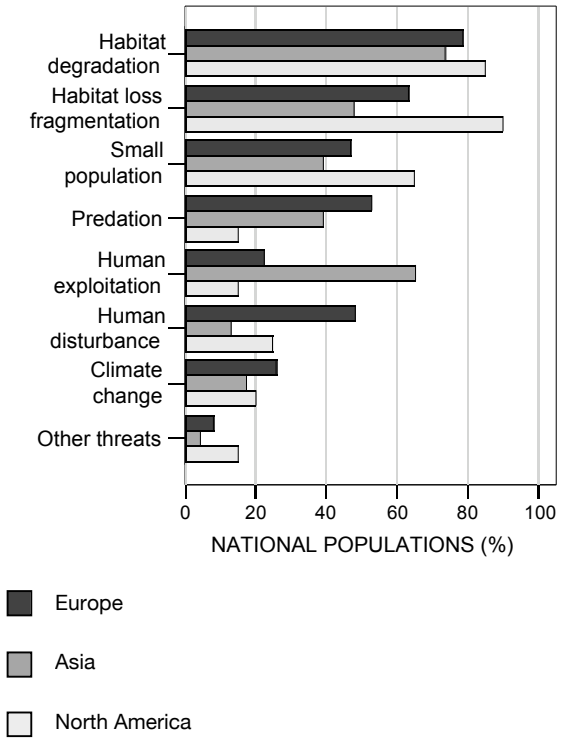

Fig. 2.2 Relative importance of various types of threats to grouse populations by continent, based on a questionnaire per country and species in 2004-2005. A total of 133 questionnaires that reported on threats to grouse on a national level were included in the analysis; all 18 species were represented. Three fourth of the correspondents reported that habitat loss or fragmentation and habitat degradation were threatening the grouse populations in their country. In most cases, small population size can be seen as a consequence of habitat changes. Predation, direct exploitation, and human disturbance were less commonly named but may regionally be critical. Climate change, that was reported by about 20% of the correspondents, had not yet been considered a potential threat to grouse in the 1990s (Storch 2000).

changes that are threatening grouse are man-made.

***Agriculture*.** The conversion of natural habitats into farmland and settlements is the process that has likely led to the largest range contractions of grouse (see Cramp and Simmons 1980, del Hoyo et al. 1994) (Photo 2.4). In temperate Eurasia, forests were cleared on a large scale for settlements and farming in the middle ages and before. Somewhat later, moors and heathlands were drained and fertilised. For grouse, the results were considerable habitat loss and fragmentation. In North America, the conversion of forests and grasslands to cropland started with the European settlers in the middle of the 19th century (see Braun et al. 1994), and has greatly reduced the distribution of several grouse species, particularly the prairie grouse. On both continents, the temperate zones are most heavily affected by human settlements and agricultural development, whereas the boreal forest and the Arctic offer little opportunity for farming and sustain only limited numbers of people. Grouse can tolerate some interspersion of natural habitat and cropland. However, both prairie grouse (e.g. Braun et al. 1994, Schroeder and Robb 1993, Giesen 1998) and forest grouse (e.g. Rolstad and Wegge 1987, Rolstad 1991, Kurki and Lindén 1995) are likely to become extinct during the transition from a natural landscape with islands of farmland to a farming-dominated landscape with scattered small islands of suitable grouse habitat. In general, grouse cannot survive in farmland because most crops are not suitable, or only during short periods, for nesting, feeding, or cover and because of increasing risk of predation.

Photo 2.4. Agricultural and urban developments have replaced prairie-grouse habitats in many parts of North America*. (Photo Michael Schroeder).*

***Grazing*.** Intensive grazing can significantly affect the structure, height and species composition of vegetation and thus destroy or degrade cover, nesting and feeding habitats of grouse (e.g. Baines 1996 and refs. therein; Gokhelashvili et al. 2003) (Photo 2.5, 2.6). Trampling and erosion are additional problems. Excessive livestock-grazing is known to impact negatively upon prairie grouse populations on North American rangelands, black grouse and Caucasian black grouse populations on Eurasian heaths and treeline habitats, as well as some capercaillie and hazel grouse populations in central European forests (see Chapter 3). Deterioration of grouse habitats may also result from high densities of deer or other wild ungulates that may reduce the ground vegetation to a few centimetres in height (e.g. Baines 1996). Some moderate livestock grazing and shepherding can be compatible with grouse populations. In some instances, livestock herding has even improved grouse habitats, e.g. in the Alps, where large-scale pasturing of cattle and sheep has significantly increased the area suitable for black grouse (Glänzer 1985, Magnani 1988). Today, the declining use and maintenance of these summer pastures are likely causes for the deterioration of alpine black grouse habitats (Zeitler 2003). Also capercaillie may profit from a moderate degree of grazing if cattle and deer contribute to maintaining open forest structures (Klaus et al. 1989).

Photo 2.5. Intensive grazing by sheep, cattle or wild ungulates can significantly alter the structure and composition of the vegetation. *(Bavarian Alps, Germany. Photo I. Storch).*

Photo 2.6. Ground vegetation reduced by grazing to a few centimetres in height loses most of its quality as hiding and nesting cover for grouse. ***(Scotland, UK. Photo I. Storch).***

Forestry. From a global perspective, forest utilisation is the major anthropogenic factor influencing forest grouse. Most intensive forestry practices lead to significant changes in forest structure, e.g. in species, age and stocking density of trees, and in height, density and composition of understorey and ground vegetation (Photo 2.7). Forestry also changes the dynamics of forested landscapes, that is the temporal and spatial distribution of successional stages (Photo 2.8).

Photo 2.7. Forestry practices change the internal structure of the forests. Dense stands like this are unsuitable for grouse. ***(Bavarian Alps, Germany. Photo I. Storch).***

Photo 2.8. Industrial forestry alters the landscape pattern: large scale clear-cutting is a major threat to forest grouse. ***(Ural Mountains, Russia. Photo I. Storch).***

Changes at both forest stand and landscape level may significantly affect the distribution and population dynamics of forest grouse. Because each forest grouse species has a different habitat preference, sylvicultural operations may affect them in different ways (Klaus 1991, Swenson and Angelstam 1993). Practices that create structures preferred by a species have positive effects, whereas those that destroy favourable habitats lead to population declines. For example, large-scale clearcutting may have positive effects on species that prefer open forest edge habitats, such as the black grouse (Angelstam 1983, Klaus et al. 1990), but will be detrimental to all species that avoid large open areas such as the capercaillie (Klaus et al 1989, Wegge et al. 1992), Siberian grouse (Hafner and Andreev 1998) and spruce grouse (Boag and Schroeder 1992, Harrison 1997). Grouse can even tolerate intensive human utilisation of forests as long as the species-specific structural habitat needs are maintained (e.g. Baines 1995, Storch 1995, Swenson 1995). At the forest stand scale, forest grouse seem to be fairly flexible with regard to species composition and stand age, but are very sensitive to structural changes such as the loss of the ground vegetation or understorey (e.g. Baines 1995, Storch 1995, Swenson 1995). At the landscape scale, forest grouse are susceptible to habitat fragmentation, and tend to decline rapidly as the patches of suitable habitat become too small and scattered (see e.g. Rolstad and Wegge 1989, Rolstad 1991, Wegge et al. 1992, Zwickel 1992, Lindén et al. 2000). Industrial forestry with large-scale clearcutting significantly alters both the structure of the single stand as well as the patterns and dynamics of the landscape. In most forest grouse species, these changes are likely to lead to declining numbers and eventually to the fragmentation and loss of populations.

Pesticides and pollution. Herbicide- or insecticide-treatment of rangeland or forests may result in the loss of nesting, brood and resting cover, and may reduce the abundance of invertebrate chick food. Increased mortality due to pesticides may occur, either directly through poisoning or indirectly due to increased susceptibility to predation. Pollutants transported through wind and rain may result in soil eutrophication and lead to vegetation changes that are disadvantageous to grouse (e.g. Bergmann and Klaus 1994a,b, Klaus and Bergmann 1994, Schroeder and Robb 1993, Connelly et al. 1998, Hannon et al. 1998, Giesen 1998).

Urban, infrastructure and tourism development. Compared to the extent of grouse habitats that have been converted into agricultural land or industrial production forests, the areas that are lost to settlements and infrastructure such as roads, power-lines, or ski-stations are more limited. However, infrastructure development increases the accessibility of an area and thus opens habitats, grouse and other wildlife populations to exploitation (e.g. Potapov and Flint 1989, Forman and Alexander 1998). Areas intensively frequented by humans, e.g. for sport and leisure activities (Photo 2.9), may virtually be lost as grouse habitats, even if the habitat structure remains unchanged (e.g. Ménoni and Magnani 1998, Zeitler and Glänzer 1998, Summers et al. 2004). Locally, collisions with features such as power-lines (Beveranger 1995), deer or sheep fences (Baines and Summers 1997, Baines and Andrew 2003) and ski-lift cables (Miquet 1986) may cause significant mortality among grouse.

Photo 2.9 Disturbance caused by outdoor activities has become a concern in parts of Europe. Areas frequented by humans may be lost as grouse habitat, even if the habitat structure remains unchanged. ***(Bavaria, Germany. Photo I. Storch).***

2.6.2 Small Population Size

In parts of the range, e.g. in western and central Europe, loss, fragmentation and deterioration of habitats has resulted in isolated grouse populations, many of which are now threatened as a result of small size. Small populations are generally vulnerable and show a high risk of extinction due to chance environmental or demographic events (Shaffer 1987, Klaus 1994). A series of years with unsuitable weather or the loss of a few females to a predator can be enough to extirpate a small population. The chances that a small, remnant population may eventually recover are low, although certainly not zero if enough suitable habitat is available (Klaus 1994, Loneux and Ruwet 1997). There are several well documented examples of small grouse populations that are now extinct, or are close to extinction despite major conservation efforts, e.g. black grouse in Denmark (Holst-Jörgensen 1995, 2001), Belgium (Loneux and Ruwet 1997, Loneux et al. 2004), Germany (Loneux and Ruwet 1997, Prüter and Wübbenhorst 2004) and the Netherlands (Niewold 1996, Ten Den and Niewold 2000, Niewold et al. 2005); capercaillie in parts of Germany (Klaus and Bergmann 1994) and prairie chickens in the USA (Schroeder and Robb 1993, Westemeier 1998). It is likely that conservation efforts were made too late. In this context, the concept of minimum viable population size is important (Shaffer 1987). Most grouse populations may fluctuate greatly in relation to annual weather conditions and other environmental factors. Therefore, an isolated grouse population or metapopulation (a system of connected subpopulations) should probably number at least several hundred birds in order to have a good (>90%) long-term (100 years) chance of survival (Grimm & Storch 2000).

Related to the patchy distribution of their habitats, many grouse populations are spatially structured. Rock ptarmigan and white-tailed ptarmigan, for example, inhabit alpine habitats that occur as discrete and often small patches. Each mountaintop provides enough space for a few breeding pairs only. If they were isolated, such a small population would not persist for very long. For the survival of grouse in patchy habitats, contact and exchange between the neighbouring habitat patches is important. Connectivity is ensured by dispersal: Juvenile birds disperse between local populations and thereby keep these populations alive – an effect called demographic rescue. Dispersal is also important to re-colonise vacant patches of habitat (e.g. Martin et al. 1997). A system of connected, spatially distinct subpopulations is called a metapopulation. Metapopulation structure and processes have been proposed, e.g. for black grouse and capercaillie in the Alps (Storch 1997a, b; Segelbacher and Storch 2002; Segelbacher et al. 2003a, b; Höglund et al. 2004) and for capercaillie in the Pyrenees (Ménoni et al. 1997). At present, our knowledge of the dispersal behaviour of grouse is not sufficient to reliably evaluate the viability of local populations (see Martin 1998; Caizergues and Ellison 2002). Therefore, the approach to the management of spatially structured populations must be conservative.

There is evidence that reduced genetic variability might be an additional problem for the survival of small grouse populations (Westemeier 1998). In an isolated remnant population of prairie chickens in Illinois, hatching success significantly decreased as the population declined. This loss in fertility might have resulted from reduced genetic heterogeneity. The fertility increased again after birds from elsewhere had been translocated into the population.

2.6.3 Predation

Parallel to large-scale land-use changes, the predation pressure on grouse regionally has significantly increased since the 1970s (Reynolds 1990, Wegge et al. 1990, Hudson 1992, Klaus and Bergmann 1994a,b, Fujimaki 1995). In the boreal forest, habitat fragmentation due to intensive clearcutting has resulted in greater numbers of generalist predators and increasing mortality of grouse (Andrén and Angelstam 1988; Andrén 1992, Wegge et al.1990). In central Europe, industrialised agriculture with intensively fertilised farmland and the availability of anthropogenic food sources has improved the conditions for small and medium-sized mammalian and avian generalist predators. At the same time, the formerly intensive persecution of predators has relaxed (e.g. Hudson 1992). In addition, large-scale vaccination of foxes against rabies has been contributing to constantly high fox populations in central Europe since the 1980s (Vos 1995). All this has contributed to increasing predator densities. Negative effects on the survival rates of prey species, such as grouse, are likely to follow (Marcström et al. 1988, Reynolds 1991, Kauhala et al. 2000; Baines at al. 2004). In Japan, a 10-fold increase in the hunting bag of red foxes indicated a significant increase in the fox population since the 1960s. This increase was paralleled by a 90% decline in hazel grouse bags (Fujimaki 1995); whether there was a causal relationship between these trends remained uncertain. Also, domestic dogs and cats are a potential problem for grouse near settled or in recreational areas (A. Zeitler pers. comm., F. Zwickel, pers. comm.). In the Caucasus Mountains, predation by shepherd dogs locally has become a serious threat to the Caucasian black grouse (Klaus et al. 1990, Gokhelashvili et al. 2004; A. Gavashelishvili, pers. comm). In the Alps, human food remains around tourist huts and ski stations attract concentrations of generalist predators such as corvids and foxes, which may negatively affect grouse populations (Storch and Leidenberger 2003).

Without doubt, predators can have major influences on the population density of grouse, as has been shown in experimental and empirical studies (Marcström et al. 1988, Reynolds 1990, Hudson 1992, Kauhala et al. 2000, Baines et al. 2004, Summers et al. 2004). However, there is also evidence that suitable habitat conditions may allow grouse to survive well despite high predator numbers (Baines 1996; Baines at al. 2004). Predation is unlikely to become a critical

threat for a grouse population in a relatively undisturbed or natural landscape. Many examples of populations that are considered to be threatened by predation come from severely fragmented and degraded habitats in landscapes intensively used by humans. There are two major explanations for this. First, human land-use practices often favour high predator numbers (Reynolds 1990), and second, small and isolated remnant grouse populations are particularly vulnerable (e.g., Klaus 1994, Loneux and Ruwet 1997, Westemeier 1998, Grimm & Storch 2000, Storch 2002).

2.6.4 Exploitation

Because of the pronounced and often unpredictable fluctuations of many populations, grouse are susceptible to over-harvesting, especially if hunted in spring. At this time, the population size is at its smallest, and birds shot are potential breeders. If hunted in autumn, many birds in the hunting bag will be juveniles. Some of these probably would not have survived the winter; there is evidence that at least some compensatory mortality occurs in the juveniles of most grouse species (Ellison 1991).

Over-exploitation may be a result of inadequate harvest planning. Attempts to harvest grouse at a maximum yield can easily lead to overshooting because of the natural fluctuations of grouse population size. Reliable monitoring schemes with data on current stocks and annual reproductive success can minimise this problem (see Ellison 1991). More often, however, over-exploitation appears to be related to insufficient enforcement of hunting regulations. Birds may be shot in excess of the legal hunting bags or outside the season; in some regions, poaching of fully protected species is common. Generally, poaching has been reported most frequently from regions with poor rural economics (parts of Asia and eastern Europe), or from regions that combine relatively poor law enforcement with a high trophy or sport value of grouse (parts of southern Europe).

The lekking species are particularly susceptible to over-exploitation. This is because birds at leks are easy targets and known leks may be extirpated with little effort. Also, the spring hunt of displaying capercaillie and black grouse males at the leks, which is traditional throughout central Europe, involves a high risk of disturbing the social system at the lek, possibly resulting in reduced reproductive success (Klaus et al. 1989, 1990).

2.6.5 Human Disturbance

In many countries, particularly those with wealthy societies, high human population densities, urban life-styles and the growing popularity of outdoor activities, increases the potential for conflicts between the interests of recreationists and the needs of wildlife. Bikers, hang-gliders, hikers, hunters, mushroom-collectors and berry-pickers, skiers, snowboarders, snowshoers and wildlife photographers frequent scenic landscapes. Grouse-watching at leks has become popular among birders, particularly in North America and Britain but also elsewhere in Europe, and sometimes carries a high risk of disturbance with negative consequences for reproductive success. Regionally, e.g. in Japan and in western and central Europe, recreationists have become one of the main concerns in grouse conservation.

The term "human disturbance" is widely used. One may find at least four different, not necessarily mutually exclusive, meanings: (1) the presence of humans in wildlife habitat, (2) human-wildlife encounters, (3) the behavioural response of an animal to an encounter, and (4) effects on population distribution and dynamics.

Thus, the term is used for both the cause (human presence) and the effect (animal response). With grouse, disturbance has become a concern particularly with regard to leks, in winter habitats and during chick-rearing and moulting. Effects can be direct and indirect. The escape of a grouse flushed by a skier is energy-consuming, may expose the bird to predators and reduces the time available for foraging. If disturbed repeatedly, death from starvation (ultimate cause) or predation (proximate cause) is a likely consequence. Frequent presence of humans may expel animals from otherwise optimal habitats - the result equals habitat loss and fragmentation. In Scotland, for example, capercaillies avoid the vicinity of forest tracks frequented by humans in otherwise uniform habitat (Summers et al. 2004).

Individual response and population-level effects may vary with a great number of inter-related variables, such as the number, sex and age of the birds, the proximity, type, intensity and cumulative number of human activities, and the temporal and spatial availability and distribution of food and cover (Storch 1998). Some summary papers on the effects of human disturbance on grouse have been compiled in the GSG´s newsletter 'Grouse News' n°15 (e.g. Ménoni and Magnani 1998, Zeitler and Glänzer 1998), see http://www.gct.org.uk/gsg/

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Box 2.1 Grouse-hunting: threat or opportunity?

Over most of their distribution range, grouse are traditional game species and grouse hunting is of great cultural importance. Grouse are legally hunted for subsistence and sport, but hunting has been banned or restricted in many (but not all) regions where populations are threatened.

There are several countries where grouse species are still legally hunted although they are listed as threatened in the National Red Data books. This practice should be questioned, because even if hunting is strictly regulated, negative effects on the population cannot be completely excluded. Particularly in industrialised countries, shooting of threatened species is considered as highly unethical by a growing proportion of the public and by many conservationists. Also, the shooting of Red-Listed species may reduce public support for conservation; as long as shooting is allowed, conservation may be perceived primarily as an attempt to secure the privileges of hunters. Indeed, the legal shooting of threatened species appears to question the seriousness of a country's conservation policy. Therefore, one may argue that the hunting of Red-Listed species should generally be prohibited.

On the other hand, hunting may also create a significant incentive for habitat preservation among landowners and hunters. In England, for example, grouse are largely dependent on private landowners and would lose much of their habitat if hunting were banned. In parts of Austria, where the hunting rights belong to small, private land owners, the chance to sell a capercaillie or black grouse cock to a guest hunter every other year appears to be a strong enough incentive to maintain great interest in the species, to implement habitat preservation measures and to contribute funds for research and management. If hunting bans cause hunters and landowners to lose interest in the birds, grouse may lose their strongest lobby group. Therefore, one may argue that in some situations, moderate, strictly controlled hunting can have a positive overall effect on grouse conservation.

2.7 Conservation Measures

The major conservation measures for individual species that are currently under way are described in the species accounts (Chapter 3). Here, the most important approaches to grouse conservation are summarised based on the questionnaire results (see History and Evolution of the Action Plan; Chapter 1) and the literature. Links to web sites on grouse conservation are provided at the link page of the Grouse Specialist Group web site: http://www.gct.org.uk/gsg/.

2.7.1 Legislation

Hunting regulations for grouse probably exist in most, if not all, countries where grouse occur (see tables in species' accounts, Chapter 3). Hunting is generally restricted by defined seasons and bag limits and some species are fully protected in all or part of their range. Where exploitation is reported as a serious threat to grouse populations, the problems seem to stem from either poaching and poor law enforcement, or from overshooting due to poor harvest planning, rather than from insufficient hunting legislation. Overshooting is a likely consequence if the grouse counts that are used to determine bag limits are conducted by the hunters themselves. In some countries where threatened populations are still legally hunted, a careful revision of the hunting regulations may be necessary. One argument for total hunting bans for threatened populations is that poaching in excess of the legal bag limits is almost impossible to control.

Commercial exploitation for the international wildlife trade, a major threat to other galliformes birds such as some pheasants, appears not to be a major issue in grouse conservation. Of the 133 returned questionnaires, international trade was not reported as a threat to grouse. The only grouse taxon mentioned in international wildlife trade regulations is Attwater´s prairie chicken *Tympanuchus cupido attwateri*, a Critically Endangered subspecies of the greater prairie chicken (see Greater Prairie Chicken Species Account and Recommended Conservation and Research Priorities for Attwater's Prairie Chicken). In the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES http://www.cites.org/), Attwater´s prairie chicken is listed under Appendix I ("taxa threatened with extinction which are or may be affected by trade"), which prohibits international trade for commercial purposes. However, under exceptional circumstances, import, export and re-export of species listed in Appendix I may be authorised at the discretion of the CITES authorities in the relevant countries for non-commercial purposes such as translocation, re-introduction, and captive breeding (WCMC 1998). Attwater´s prairie chicken is also included in Annex A of the EU Regulations on Protection of Species by Regulating Trade (EC 338/97).

The European Union (EU) Habitats Directive 92/43/EEC aims at the protection of habitats and species listed as endangered at a European scale. Several habitat types valuable for grouse, e.g. some bogs, heaths and montane conifer forests, have been included. The EU Birds Directive (79/409/EEC) lists the black grouse, capercaillie, hazel grouse, and rock ptarmigan in Annex I ('species that shall be subject to special habitat conservation measures in order to ensure their survival'). The major approach is the ongoing creation of a network of protected areas that aims at habitats and species listed under the Habitats and Birds Directives. This European network is called 'Natura 2000' (See http://europa.eu.int/comm/environment/nature/nature_conservation/index_en.htm as well as http://europa.eu.int/comm/environment/nature/nature_conservation/natura_2000_network/managing_natura_2000/index_en.htm). The problem remains that most protected areas, including the Natura 2000 reserves, will be too small to sustain viable grouse populations. The Bern Convention (Convention on the Conservation of European Wildlife and Natural Habitats; European Treaty Series/104; Council of Europe 1979) mentions the Cantabrian subspecies of the capercaillie *Tetrao urogallus cantabricus* as "strictly protected" under Appendix II, which requires the member states to ensure the conservation of the listed taxa and their habitats. The convention has been signed by the member states of the Council of Europe and a number of additional European countries.

Current legislation relevant to grouse mostly concerns direct exploitation. Few national regulations or international agreements address the habitat needs of grouse. At a national level, the US American Endangered Species Act (US Public Law No 93-205, 81 Stat. 884; Dec. 28, 1973) is a prominent example that prescribes habitat preservation measures for nationally Red-Listed species; in Europe the Bern Convention concerns habitats of species threatened at a continental level. Because habitat loss, fragmentation and degradation due to human land-use practices are the predominating cause of grouse population declines and extinctions, instruments that address and effectively implement habitat preservation are desirable at global, regional and national scales. Integration of grouse habitat requirements into land-use practices should become mandatory where grouse populations are threatened or declining. In this context, a major shortcoming is in the separation between wildlife management and land-use management: In many countries, the agencies or groups that are responsible for managing the grouse do not control the land use in grouse habitats.

2.7.2 Protected Areas

Worldwide, grouse occur in many protected areas such as state, provincial and national parks, nature reserves and state wildlife management areas. Generally, only a minor proportion of the species'range is covered by protected areas and their role for the long-term survival of grouse populations is considered to be limited. Protected areas may effectively maintain a grouse population if the area is large enough (e.g. for capercaillie in the Alps, a magnitude of 250 km^2 may be required for a minimum viable population; see Grimm and Storch 2000), if the habitat is and remains suitable and if utilisation and disturbances are strictly regulated and controlled. Many existing protected areas appear to be too small for self-sustaining, viable populations of grouse. Nevertheless, protected areas may preserve important habitats and thus contribute to the survival of grouse populations.

In a few countries, protected areas are seen as critical for the long-term survival of grouse. Based on the questionnaire

(see History and Evolution of the Action Plan; Chapter 1), calls for protected areas for grouse conservation generally come from regions where grouse have a limited distribution and are threatened by factors that appear difficult to control outside reserves, e.g. because of the socio-economic situation, or poor enforcement and public acceptance of laws and regulations. Protected areas may ease the implementation of conservation measures particularly where they conflict with human land-use interests.

Well-managed reserves are believed to play an important role in the conservation of the Caucasian black grouse and Chinese grouse; there are several protected areas in the ranges of both species, but the present effectiveness or extent in some was judged to be insufficient (S. Baskaya, pers. comm., A. Solokha, pers. comm.). With black grouse, most of the small and isolated remaining populations in Belgium, the Netherlands and northern Germany are in nature reserves, which are considered to be critical for their survival by maintaining the habitat and reducing human disturbance (see Loneux and Ruwet 1997). The same holds true for some highly threatened prairie-grouse populations in North America, e.g. the Attwater´s prairie chicken (see Greater Prairie Chicken Species Account and Recommended Conservation and Research Priorities for Attwater's Prairie Chicken). Also in regions of Europe and Asia where poaching is seen as a problem, reserves are believed to be important for grouse conservation.

2.7.3 Surveys and Monitoring

Where grouse counts have a long tradition of being used in harvest planning, various specialised count methods have been developed (e.g. Klaus et al. 1989, 1990, Hudson 1992, Lindén et al. 1996). Generally, counts are done in either spring or autumn, depending on the species and on regional hunting traditions. In spring, displaying males are usually counted, e.g. on known leks or along standardised transect routes. The breeding population indices derived are either the number of displaying males or the number of leks per area. Autumn counts are generally based on some kind of transect methods and result in indices of population size and sex and age ratios. A third approach, which is common in North America, is to obtain harvest numbers and age composition of the kill by hunter check stations, wing surveys and questionnaires sent to hunters (see Chapt. 3).

Monitoring of grouse populations is common as a means of harvest planning in parts of Europe and North America. Only in a few countries are standardised and statistically designed monitoring schemes applied, resulting in generally reliable estimates of population size, structure and trends (e.g. Hudson 1992, Lindén 1996). The quality of the data collected by some of the more traditional count methods, such as capercaillie lek counts in central Europe, (see Klaus et al. 1989) is questionable: Larger leks are often difficult to overlook, the spatial organisation and attendance of a lek may change over the season and small leks and individually displaying cocks may be missed. Lek counts may both under- and overestimate the population (compare in section 3.9).

Monitoring as a tool in grouse conservation is even less common. Regular counts are conducted to observe the trends of a few highly threatened, remnant populations, e.g. black grouse and capercaillie in some parts of Europe and some prairie grouse populations in North America (e.g. Klaus et al. 1989, 1990, Loneux and Ruwet 1997, Silvy et al. 1999). There are no monitoring schemes yet for any of the three globally red-listed Eurasian grouse species, the Caucasian black grouse, Chinese grouse and Siberian grouse, although some irregular and localised surveys have been done or are under development. Even in parts of central Europe where grouse are nationally Red-Listed and hunting is banned, grouse monitoring is not generally common, although it would be an important means of observing population trends and assessing the success of conservation measures.

2.7.4 Habitat Management

Habitat preservation is considered the most important measure to ensure the long-term survival of grouse. The major challenge is to integrate grouse habitat requirements with agriculture, forestry and other human land-use practices. A multitude of approaches has been developed and carried out, particularly for the prairie and forest grouse. These include preservation of natural primary or of secondary habitats in cultural landscapes by maintaining traditional management practices, mitigation or restoration of successional habitats by prescribed burning or logging regimes, and restoration of habitats altered by human land-use.

In some countries, particularly in North America and parts of Europe, habitat management programmes, specifically designed to favour grouse, have been carried out by the forest products industry, resource management agencies, private forest landowners and non-governmental conservation organisations. Recent policy changes by the state forest agencies in many countries towards increasing naturalness of the forest are considered to be favourable to grouse habitat preservation.

Habitat management programmes for grouse appear to be of mixed success. There are encouraging examples that demonstrate that habitat improvement can result in significant increases in grouse populations. High densities of the British subspecies of willow ptarmigan, the red grouse, are maintained by intensive heather moorland management (Hudson 1992). Also, the EU-Life Project “Urgent Conservation Management for Scottish Capercaillie” is showing some preliminary success (http://www.capercaillie-life.info/htm/bird_importance.php). In North America, the Conservation Reserve Program (Joyce et al. 1991, Dunn et al. 1993, Douglas and Schwartz 1993; http://www.nrcs.usda.gov/programs/crp/), a federal programme launched in 1985 to plant perennial vegetation on large quantities of set-aside farmland, is an example of successful prairie habitat restoration on private lands; an increase in perennial vegetation has resulted in increased numbers of sharp-tailed grouse and other prairie grouse. On the other hand, there are many cases of localised initiatives of habitat preservation and improvement that failed to save threatened, remnant populations from further declines and extinction: The decline of black grouse and capercaillie in northern central Europe (Niewold 1991, Klaus 1994, Holst-Jörgensen 2001), and prairie chickens in North America (Schroeder and Robb 1993, Westemeier at al. 1998) were not reversed despite significant efforts and good success in preserving and restoring optimal habitat structures. In many cases, species conservation and habitat preservation programmes are initiated as a response to a serious population decline. However, the smaller the size of a remnant population the less likely its recovery appears to be, even if the remaining habitat is optimal (see Small Population Size; this Chapter). Therefore, habitat management measures may often have been initiated too late. Habitat management

may be much more successful if conducted in a preventative rather than a reactive approach to grouse conservation. At least as important as the timing of habitat conservation measures, is their spatial extent. Many grouse habitat management initiatives remain restricted to some hectares, focus on small-scale habitat factors and neglect the landscape context (Storch 2002). Grouse populations, however, are influenced by habitat features from local vegetation structure measured at the level of hectares, to the landscape mosaic within areas of thousands of km_ (Kurki et al. 2000, Storch 2002). For a grouse population to persist, its habitat requirements must be met at all scales (e.g., Storch 1995, 2002; Kortland 2003). The extent and landscape context of a habitat is equally relevant as its vegetation structure.

2.7.5 Captive Breeding

Captive breeding programmes can play an important role in the conservation of biotic diversity. Especially with species at high risk, conservation in the wild alone may not be sufficient and the establishment of self-sustaining captive populations will be needed to prevent their extinction. As species-conservation measures, captive breeding programmes need to be established before species are reduced to critically low numbers, and thereafter need to be co-ordinated internationally according to sound biological principles, with a view to the maintenance or possible re-establishment of viable populations in the wild. Such captive stocks have in the past provided critical support for some wild populations (e.g. American bison *Bison bison*) and have been the sole escape from extinction for others which have since been re-introduced to the wild (e.g. Arabian oryx *Oryx leucoryx*) (IUCN Policy Statement on Captive Breeding; IUCN 1987; IUCN Technical Guidelines on the Management of *Ex Situ* Populations for Conservation; IUCN 2002). An expert group on conservation breeding of galliformes is currently (early 2006) being organised by the World Pheasant Association.

Grouse are kept and bred by a small number of specialised aviculturists. In most cases, captive breeding of grouse was started without particular conservation objectives in mind. Because most grouse taxa are not globally threatened, captive breeding generally cannot be viewed as a conservation priority essential for their survival. An exception to this is Attwater´s prairie chicken, a Critically Endangered subspecies of the greater prairie chicken (see Greater Prairie Chicken Species Account and Recommended Conservation and Research Priorities for Attwater's Prairie Chicken), which is the subject of a special breeding and release programme to support the remnant wild population (Morrow et al. 1997). According to the IUCN Policy Statement on Captive Breeding (IUCN 1987), the establishment of captive populations as a long-term strategy to reduce the risk of extinction is recommended before a taxon has declined to less than 1000 individuals in the wild. The more recent IUCN Technical Guidelines on the Management of *Ex Situ* Populations for Conservation
(IUCN 2002, http://www.iucn.org/themes/ssc/pubs/policy/exsituen.htm) recommend the establishment of captive populations when a species is likely to become Critically Endangered, Extinct in the Wild or Extinct in a very short time.

Conservation breeding of grouse should only be undertaken as part of an integrated recovery strategy involving defined conservation objectives. It is important to note that release into the wild is not an automatic consequence of conservation breeding and should only be undertaken in accordance with the IUCN position Statement on Translocation of Living Organisms (1987) and the IUCN/SSC Guidelines for Reintroductions (1996). For further guidance see the WPA policy statement on conservation breeding (http://www.pheasant.org.uk/exsit.htm).

Several captive breeding programmes for grouse conservation, at local or regional scales, have attempted to re-stock or re-establish threatened or extinct populations. Most of these examples come from central Europe and concern capercaillie or black grouse; they were of varying success, but generally failed to establish self-sustaining populations in the wild (Klaus 1998, Seiler et al. 2001; see Re-introduction and Re-enforcement below).

Grouse are not easy birds for aviculture. Many species have a short life expectancy, they tend to be highly vulnerable to disease and stress can be lethal for some; the natural pugnacity between males, whether polygamous or monogamous, often leads to hens being damaged or killed either in or out of the breeding season (Aschenbrenner 1981, 1985, Mäkinen et al. 1997). Outside the breeding season, both sexes may be incompatible and females may harass males and vice versa (K. Martin, pers. comm.). For all these reasons, many aviculturists, both private and public, will not keep grouse species in their collections.

The challenge, however, does make some enthusiasts tackle these problems, sometimes with considerable success. In the United Kingdom, there are probably around 10-12 aviculturists, mainly keeping the four indigenous species, but some have imported and bred willow ptarmigan from Scandinavia and hazel grouse from central Europe. One or two breeders in the UK keep New World species. On the continent of Europe, a small number of aviculturists keep and breed grouse, selling or exchanging the progeny on a larger scale. Several species are kept, particularly capercaillie and back grouse, but there also some captive Caucasian black grouse and Siberian grouse. In North America, New World species are more numerous among captive collections. Very few sage grouse are believed to be in captivity whereas ruffed grouse, blue grouse, spruce grouse and willow ptarmigan are more commonly kept. Some greater and lesser prairie chickens are bred in captivity (Copper and Bendell 1981, Merker 1997, Morrow et al. 1997). No accurate estimates of numbers and breeding success in captivity are known. No studbooks exist for grouse.

2.7.6 Re-introduction and Re-enforcement

The release of birds reared in captivity or caught in the wild has become a common grouse conservation tool in central Europe and North America. In central Europe, release of captive-bred birds has been the principal technique used in re-introduction (release after the native population became extinct) and re-enforcement (release to supplement a remnant population) attempts (Klaus and Bergmann 1994, Bergmann et al. 1996, Klaus 1997, 1998, Nappée 1999, Seiler et al. 2001). In Germany alone, four release projects for black grouse and nine for capercaillie were carried out during the last 20 years of the 20th century; although in total several thousand birds have been released, still not a single example exists of a self-sustaining population established from birds reared in captivity (Klaus 1997, 1998). In a historic re-introduction of capercaillie into Scotland in the 1830s, 64 birds translocated from Sweden had grown to an estimated population of 2000 within 25 years (Starling 1991); this

increase, however, was enabled by wide spread and large-scale elimination of predators by professional game keepers, and cannot be compared with present conditions.

In general, the recent central European release projects have failed due to high mortality from predation among newly released birds, which may be partly related to rearing and releasing techniques. However, major losses, fragmentation and/or degradation of habitats preceded all cases of serious population declines or extinctions of black grouse and capercaillie in central Europe; in addition, predation pressure has significantly increased during the past few decades. The prospects for re-establishing lowland populations in central Europe appear to be limited mainly by the small size of habitat patches and high predation pressure, and only secondarily by suboptimal rearing and release techniques. Experience with central European release projects have been summarised by Klaus and Bergmann (1994; black grouse), Seiler et al. (2001; black grouse), Klaus (1998; capercaillie) and Bergmann et al. (1996; hazel grouse).

It is now widely agreed that translocations, i.e. release of birds caught in the wild elsewhere, might be more successful than the release of captive-bred birds (e.g. Starling 1991, Klaus 1997, 1998). Translocation is the method most used in North America. Although there has been more success than with captive-bred birds, failures have far outweighed successes. With white-tailed ptarmigan and ruffed grouse, populations have been successfully restored and newly introduced by translocations into various parts of North America. Most North American re-enforcement attempts, however, have concerned prairie grouse. Since 1950, there have been at least 14 attempts to establish and re-establish sharp-tailed grouse populations by translocations; most attempts failed or established only small temporary populations and were poorly documented, but some recent translocations have apparently been successful (Connelly et al. 1998). Lesser prairie chickens have been translocated in more than 10 attempts to reintroduce the species, but none of these resulted in an established, self-sustaining population (Giesen 1998). Also with greater prairie chickens, translocations into formerly occupied habitats have mostly been unsuccessful (Schroeder and Robb 1993). The major reasons for failure are seen as inadequate habitat at the release site and poor survival and reproductive success of the transplanted birds. Experience with North American translocation projects has been summarised by Connelly (1997). In Europe, a recent translocation of capercaillie from Russia to restock the remnant population of Thuringia, Germany, showed that translocated individuals survived better after release than did captive-bred birds (Klaus and Graf 2000; Graf and Klaus 2001). Still, there was no longer-term success at the population level. Guidelines and international standards for translocations as a management technique have been summarised in the IUCN Position Statement on Translocation of Living Organisms: Introductions, Re-introductions and Re-stocking (IUCN 1987).

The present state of knowledge and experience with release projects of grouse is sufficient to conclude that the chances of re-establishing a self-sustaining population are generally very poor. Still, grouse re-introduction and re-enforcement initiatives receive much support. To release animals into the wild seems to be appealing to the public, decision makers, funding agencies, the media and last, but not least, to the aviculturists involved, despite their poor chance of success. In times of limited funding available for grouse conservation, however, release projects bear the risk of outcompeting habitat preservation projects that are urgently needed to secure existing populations. Reintroduction attempts are likely to divert attention and resources away from priority work such as habitat preservation and restoration.

International standards for re-introductions as a management technique, such as The IUCN/SSC Guidelines For Re-Introductions (IUCN 1998) and the IUCN Technical Guidelines on the Management of *Ex Situ* Populations for Conservation (http://www.iucn.org/themes/ssc/pubs/policy/exsituen.htm, IUCN 2002), need more attention among grouse conservationists. Grouse conservationists should interact more closely with the IUCN Re-introduction Specialist Group and vice versa so that there is a flow of information and co-operation in both directions. In the future, translocations are likely to be used more to increase genetic heterogeneity and fertility of small isolated populations. Translocations of birds into an isolated remnant population of greater prairie chickens in Illinois, resulted in an increased breeding success (Westemeier et al. 1998).

2.7.7 Predator control

In some limited parts of the range, predator control is considered to be a major measure of grouse conservation. Britain has a long history of game-keeping and intensive predator control to support high densities of grouse and other small game for shooting (e.g. Hudson 1992). In some areas of central Europe where grouse are highly threatened, predation is seen as a major threat to the remaining populations, and to many conservation practitioners, predator control seems to be desirable (Kaphegyi 1998; Weiss 1998; Omerod 2002). Predator control is considered as an important accompanying measure to grouse population recovery programmes (e.g. Holst-Jörgensen 1995) and of release projects for re-enforcement or re-introduction attempts (Starling 1991).
A significant reduction of predators will probably result in improved survival of grouse (e.g. Parker 1984, Marcström et al. 1988, Reynolds 1990, Hudson 1992, Kauhala et al. 2000, Summers et al. 2004; but see Baines 1996, 2004). To maintain low predator densities on a large scale, however, is technically difficult and ethically questionable, and in many countries not easily accepted by the public (see Messmer et al. 1999). Also, some predator species are legally protected themselves. For these reasons, in most areas predator control cannot be a sustainable approach to grouse conservation.

2.7.8 Reduction of human disturbance

In the mountain ranges of industrialised regions, e.g. in Europe and Japan, disturbance by tourism and leisure activities such as hiking, skiing, mountain biking, snowshoeing and by related infrastructure such as cable cars, tourist resorts and snow-machines, is viewed as a serious threat to local populations of grouse (Storch 1998; Suchant and Schäfer 2002, Summers et al. 2004; Suchant and Braunisch 2005). Because population-level effects of disturbance are often difficult to prove, there are a lack of rigorous disturbance studies on grouse. Several are currently under way. Recently, Scottish ecologists could show that capercaillie clearly avoid the vicinity of forest tracks frequented by humans in otherwise uniform habitat (Summers et al. 2004).

In some countries, programmes to limit the effects of human disturbance on grouse have been initiated (e.g. Austria, France, Germany, Switzerland) (e.g. Ménoni and Magnani 1998, Zeitler and Glänzer 1998, Suchant and Schäfer 2002).

The major approaches are public awareness campaigns, re-routing of hiking and ski-trail networks and the designation of core areas closed to the public in order to minimise spatial and temporal overlap between important habitats and recreational activities. Preliminary experience indicates that co-operative approaches may be promising, including all stakeholders such as mountaineering, nature-protection and sportsmen's organisations, tourist boards and the conservation, forest and hunting agencies. As a long-term goal, minimising disturbance of wildlife during all kinds of outdoor activity needs to become a widely accepted precept.

2.7.9 Education and Information

Because grouse are mostly threatened by human influences, education is an important accompanying measure in grouse conservation programmes. Public awareness and support can greatly improve the success of conservation efforts. Education was reported as a grouse conservation measure from many countries and most species (see Chapter 3). In general, resource managers, landowners and decision-makers require better education on habitat requirements, threats and population ecology of the species on their land and under their responsibility. Government agencies need better access to more specialised knowledge and information, and contact with experts. Those sectors of the public domain whose land-use practices may interfere with threatened grouse populations and their habitats need to be involved in conservation efforts.

In some regions, hunters may need better information on hunting regulations. A systematic review of education programmes in grouse conservation and their potential, approaches and successes would be helpful in developing guidelines for future efforts.

Box 2.2 The predator controversy

Predation is a natural process in the dynamics of any grouse population. Grouse have evolved and co-evolved with a set of different predators, and they have developed morphological, physiological and behavioural adaptations to avoid predation. Without predators, the evolution of the grouse species we know today would have been different. Still, in some parts of the range, particularly in central Europe and Britain, predation is considered to be a serious threat to grouse populations. There is good evidence that a significant reduction of predators will probably result in improved survival of grouse (e.g. Parker 1984, Marcström et al. 1988, Reynolds 1990, Hudson 1992, Kauhala et al. 2000, Baines et al. 2004, Summers et al. 2004). Consequently, predator control seems to be desirable to many conservation practitioners. Others, however, point out that predation is unlikely to limit a grouse population as long as the habitat is intact (see Baines 1996, Baines et al. 2004), and oppose predator control as a major conservation measure. Growing public opposition to the killing of predators complicates the controversy.

When assessing the relative importance of factors that may influence the size and dynamics of a population, it is helpful to distinguish proximate and ultimate factors. No doubt predators have increased in many areas and predation can lead to the extirpation of remnant grouse populations. Many highly threatened grouse populations live in habitat islands surrounded by farmland that supports high predator numbers. Generalist predators have increased because they are unintentionally augmented by human activities. Therefore, predation is a proximate threat to grouse populations. The ultimate cause is the man-made loss, fragmentation and degradation of the habitat. In this situation, predator control simply cures a symptom, and does not solve the ultimate problem. Whether this is desirable and acceptable as a sustainable measure of grouse conservation is a matter of human values and not of ecology.

3. Species Accounts

The species accounts provide a short overview for each of the 18 species of grouse. They are treated in their taxonomic order. For the first IUCN Grouse Action Plan (Storch 2000), status, taxonomy, distribution, population, ecology, cultural importance, threats, research needs and current and recommended conservation measures were summarised for each species based on information obtained from specialists (see History and Evolution of the Action Plan; Chapter 1) and relevant literature. For this revision of the Action Plan, species accounts were updated based on the results of a total of 140 questionnaires and recent publications. Data on the legal status of grouse were obtained from the IUCN Environmental Law Centre in 1999 (Storch 2000) and revised by grouse specialists in 2004-2005. Several species specialists from different parts of the world reviewed each species account and also contributed recommendations for research and conservation priorities.

Summarising tables are provided including all countries within the known distribution range of each species. For a few countries, no contacts could be made or no data could be obtained. Reliable quantitative data on grouse population numbers and trends exist only for a few countries and species. Therefore, the information given in the species summary tables are mostly a mixture of specialist opinion, coarse estimates and extrapolations from local or regional studies. Although the quality of this information is not optimal, it is still the best currently available.

For each species, a list of people who returned questionnaires, provided other information on the species and reviewed the text is provided. These correspondents can be contacted for further information (see Appendix 1 for list of names). However, the lists of correspondents do not provide complete lists of experts on the various species.

Table 3.0. Conservation status of grouse at global level according to the 2006 IUCN 'Red List of Threatened Species', and at the national level according to national red data books. [Listing at state (USA) or province (Canada) level is noted in brackets.]

		Conservation status	
Species		**IUCN 2006**	**National Red Data Books***
Siberian grouse	*Dendragapus falcipennis*	Near Threatened	China, Russia
Spruce grouse	*Dendragapus canadensis*	Lower Risk	Not listed (several eastern U.S. states)
Blue grouse	*Dendragapus obscurus*	Lower Risk	Not listed
Willow ptarmigan	*Lagopus lagopus*	Lower Risk	Belarus, China, Estonia, Latvia, Lithuania
Rock ptarmigan	*Lagopus muta*	Lower Risk	China, Germany, Iceland, Italy, Japan, Portugal, Slovenia, Spain
White-tailed ptarmigan	*Lagopus leucura*	Lower Risk	Not listed (British Columbia, Canada)
Black grouse	*Tetrao tetrix*	Lower Risk	Austria, Belgium, China, Czechia, Denmark, Estonia, Germany, Italy, Kyrgystan, Latvia, Lithuania, Netherlands, Poland, Romania, Slovakia, Slovenia, South Korea, UK
Caucasian grouse	*Tetrao mlokosiewiczi*	Data Deficient	entire range: Armenia, Azerbaijan, Georgia, Iran, Russia, Turkey
Capercaillie	*Tetrao urogallus*	Lower Risk	Austria, Bulgaria, Czechia, Estonia, Germany, Greece, Italy, Liechtenstein, Latvia, Lithuania, Poland, Slovakia, Slovenia, Spain, Switzerland, UK, Ukraine
Black-billed capercaillie	*Tetrao parvirostris*	Lower Risk	China
Hazel grouse	*Bonasa bonasia*	Lower Risk	Austria, Belgium, Bulgaria, China, Czechia, Germany, Greece, Hungary, Italy, Japan, Liechtenstein, Serbia, Slovakia, Slovenia, South Korea, Spain, Switzerland
Chinese grouse	*Bonasa sewerzowi*	Near Threatened	China
Ruffed grouse	*Bonasa umbellus*	Lower Risk	Not listed
Greater sage-grouse	*Centrocercus rophasianus*	Near Threatened	Canada; USA candidate species (some U.S. states)
Gunnison sage-grouse	*Centrocercus minimus*	Endangered	Not listed, USA candidate species
Sharp-tailed grouse	*Tympanuchus hasianellus*	Lower Risk	Not listed (some U.S. states and Canadian provinces)
Greater prairie-chicken	*Tympanuchus cupido*	Vulnerable	Canada. *T. c. attwateri*: USA
Lesser prairie-chicken	*Tympanuchus allidicinctus*	Vulnerable	Not listed, USA candidate species (some U.S. states)

** No information for a few countries; therefore, lists may not be complete.*

3.1 Siberian Grouse

Scientific name:	*Dendragapus falcipennis*	Hartlaub, 1855
Synonyms:	*Falcipennis falcipennis, Tetrao falcipennis*	
Common names:	Lian chi ji	Chinese
	Siberian grouse, Siberian spruce grouse, sharp-winged grouse	English
	Tétras de Sibérie	French
	Sichelhuhn	German
	Dikusha	Russian
	Gallo siberiano	Spanish

Photo 3.1a Siberian grouse male. ***(Photo Franz Hafner).***

Photo 3.1b Siberian grouse female. ***(Photo Franz Hafner).***

Photo 3.1c Siberian Grouse male in captivity*. (Photo Franz Hafner).*

3.1.1. Conservation Status

IUCN 2006 (http://www.redlist.org/): Lower risk (near threatened).
CITES 2005 (http://www.cites.org/eng/app/index.shtml): not listed in Appendices.
National Red Data books: China and Russia.
The recent rate of habitat loss may possibly justify listing the species as threatened according to IUCN criteria (A. Andreev, pers. comm., 2005). A revision of status is recommended.

3.1.2. Taxonomy

No subspecies recognised. Despite recent phylogenetic studies that support the separation of the genera *Falcipennis*, with the species *F. falcipennis* and *F. canadensis*, and *Dendragapus* (Dimcheff at el. 2002, Drovetski 2002), BirdLife International currently classifies the Siberian grouse into the genus *Dendragapus* together with the spruce grouse (*D. canandensis)* and the blue grouse (*D. obscurus)*.

3.1.3. Distribution

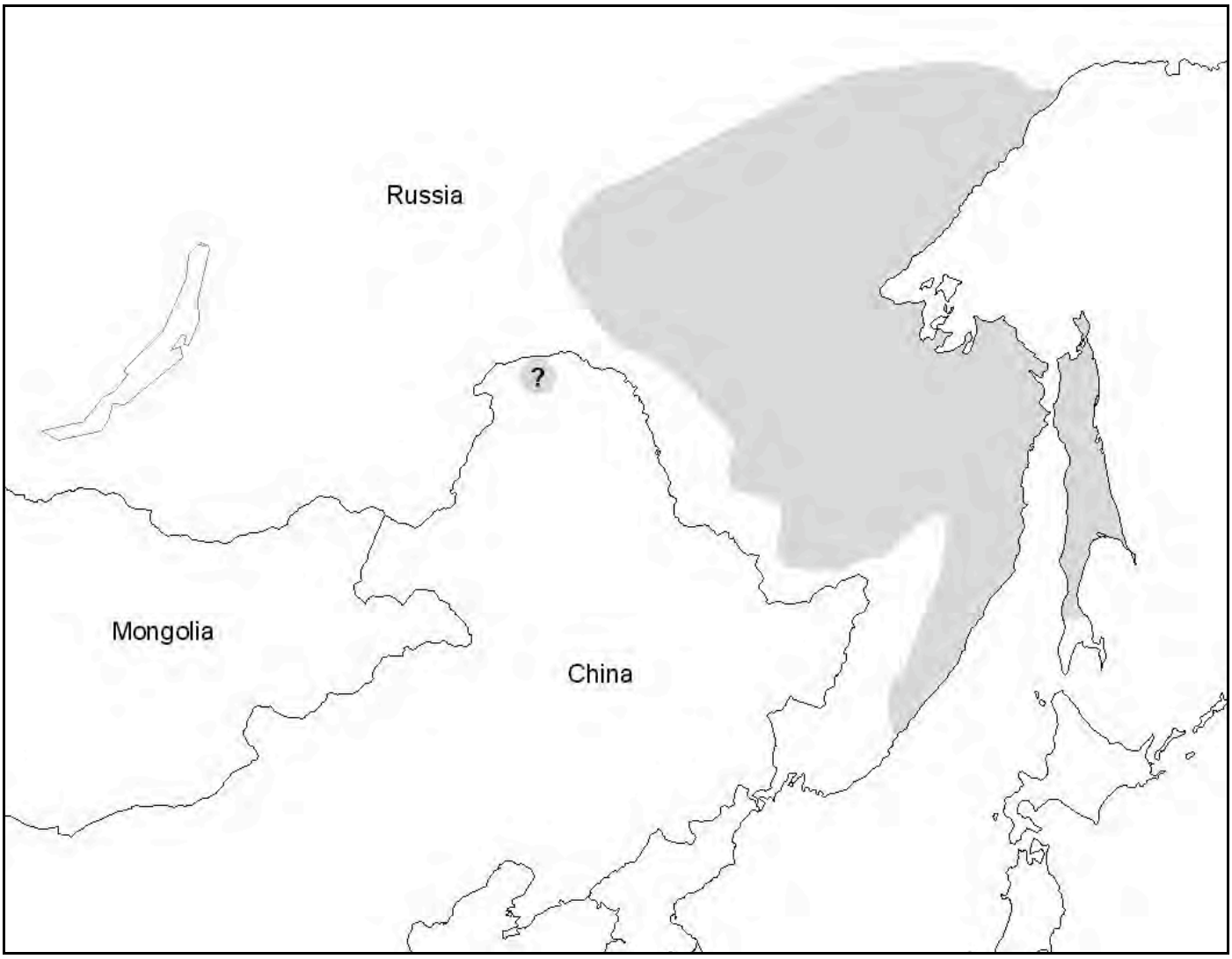
Russia; formerly occasionally in China. Resident in far eastern Russia from approx. 120°E. to the shores of the Sea of Okhotsk (Ayan) and the island of Sachalin south to the Sichote Alin mountains and north to approx. 57°N. In northernmost China, the species was found in the Chingang Mountains and in the low reaches of the Heilongjiang river valley in the late 1970s. Surveys between 1986-89 in these areas failed to confirm the species; present occurrence in China is unlikely; further surveys are planned (Sun pers. comm). A new distribution map is given by Klaus & Andreev (2003) showing a total range extent of 1 Million km^2.

3.1.4. Population Size and Trend

Few population estimates are available. They report low densities of between six and 25 birds per 100 km^2; these population densities may however be underestimates due to the species´ elusive behaviour (Potapov 1989). An intensive telemetry study in the late 1990s resulted in an average density of 6-8 birds per km^2 in the core habitats (Hafner and Andreev 1998, Andreev et al. 2001). It is assumed that the species has been declining since at least the 1970s due to increasing land use and forest exploitation (Potapov 1989, Flint 1995). The rate of decline is unknown (Hafner and Andreev 1998; F. Hafner, pers. comm., 1999, S. Klaus, pers. comm., 1999). The Russian Red data Book of 2000 (Nachev 2000) reports ongoing population declines.

3.1.5. Habitat and Ecology

The Siberian grouse mostly occurs in forests of spruce (*Picea jezoensis, P. abies)*, fir (*Abies nephrolepsis)*, larch (*Larix dahurica*), and pine (*Pinus koraiensis*) which characterise the Amurland taiga, the typical vegetation type of the region (see Klaus et al. 1995 for forest dynamics). Most descriptions of the habitat report mixed forests with at least some spruce



Map 3.1. Siberian Grouse distribution as assumed in 2003 (Klaus & Andreev 2003, in Martens et al. (Eds)).

and with dense understorey and ground vegetation. The species is not exclusively associated with mature coniferous forest but also uses young succession forest with as little as 5% spruce cover. Spruce needles are its exclusive winter food. Siberian grouse avoid open areas, the youngest stages of forest succession and pure deciduous forest. They are particularly susceptible to habitat changes related to forestry and to large-scale clearcutting. Therefore, the species is an indicator for the entire ecosystem, including the typical flora and fauna of the Ochotsk Taiga. Many other species as well as the Siberian grouse, will profit from long-term conservation of its habitat (see Hafner and Andreev 1998).

3.1.6. Hunting and Cultural Importance

Because of its elusive behaviour and the poor accessibility of its habitat, the Siberian grouse has never had any economic importance other than occasional hunting by locals. The species has been listed in the Russian red data book since 1978; hunting is prohibited. Nonetheless, Siberian grouse are occasionally hunted for food or used as bait by sable *Martes zibellina* trappers. The overall influence of hunting on population dynamics is considered to be low (Hafner and Andreev 1998).

3.1.7. Principal Threats

Socio-economic situation. The ongoing insecure socio-economic situation in Russia may pose significant threats to the Siberian grouse and its habitats. The demand for resources is great, both by the state and by local inhabitants. Timber exploitation is uncontrolled in many parts of far eastern Russia. Large, industrial clearcutting dominates and is often carried out by international joint-ventures or by foreign companies; however, large clearcuts were already common in soviet times. Private local Russian forestry enterprises are usually small and work with small clearcuts, or selectively cut the most valuable, mature trees. The future of the Siberian grouse will depend primarily on the socio-economic and political development in Russia. In China, agriculture and forestry may be degrading and threatening the species' habitat. It is doubtful, however, whether this species has occurred much further south of the present distribution, at least during the 20th century.

Forest exploitation. Habitat loss and deterioration related to forest exploitation are major threats to the Siberian grouse. The species disappears from areas with large-scale clearcutting. The purely deciduous secondary growth following clearcutting is unsuitable grouse habitat. Also, clearcuts are not usually replanted, are dominated by grasses, and their natural regeneration may take several decades during which they are unsuitable for Siberian grouse. Other cutting regimes with a smaller-scale mosaic of cut and uncut stands, however, may allow rapid regeneration and are therefore advantageous for the species (Hafner and Andreev 1998), because they resemble natural processes of forest regeneration.

Forest fires. Since the 1980s, forest fires caused by people

have significantly increased both in extent and frequency. Because of the great demand for forest products such as venison, fur, berries, herbs, mushrooms and medicinal plants such as ginseng, etc. for private consumption as well as for local and international markets, many people frequent the forests; most forest fires probably result from the local custom of burning grass in the spring (A. Andreev, pers. comm.. 2005). The prevention and fighting of forest fires is poor to absent, mostly due to a lack of funding for equipment, training and salaries. Siberian grouse do use succession forest after fire; however, they rely on conifers and if the frequency of fires is too high, conifers disappear from regenerating forests. In the southern part of the range, e.g. in the Sichote Alin mountains, forest regeneration after fire is exclusively deciduous and so unsuitable for Siberian grouse. Therefore, the populations in the south are probably more threatened than those in the north (F. Hafner pers. comm., 1999; see Klaus et al. 1995).

Exploitation. Besides the threats to its habitat, poaching for meat has become common practice in Russia, and law enforcement is generally poor. To what extent this situation is affecting the species is unclear. At least for their study areas, Hafner and Andreev (1998) believe that the influence of hunting on population dynamics is low.

3.1.8. Research Needs

The first systematic studies have been published in the late 1990s (see Hafner & Andreev 1998 and refs. therein). They have revealed important insights into life-history traits, behaviour, food habits, habitat use and spacing patterns. Many questions remain unanswered.

Habitat relationships. Siberian grouse occur in a great variety of habitat types. The principal structural and spatial habitat requirements are not yet understood. Research is recommended into habitat needs in different types of habitat to identify the key elements, including clarifying the factors determining the western and northern limits of the distribution.

Recolonisation after forest fires. Forest fires can result in major loss and fragmentation of Siberian grouse habitats, because many succession forests regenerating after fire are dominated by deciduous trees and therefore unsuitable for the grouse. It is important to understand the length of time needed for regenerating stands to be recolonised by the grouse. Therefore, surveys in regenerating succession forests of different ages are suggested. Differences between the northern (mixed regeneration) and southern (deciduous regeneration) parts of the range are to be expected.

Effects of forestry practices. Siberian grouse also occur in managed forests and in coniferous or mixed second-growth habitats. To better understand the effects of various forestry practices on the persistence and population density of Siberian grouse, a series of surveys is suggested in different types of managed forests with different cutting regimes, including both newly cut primary habitats as well as second-growth forests; also, populations should be monitored before and after cutting. The results will enable important advice to be given to the state forestry agencies and logging companies on how to integrate forestry operations and grouse habitat conservation.

3.1.9. Current Conservation Measures

Legal protection. In Russia and China, the Siberian grouse is Red-Listed and protected by law. Nevertheless, some illegal hunting occurs.

Protected areas. There are nine protected areas within the Russian range of the Siberian grouse, which exclude all human utilisation. These reserves are 570 – 8420km_ in area and are probably large enough to maintain viable populations of grouse (Hafner and Andreev 1998). According to Nechaev (2000), Siberian Grouse is under protection in the Sikhote-Alin, Komsomolsk, Zeya, Bureya, Dzhudzhur and Poronai Reserves (Zapovedniki) and in Game Reserves (Sakazniki), particularly in Tudrovyi Game Reserve and Severnyi Game Reserve on Sakhalin Island.In the Sichote Alin Mountains, the stronghold of the remaining population of Siberian tigers, anti-poaching units have been set up and a network of protected areas and habitat corridors has been created for tiger conservation, largely financed by international organisations. These measures may also secure some habitats of the Siberian grouse.

Captive breeding. The species successfully breeds at Novosibirsk Zoo (Nechaev 2000) and by some private breeders.

3.1.10. Priority Conservation Measures

The Siberian grouse is listed as a globally near threatened species. Therefore its conservation has high priority. A short summary of recommended conservation measures are given here. Recommendations for research and conservation priorities for the Siberian grouse are described in greater detail in Chapter 4.

Assessment of population trends and habitat loss. Distribution, population sizes and trends of the species are insufficiently known; surveys throughout the range are lacking. Most urgently, the rate of habitat loss and fragmentation due to clearcutting should be identified based on remote sensing techniques, in order to re-assess the threat category for the Siberian grouse according to IUCN criteria (see Appendix 2).

Effective fire control. Forest fires caused by people have increased both in extent and frequency. Fires may significantly change the structure and tree-species composition of forests, and may thus lead to the degradation, loss and fragmentation of grouse habitats. Measures should be taken to re-establish an effective fire-control system. Funding, equipment and training are needed.

Creation of protected areas. In the western part of the range, a large protected area should be created to preserve old-growth forest habitats, particularly along the Baikal-Amur Railway, on the Sikhote-Alin' Ridge and on Sakhalin Island (Nechaev 2000).

Integrate forest use with grouse conservation. As a first step towards the integration of forest use and grouse conservation, clearcuts larger than 0.05km² should be prohibited throughout the distribution range.

3.1.11. Recent changes

No new information available. The species account in the Russian Red Data Book (Nechaev 2000) confirms the situation outlined above. Major threats ongoing (habitat degradation due to logging, forest fires, roads construction, industrial development, illegal shooting and trapping). The recent rate of habitat loss may justify listing the species as threatened according to IUCN criteria (A. Andreev, pers. comm., 2005).

Table 3.1: Siberian grouse *Dendragapus falcipennis* Hartlaub, 1855

Country	Red list[1]	Legal protection[2]				Hunting[3]	Population[4]		Threats[5]							Conservation measures[6]						
		TP	PP	NT	IT		Size	Trend	S	F	H	P	E	D	C	O	S	M	H	C	R	E	O
China	x			X	x	-	?	?	x		x						x						
Russia	x	x				P	275,000?	-	x		x		x					x				x	

***1 Red list**: x listed as threatened species at the national level, - not listed*

***2 Legal Protection**: TP total protection, PP partial protection, NT possession and/or national trade prohibited or regulated, IT international trade prohibited or regulated*

***3 Hunting**: L legal, P poaching (illegal), R regionally restricted, S restricted hunting season, M males only*

4 Population size (order of magnitude): estimated number of individuals in spring;

***Population trend (during the past 10 years)**: + increasing, 0 stable or fluctuating, - declining, ? unknown*

***5 Threats (factors suspected to cause significant, longer-term population declines and extinction)**: S small population size, F habitat loss/fragmentation, H habitat degradation, P predation, E exploitation, D disturbance by tourism/leisure activities, C climate change, O other threats*

***6 Conservation measures (ongoing at the time of reporting)**: S surveys, M monitoring, H habitat management, C captive breeding, R restocking/reintroduction, E education, O other measures*

3.1.12. Correspondents

1999: Franz Hafner, Siegfried Klaus, Roald Potatpov, Yue-Hua Sun.

2005: Alexander Andreev, Siegfried Klaus, Roald Potatpov, Yue-Hua Sun.

3.1.13. Key Publications

Andreev A V, F Hafner, S Klaus & H Gossow (2001): Displaying behaviour and mating system in the Siberian spruce grouse *Falcipennis falcipennis* .-J. Orn. 142: 404-424.

Andreev AV 1990. The winter biology of Siberian spruce grouse (*Falcipennis falcipennis*) in Primorye. Zoologichesky Zhurnal 69 (3): 69-80.

Hafner, F. & Andreev, A. V. 1998. Das Sichelhuhn. Naturwissenschaftlicher Verein für Kärnten, Klagenfurt, Austria. 118 pp. (ISBN 3-85328-014-5) (in German with English summaries).

Klaus, S. & A. V. Andreev (2003): *Falcipennis falcipennis* (Hartlaub, 1855) Sichelhuhn. In Martens J., Eck S. and Sun Y.-H. (Editors), Atlas der Verbreitung paläarktischer Vögel. Lieferung 20 (2003), 6 pp.

Nachev, V.A. 2000. Dikusha [Siberian Grouse]. In: Krasnaya kniga Rossijskoi Federatsii (Zhivotnye) [Red Data Book of the Russian federation (Animals)]. Moscow, ACT Press-Astrel Press. Pp. 465-467. In Russian.

Potapov R.L. 1989. Gattung *Falcipennis* Elliot, 1864. In Potapov R.L. & Flint V.E. (Eds). *Handbuch der Vögel der Sowjetunion*. Volume 4, pp 117 – 126. Ziemsen Verlag Wittenberg Lutherstadt, Germany. (ISBN 3-7403-0027-2).

For an extended list of references on the species see Hafner and Andreev 1998. All publications referred to in the text are listed in the References section.

3.2 Spruce Grouse

Scientific name:	*Dendragapus canadensis*	Linnaeus, 1758
Synonyms:	*Falcipennis canadensis, Canachites canadensis*	
Common names:	Spruce grouse	English
	Tétras du Canada	French
	Fichtenhuhn	German
	Gallo canadiense	Spanish

Photo 3.2a Male spruce grouse displaying (taiga subspecies) in Alberta. *(Photo Michael Schroeder).*

Photo 3.2b Male spruce grouse displaying (Franklin's subspecies) in Washington. *(Photo Michael Schroeder).*

3.2.1. Conservation Status

IUCN 2004 (http://www.redlist.org/): Lower risk (near threatened).
CITES 2005 http://www.cites.org/eng/app/index.shtml): not listed in Appendices.
National Red Data books: listed in several states of the eastern US.

3.2.2. Taxonomy

The taxonomy of the spruce grouse has long been under debate. Sibley and Monroe (1991) and Boag and Schroeder (1992) placed the species in the genus *Dendragapus* and accepted only two subspecies, which are well differentiated based on plumage and behaviour: the south-western *D. c. franklinii* and the more broadly distributed north-eastern *D. c. canadensis*. Later, del Hoyo et al. (1994) and the American Ornithologists´ Union (1998) listed the spruce grouse as *Falcipennis canadensis* and recognise two groups of subspecies, the *F. c. canadensis*-group with five subspecies and the *franklinii*-group with *F. c. franklinii*, for which a new subspecies *F. c. isleibi* has recently been proposed for the Prince of Wales and nearby islands of the Alexander Archipelago (Gustafson 1994, Dickerman and Gustafson 1996).

In this Action Plan, we follow BirdLife International in placing the spruce grouse in the genus *Dendragapus*, although recent phylogenetic studies support the separation of the genera *Falcipennis,* with the species *F. falcipennis* and *F. canadensis* from *Dendragapus* (Dimcheff et al. 2002, Drovetski 2002).

Photo 3.2.c Spruce grouse male in autumn. *(Washington State, Sept. 2003. Photo Michèle Loneux).*

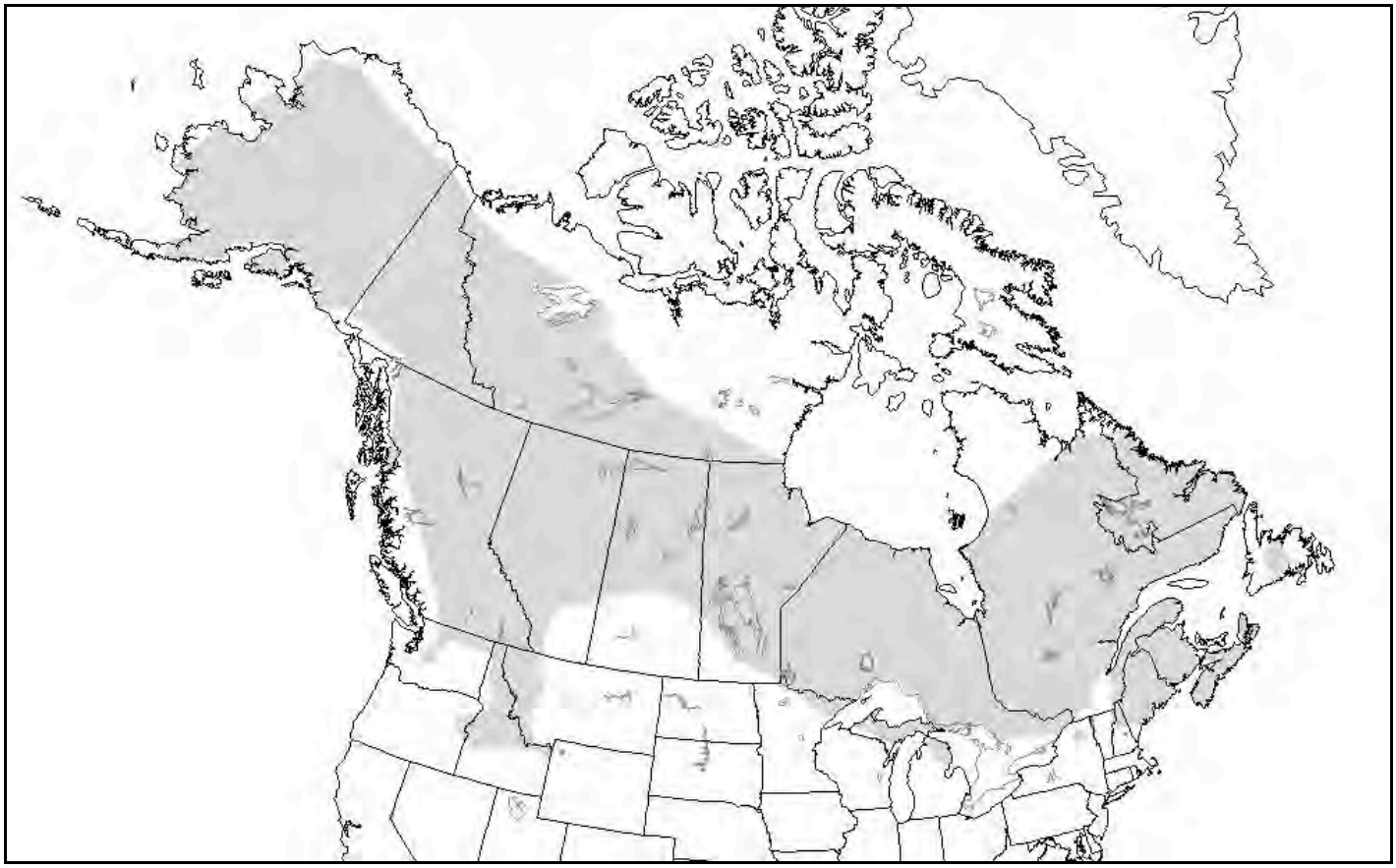
Photo 3.2.d Female spruce grouse (Franklin's subspecies) in Alberta. *(Photo Michael Schroeder).*

3.2.3. Distribution

Throughout northern North America. The range extends from Alaska to Labrador and south into New England and the northern states of the western USA. *D. c. franklinii* occupies the montane forests of the cordilleras of the south-west, and *F. c. canadensis* the remaining northern taiga. Spruce grouse are mostly sedentary with some restricted, undirectional movements between individual summer and winter habitats.

3.2.4. Population Size and Trend

Spruce grouse are widespread and still fairly common throughout most of their original range. Some localised habitat loss and range contractions due to logging have been



Map 3.2 Spruce grouse distribution

observed along southern limits. Estimated densities are commonly below 10 birds per km², but range to over 50 in Ontario (D. Keppie, pers. comm., 1999). Populations may markedly fluctuate between years. Spruce grouse in the temperate rainforest of southeast Alaska appear to be living in isolated and scattered low-density populations. (Compare Boag and Schroeder 1992.)

3.2.5. Habitat and Ecology

The spruce grouse uses a wide range of conifer-dominated forest habitats from sea level to >3600 m in elevation. Over most of its range, it uses spruce and pine-dominated seral stages following fire and other disturbance, and unburned patches of wet spruce forest. In the breeding season, spruce grouse also use open subalpine parklands with widely scattered trees in western mountains (F. Zwickel, pers. comm., 1999). A widespread structural attribute of spruce grouse habitats are branches and/or subordinate trees or shrubs in the range of 2-8 m above ground (D. Keppie, pers. comm., 1999). Short-needled pines and spruce needles are the exclusive winter food. They generally prefer relatively young (<30 years), dense forests with a well-developed middle storey. In the snow-free seasons, spruce grouse feed on ericaceous shrubs and various other plants and typically forage alone on the ground; during winter they may form loose flocks of up to 30 birds. Their association with conifer forest may be less close during periods of dispersal and migration, and the birds may occasionally be found several kilometres from the next coniferous habitat. (See Boag and Schroeder 1992.)

3.2.6. Hunting and Cultural Importance

The spruce grouse is commonly hunted although to most hunters it is an occasional prey rather than a major game species. Annual hunting bags comprised some 500,000 birds

Photo 3.2.b Spruce grouse juvenile. ***(Washington State, Sept. 2003. Photo Michèle Loneux)***

in the late 1970s. The impact of hunting on population is generally considered to be low. Spruce grouse populations, however, may rapidly decline near advancing roads and settlements due to over-exploitation.

3.2.7. Principal Threats

Habitat degradation. Spruce grouse rely on conifer forests. A mosaic of older coniferous habitats interspersed with burned, regenerating patches support high grouse densities. Changes in forest structure, e.g. the loss of softwood patches due to forest harvesting and fire suppression, may lead to population declines. Logging may result in temporary, local extinctions.

In a large, empirical study in the spruce/pine forests of central British Columbia, Harrison (2001) studied the effects of forest connectivity on the natality, movement, dispersal and survival rates of spruce grouse. The 4,160-km² study area had no human settlements, no agriculture and no

ranching. Clear-cut logging was the predominant human influence. Harrison (2001) radio-tagged 253 spruce grouse in eight 100-ha connectivity treatment units (4 low connectivity and 4 high connectivity). Although spruce grouse densities were not different between the low- and high-connectivity sites, juveniles living in, and dispersing from, the low-connectivity sites had significantly lower survival rates due to increased predation risk from raptors. Modelling these empirical data revealed that the spruce grouse population appeared stable with similar densities among sites because of source-sink dynamics. The model also indicated that further loss of high connectivity in the study area would lead to population decline.

Small population size. Along the limits of the its range, spruce grouse live in scattered low-density populations, in highly isolated patches of spruce forest, e.g. in southeast Alaska, New York, Maine and Vermont. The total population of the newly proposed subspecies *F. c. isleibi* is considered to be low, but its population status is unknown (J. Gustafson, pers. comm., 1999). Isolated, small populations are particularly vulnerable; the advance of new roads and settlements may reduce the exchange between neighbouring populations, making it difficult for isolated populations to recruit new breeders.

3.2.8. Research Needs

Over major parts of the range, little is known about the local subspecies and populations. In particular, the specific life-history traits and habitat requirements of the *franklinii* populations in southeast Alaska are poorly understood. In some localities, more research is needed regarding densities and trends of populations in relation to current and cumulative habitat modifications, such as habitat losses and the development of interconnected road systems. In the south, the capability of timber management interventions to produce the stand structure that the birds use, needs to be determined.

3.2.9. Current Conservation Measures

Legal protection. The spruce grouse is partially protected throughout its range; hunting is regulated by defined seasons and bag limits.

Habitat preservation. In Vermont, the state is actively engaged with the industrial landowner in some timber management planning and harvesting to foster better forest structure in the small area in which the bird occurs (D. Keppie, pers. comm., 1999).

Education. There are some regional and local public education programmes on spruce grouse along the southern distribution limits. In New York, there is public education for landowners in the Adirondacks region about the bird's endangered status. In Wisconsin, there is a local group (Fool-hen's Forever) trying to encourage naturalists to see the bird (D. Keppie, pers. comm., 1999).

3.2.10. Priority Conservation Measures

Habitat and forestry. Because so little is known about the species from much of the range, research into the effects of man-made habitat alterations appear most important; guidelines should be developed on how to integrate habitat conservation with forest utilisation practices.

Monitoring. Species-specific counting methods (Schroeder and Boag 1989, Keppie 1992) and monitoring schemes should be developed and applied in localities where populations appear to be declining or threatened.

Protected areas. In some locations where spruce grouse appear to be threatened by advancing forest exploitation, protected areas may be important for the long-term survival of highly isolated and scattered low-density populations; e.g. in south-east Alaska (J. Gustafson, pers. comm., 1999). Others, however, caution that protected areas may not be the best tool for spruce grouse conservation because the species favours diverse forest age structures and is most abundant in young, upland stands (D. Keppie, pers. comm. 1999).

3.2.11. Recent Changes

Declining in parts of the range due to continued loss of connected, structurally complex, old forests through logging.

3.2.12. Correspondents

1999: David Boag, Jack Gustafson, Scott Harrison, Dan Keppie, Amy Russell, Mike Schroeder, Loren Smith, and Fred Zwickel.

2004: Scott Harrison.

3.2.13. Key Publications

Harrison, S. 2001. Effects of forest connectivity on ecological processes: using spruce grouse as a model system. Ph.D. thesis. University of British Columbia, Vancouver, Canada.

Boag, D. A. and Schroeder, M. A. 1992. Spruce grouse. *The birds of North America*, No. 5. The birds of North America, Inc., Philadelphia, PA.

For an extended list of references on the species see Boag and Schroeder 1992. All publications referred to in the text are listed in the References section.

Table 3.2: Spruce grouse *Dendragapus canadensis* Linnaeus, 1758

Country	Red list[1]	Legal protection[2]				Hun-ting[3]	Population[4]		Threats[5]								Conservation measures[6]						
		TP	PP	NT	IT		Size	Trend	S	F	H	P	E	D	C	O	S	M	H	C	R	E	O
Canada	-	x	x	x	x	L, S, R	>1 million	?	x	x	x							x				x	
USA	-	x	x	x		L, S, R	?	?	x	x	x							x				x	

***1 Red list**: x listed as threatened species at the national level, - not listed*

***2 Legal Protection**: TP total protection, PP partial protection, NT possession and/or national trade prohibited or regulated, IT international trade prohibited or regulated*

***3 Hunting**: L legal, P poaching (illegal), R regionally restricted, S restricted hunting season, M males only*

4 Population size (order of magnitude): estimated number of individuals in spring;

***Population trend (during the past 10 years)**: + increasing, 0 stable or fluctuating, - declining, ? unknown*

***5 Threats (factors suspected to cause significant, longer-term population declines and extinction)**: S small population size, F habitat loss/fragmentation, H habitat degradation, P predation, E exploitation, D disturbance by tourism/leisure activities, C climate change, O other threats*

***6 Conservation measures (ongoing at the time of reporting)**: S surveys, M monitoring, H habitat management, C captive breeding, R restocking/reintroduction, E education, O other measures*

3.3 Blue Grouse:
now dusky grouse and sooty grouse.

Scientific name:	*Dendragapus obscurus*	Say 1823
Common names:	Blue grouse	English
	Tétras sombre	French
	Gallo azul	Spanish

Photo 3a Dusky Grouse (formerly Blue grouse *Dendragapus o. obscurus*), male displaying. *(Southwestern Alberta, Photo Michael Schroeder).*

Photo 3.3c. Dusky Grouse female. *(Wyoming, Photo Michael Schroeder).*

3.3.1. Conservation Status

IUCN 2006 (http://www.redlist.org/):
Lower risk (near threatened).
CITES 2005 (http://www.cites.org/eng/app/index.shtml): not listed in Appendices.
National Red Data books: not listed.

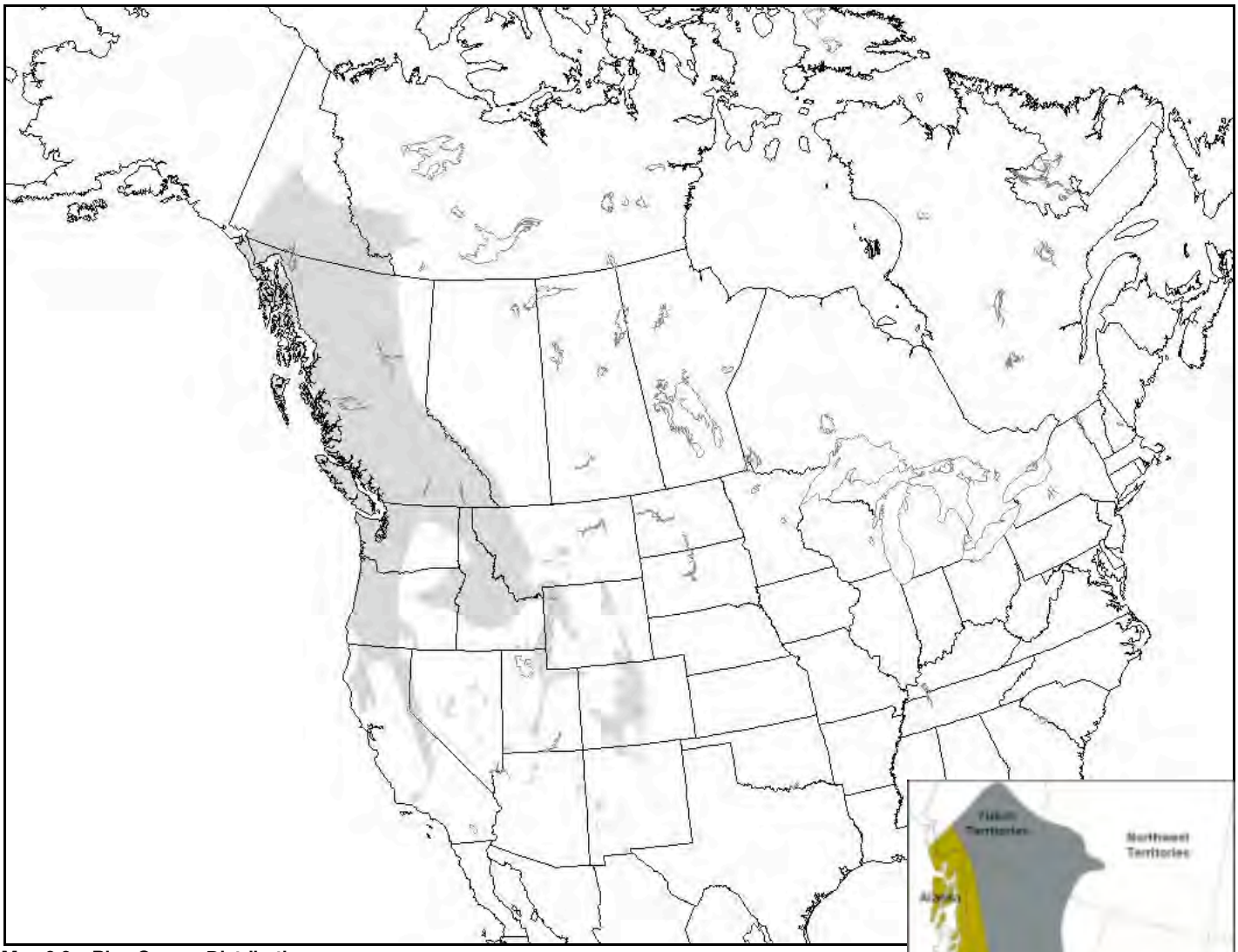
Photo 3.3b. Sooty Grouse (formerly Blue grouse Dendragapus o. fuliginosus), male displaying. (Western Washington, Photo Michael Schroeder).

Photo 3.3d Blue Grouse male. *(Wyoming. Photo Ilse Storch).*

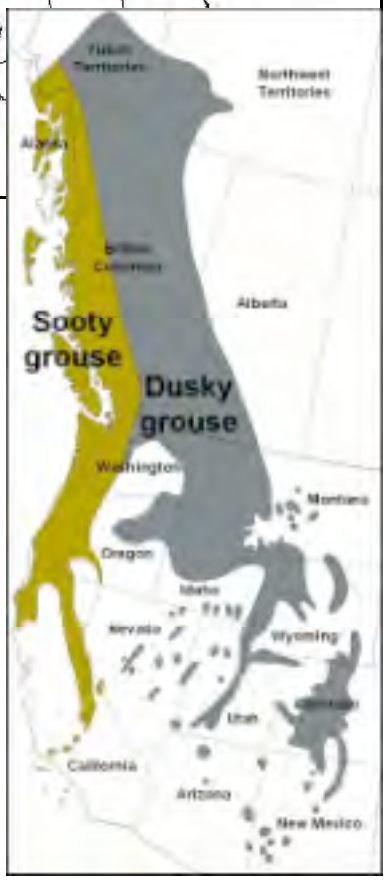
3.3.2. Taxonomy

Eight subspecies are recognised (Potapov and Flint 1989; del Hoyo 1994); the four coastal subspecies are morphologically and geographically distinct from the four interior subspecies. Recent genetic studies reported three clades corresponding to the parapatric sooty (*D. o. fuliginosus*) and dusky (*D. o. obscurus*) subspecies groups plus a previously unrecognized division between northern and southern dusky grouse populations; the latter does not correspond closely to any currently recognized subspecies boundary. Genetic, morphological and behavioural evidence suggest that sooty and dusky grouse are species-level taxa; the specific status of a third clade remains ambiguous (Barrowclough et al. 2004).

In mid 2006, the American Ornithologist's Union (AOU) split the blue grouse into two species: the dusky grouse *Dendragapus obscurus* and the sooty grouse *Dendragapus fuliginosus* (Banks et al. 2006). BirdLife has adopted the AOU's suggestion in its 2007 Red list update.



Map 3.3a. Blue Grouse Distribution.



Map 3.3b. Detailed distribution of the Sooty and Dusky grouses. ***(Source Michael Schroeder, based on Zwickel and Bendell's book 2004 and modifications based on Banks et al. 2006.)***

3.3.3. Distribution

Western North America from about 33° to 63° N. and 105° to 138° E.; mountainous areas and coastal islands. Most populations are locally migratory

3.3.4. Population Size and Trend

Blue grouse still occupy most of their original range with some local extinctions due to urban development and agriculture. The species is common throughout its range with spring densities of about 10 adult males per km_ in the interior, and mostly between 10-30, but also up to 100, in the coastal populations; however, there are also vast areas where the species is absent or occurs at very low densities. Generally, there is greater variation among populations and years in the coastal than in the interior populations. Populations may greatly increase after fires or clear-cutting, and rapidly decline as the tree canopy closes. The subspecies *howardi* in southern California is now absent from parts of its former range and may be threatened due to small population size (see Zwickel 1992, Zwickel and Bendell 2004).

3.3.5. Habitat and Ecology

Blue grouse use a wide range of habitats from sea level to >3600 m in elevation, and from coastal rainforest to shrub and steppe high desert and subalpine and alpine tundra, often moving from summer to winter quarters. They inhabit montane forests with relatively open canopies, forest edge habitats including shrub or grassland up to 2km from the forest edge, and subalpine-alpine ecotones. From north to south, they inhabit some of the coldest and some of the hottest montane habitats of North America. The coastal subspecies also inhabit lowland forests. Aspen communities, especially where they interface with mountain shrub and grassland habitats, are important breeding areas for interior races of blue grouse. Almost all populations winter in conifer forest where conifer needles are the main winter food. In

part, the distribution of blue grouse appears to be determined by the interspersion of breeding habitats with a well-developed herb, grass and shrub layer and montane coniferous winter habitats. Many but not all populations breed at lower elevations and winter at higher elevations. Some coastal populations, but less so the inland races, may rapidly increase in numbers following large-scale clear-cutting that may create suitable breeding habitats; populations will decline as the canopy closes. Availability of breeding habitat may in these circumstances be more limiting than availability of winter habitat (see Zwickel 1992, Zwickel and Bendell 2004).

3.3.6. Hunting and Cultural Importance

The blue grouse is a popular game bird throughout its range. It is shot in autumn both for sport and food; hunting bags comprised some 500,000 birds in the late 1970s. Banding studies suggest that the impact of hunting on the populations is low; apparently, the autumn migration to often poorly accessible winter ranges limits the impact of hunting.

3.3.7. Principal Threats

Habitat degradation. A rugged mountainous habitat has helped to protect the species and the long-term perspective for many populations is good. Nevertheless, habitat loss and degradation remain threats. Logging at higher elevations is increasing and may negatively impact winter ranges. In general, however, the effects of forestry practices on blue grouse are poorly understood. Grazing by domestic livestock in breeding ranges, particularly in shrub and steppe habitats, may affect reproduction. Fire suppression may lead to the loss of aspen communities and thus important breeding habitats; this particularly affects the inland races of blue grouse. Urban development may lead to local habitat loss and population declines (see Zwickel 1992, Zwickel and Bendell 2004).

Oil and gas exploitation. In recent years, oil and gas exploration and development have increased as potential threats to breeding habitat for interior races of blue grouse (R. Hoffmann, pers. comm., 2005).

3.3.8. Research Needs

Despite some 40 years of study, the ability to predict population levels and trends is still limited. Long-term, basic research is needed with mission-oriented studies applied to immediate management problems. In particular, the effects of forest management and the impact of grazing on population dynamics need to be better understood in order to integrate habitat conservation and land use practices.

3.3.9. Current Conservation Measures

The blue grouse is partially protected throughout its range; hunting is regulated by defined seasons and bag limits. There are some limited monitoring and habitat preservation programmes.

3.3.10. Priority Conservation Measures

Integrating habitat preservation and forestry practices is the most important conservation need for the species throughout its range, and particularly in breeding habitats.

3.3.11. Recent Changes

In mid 2006, the AOU split the blue grouse into two species: dusky grouse (*Dendragapus obscurus*) and sooty grouse (*Dendragapus fuliginosus*) (Banks et al. 2006).

3.3.12. Correspondents

1999: Jim Bland, Jack Gustafson, Rick Hoffman and Fred Zwickel.
2006: J. W. Connelly, Rick Hoffman, Michael Schroeder.

3.3.13. Key Publications

Zwickel, F. C. 1992. Blue grouse. The birds of North America, No. 15. The birds of North America, Inc., Philadelphia, PA.

Zwickel, F. C., and J. F. Bendell. 2004. Blue grouse: their biology and natural history. NRC Research Press, Ottawa, Ontario, Canada. 284.

Barrowclough GF, Groth JG, Mertz LA, Gutierrez RJ 2004. Phylogeographic structure, gene flow and species status in blue grouse (*Dendragapus obscurus*). Molecular Ecology 13: 1911-1922.

Banks R.C., C. Cicero, J.L. Dunn, A.W. Kratter, P.C. Rasmussen, J.V. Remsen Jr, J.D. Rising and D.F. Stotz. 2006. Forty-Seventh Supplement to the American Ornithologists' Union Check-List of North American Birds. The Auk 123(3):926–936.

For an extended list of references on the species see Zwickel (1992) and Zwickel and Bendell (2004). All publications referred to in the text are listed in the References section

Table 3.3: Blue grouse *Dendragapus obscurus* Say, 1823

Country	Red list[1]	Legal protection[2]				Hunting[3]	Population[4]		Threats[5]								Conservation measures[6]						
		TP	PP	NT	IT		Size	Trend	S	F	H	P	E	D	C	O	S	M	H	C	R	E	O
Canada	-		x			L, S	600,000	-	x	x	x						x	x	x				
USA	-		x			L, S	400,000	-	x	x	x						x	x	x				

1 Red list: x listed as threatened species at the national level, - not listed

2 Legal Protection: TP total protection, PP partial protection, NT possession and/or national trade prohibited or regulated, IT international trade prohibited or regulated

3 Hunting: L legal, P poaching (illegal), R regionally restricted, S restricted hunting season, M males only

4 Population size (order of magnitude): estimated number of individuals in spring;
Population trend (during the past 10 years): + increasing, 0 stable or fluctuating, - declining, ? unknown

5 Threats (factors suspected to cause significant, longer-term population declines and extinction): S small population size, F habitat loss/fragmentation, H habitat degradation, P predation, E exploitation, D disturbance by tourism/leisure activities, C climate change, O other threats

6 Conservation measures (ongoing at the time of reporting): S surveys, M monitoring, H habitat management, C captive breeding, R restocking/reintroduction, E education, O other measures

3.4 Willow Ptarmigan

Scientific name:	*Lagopus lagopus*	Linnaeus 1758
Synonyms:	*Tetrao lagopus, Tetrao albus, Lagopus albus*	
Common names:	Liu lei niao	Chinese
	Willow ptarmigan, willow grouse	English
	Red grouse (*L. l. scoticus*)	
	Riekko	Finnish
	Lagopède des saules *(L. l. lagopus)*	French
	Lagopède d'Ecosse (*L. l. scoticus)*	
	Moorschneehuhn	German
	Lirype	Norwegian
	Belaya kuropatka	Russian
	Lagopodo comun	Spanish
	Dalripa	Swedish

Photo 3.4a Willow ptarmigan in spring. *(Photo Hans Aschenbrenner).*

Photo 3.4b Male willow ptarmigan in summer in central Alaska. *(Photo Robert E. Bennetts).*

3.4.1. Conservation Status

IUCN 2006 (http://www.redlist.org/): Lower risk (near threatened).
CITES 2005: not listed in Appendices (http://www.cites.org/eng/append/appendices.shtml)
National Red Data books: listed in some European countries and China.

3.4.2. Taxonomy

Numerous subspecies have been described by various authors; their validity needs evaluation. Johnsgard (1983) lists 16, Potapov and Flint (1989) recognise 15, and del Hoyo et al. (1994) suggest 19 subspecies worldwide. Hannon et al. (1998) describe six subspecies for North America.

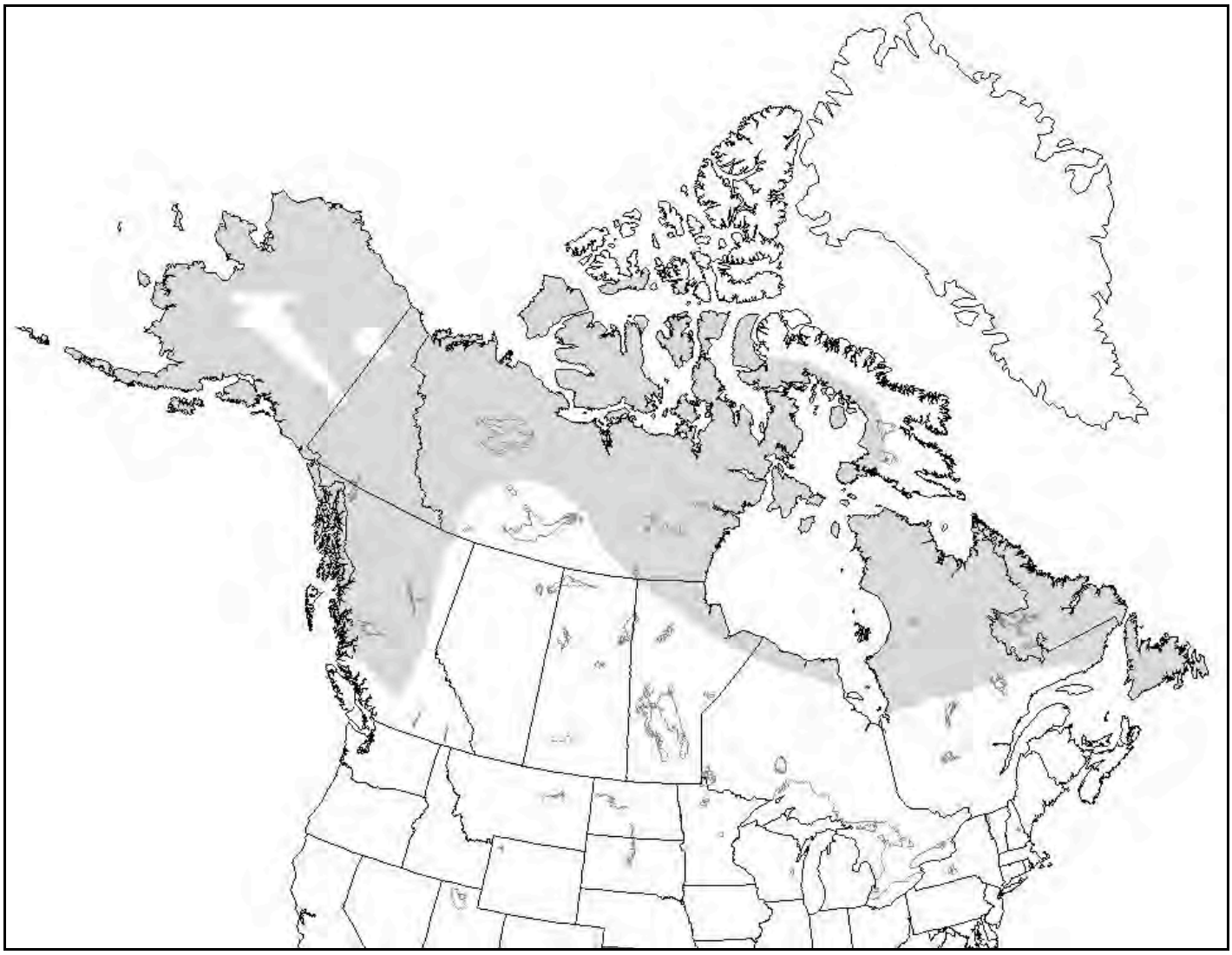
3.4.3. Distribution

Circumpolar. Arctic, subarctic and subalpine tundra of North America and northern Eurasia, and heather moorland in Britain. The northernmost extension of the range is at 76°N., the southern distribution limits vary between 47° and 62°N. In winter, the species may occur both lower in altitude and latitude than the breeding range. Most populations winter within their breeding range; however, in the northernmost parts of the range and in years with high population density, some winter flocks migrate up to 200km (Russia) and up to 1000km (North America) south of the breeding range. Many populations are locally migrant. The willow ptarmigan has the largest distribution area of all grouse species (see Potapov and Flint 1989, Sablevicius 1997, Hannon et al. 1998).

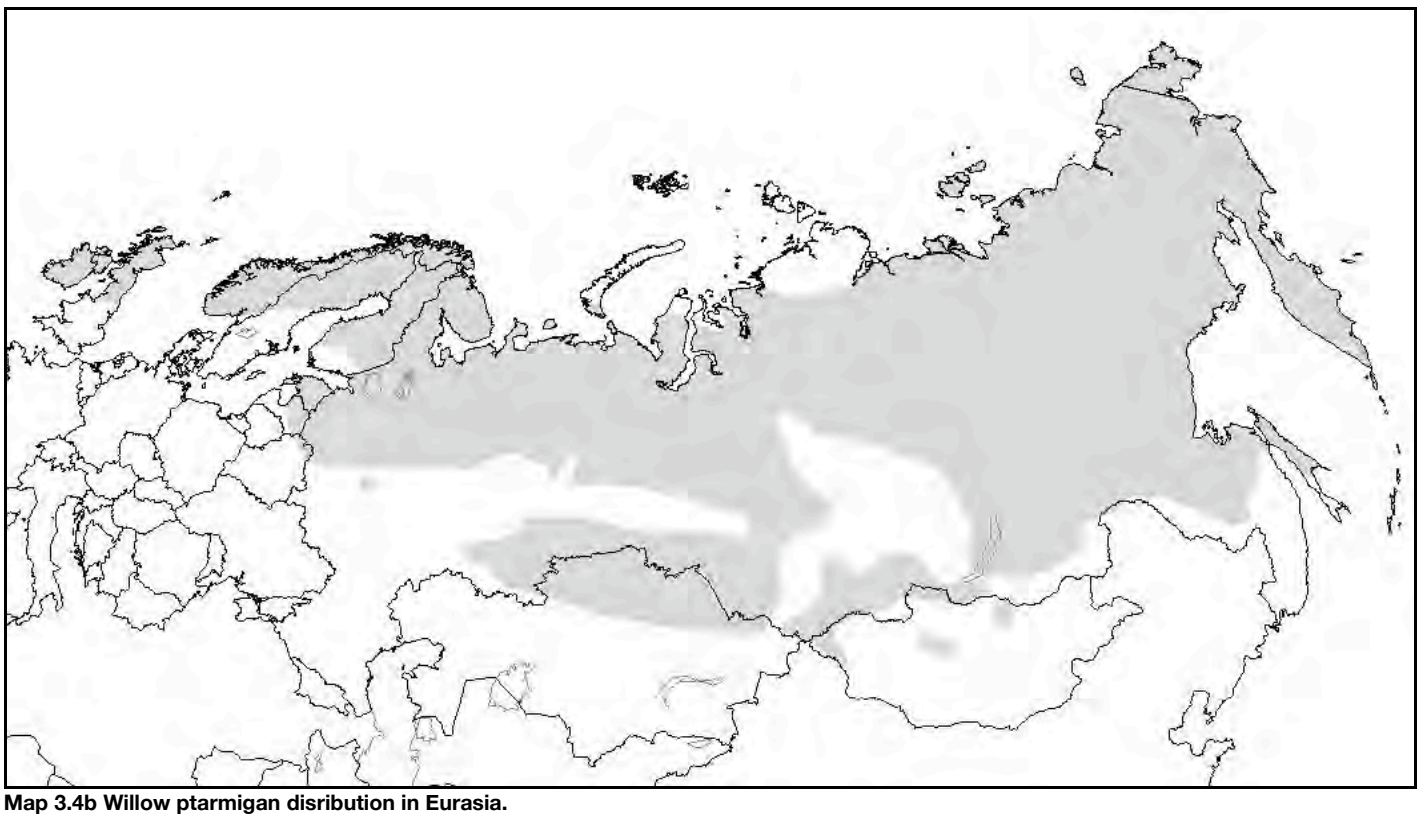
The willow ptarmigan is widespread and common in many parts of its extensive range. Populations fluctuate in number and are regionally cyclic in 3-4 year (Eurasia) or 8-10-year (North America) cycles (Lindén and Pedersen 1997). In Canada, local spring densities vary between <1 to >200 birds per km^2; in the Russian tundra, densreach 20-30 and up to 60 pairs per km^2 (see Potapov and Flint 1989, Hannon et al. 1998). For Britain, breeding densities may reach a maximum of 115 pairs per km^2 in areas intensively managed for grouse (Hudson and Rands 1988). In Fennoscandia, breeding densities may reach > 100 pairs per km^2 on some islands in Northern Norway, whereas more average values for Scandinavia are 5-10 pairs per km^2 (Lindén and Pedersen 1997). Some range contractions have been recorded in parts of Europe (Baltic countries, Belarus) and in central Asia (steppes of Kazakhstan and south-west Siberia).

3.4.5. Habitat and Ecology

The willow ptarmigan inhabits primary Arctic tundra, clearings in boreal forest, forest edge habitats and subalpine vegetation. They prefer moderately moist lowland areas rich in low willows (*Salix)* or birches (*Betula)* and ericaceous shrubs, mosses, grasses and herbs, and more rarely use steep slopes, rocky areas and lichen-rich tundra. In winter,



Map 3.4a Willow ptarmigan distribution in North America.



Map 3.4b Willow ptarmigan disribution in Eurasia.

the birds prefer valley bottoms and riparian habitats with dense cover of willows, birches, alder, aspen or conifers. In some regions, willow ptarmigan use farmland to some degree. The willow ptarmigan generally occurs at lower elevations and in wetter habitats with denser vegetation than the rock ptarmigan *L. muta*, when both species occur in sympatry. Where all three *Lagopus* species occur, e.g. in the Yukon, Alaska and parts of British Columbia, the white-tailed ptarmigan *L. leucura* is found at the highest elevations (see Potapov and Flint 1989, Hannon et al. 1998).

3.4.6. Hunting and Cultural Importance

The willow ptarmigan is hunted throughout its range, except for the Baltic countries, Belarus and China, where it is fully protected. At least regionally, it is a game bird of great cultural and economic importance. The willow ptarmigan (called willow grouse in Europe) is the most numerous grouse species in the bag of British, Fennoscandian and Russian hunters. Estimates of annual harvest are 1.2 million in the Russian tundra (Grabuzov 1995) and >600,000 in both Britain and Fennoscandia (del Hoyo et al. 1994; H.C. Pedersen, pers. comm., 2005). The habitats of the British subspecies *scoticus*, the "red grouse", are intensively managed to produce high densities for sport hunting. The species is hunted for both sport and food in northern Europe and America, and primarily for food in eastern Europe and Asia.

3.4.7. Principal Threats

Habitat degradation. Willow ptarmigan habitats are generally well protected by their remoteness. Locally, habitats may be affected by settlements, military bases, roads, mining, afforestation, cultivation and other human activities. Road construction increases the accessibility of willow ptarmigan habitats and may result in increased hunting pressure (North America, Russia, Scandinavia). Forestry practices were reported to impact habitats negatively in Finland.

Small population size. In some areas at the edge of the range, some local populations may be threatened by their small size in possibly suboptimal habitats (e.g. Baltic countries).

Collisions. In Scandinavia, collisions with high-tension power lines and reindeer fences may kill significant numbers of willow ptarmigan, e.g. ≥100,000 annually have been estimated to be killed in this way in Norway (H.C. Pedersen, pers. comm., 1999, see Bevanger 1995, Bevanger and Brøseth 2000). In Scotland, many birds die from collisions with deer fences (Baines and Summers 1997).

3.4.8. Research Needs

The willow ptarmigan has received much more attention in research than the other *Lagopus* species, especially work related to behaviour, population dynamics and cycles, and predator-prey and host-parasite relationships (see Hudson 1992, Hannon et al. 1998 and refs. therein). Clarification of the taxonomic relationships within the species is needed. Causes of cyclic population fluctuations are still not fully understood. In a conservation context, a better understanding of the effects of hunting and habitat alteration on population dynamics is desirable. There is a lack of understanding of migration and dispersal behaviour in relation to landscape patterns and their effects on population and metapopulation dynamics. The ability of the species to cope with climate warming in some parts of its range is also an area in need of research.

Photos 3.4c & 3.4d Male Red grouse in spring, Scotland *(April 2003. Photos Michèle Loneux).*

3.4.9. Current Conservation Measures

Legal protection. In most of the range, setting of hunting seasons and bag limits is the only management activity.

***Protected areas*.** Only a minor proportion of the range is covered by protected areas; their role for the species was generally considered to be minimal (source: questionnaires).

***Surveys and monitoring*.** In parts of the range, surveys and monitoring are restricted to the local scale. In Canada, monitoring is restricted to several sites in British Columbia and the Yukon. In Norway several populations are regularly monitored, whereas in other parts of Fennoscandia and Britain, only some populations are monitored.

Habitat improvement. In Britain, the heather moorland habitat of the red grouse is intensively managed to maintain high population densities of grouse for sport hunting. The major measure is burning to produce a mosaic of different ages of heather-dominated vegetation. Additional measures are predator and disease control. Management for red grouse has a long tradition and a great cultural and economic importance in Britain, and has increased grouse population densities well above natural levels in many places (see Hudson 1992 and refs. therein). Habitat management by burning also reported for Ireland, Newfoundland and Labrador.

3.4.10. Priority Conservation Measures

Due to the vast range and secure status of the species, conservation needs are local. Population monitoring to ensure sustainability of exploitation is recommended in areas with potentially high hunting pressures.

3.4.11. Recent changes

Population trends are unknown for major parts of the range due to lack of data. In Canada, there is some concern about disturbance by snowmobiles and all-terrain vehicles. The impact of climate change is unknown, but specialists expressed concerns that there might be an effect. In Finland, southernmost populations at the edge of the range are continuously declining.

3.4.12. Correspondents

1999: Ayurzanyn Bold, Volodymyr Domashlinets, David Jenkins, Harto Lindén, Kathy Martin, David Mossop, David Newborn, Hans-Christian Pedersen, Roald Potatpov, Torstein Storaas, Sun Yue-Hua, Ene Vith, and Fred Zwickel.

2004: David Baines, Susan Hannon, Pär Jacobsson and Jacob Höglund, Pekka Helle, Kathy Martin, Tatiana Pavlushchick, Hans-Christian Pedersen, John O´Halloran, Roald Potapov, Yue-Hua Sun, Ene Vith.

3.4.13. Key Publications

Bevanger, K. 1995. Estimates and population consequences of tetraonid mortality caused by collisions with high tension power lines in Norway. J. Appl. Ecol. 32: 745-753.

Bevanger, K. and Brøseth, H. 2000. Impact of power lines on bird mortality in a subalpine area. Animal Biodiversity and Conservation 27.2: 67-77.

Hannon, S.J., P. Eason and K. Martin. 1998. The Willow Ptarmigan. In 'The Birds of North America'. No. 369, (A. Poole and F.Gill, eds). The Birds of North America, Inc., Philadelphia, PA.

Hudson, P.J. 1992. Grouse in space and time. The population biology of a managed gamebird. Game Conservancy Ltd., Fordingbridge, UK.

Lindén, H. and Pedersen, H.C. 1997. Willow grouse, *Lagopus lagopus*. In: Hagemeijer, W. J. M. and Blair, M. J. (red.). The EBCC Atlas of European Breeding Birds: Their Distribution and Abundance. Pp. 196-197. T & A D Poyser, London.

Martin, K. and K. L. Wiebe. 2004. Coping mechanisms of alpine and arctic breeding birds: extreme weather and limitations to reproductive resilience. Integrative and Comparative Biology 44:177-185.

Potapov R.L. 1989. Gattung *Lagopus* Brisson, 1760. In Potapov R.L., Flint V.E. (Eds). Handbuch der Vögel der Sowjetunion. Ziemsen Verlag Wittenberg Lutherstadt, Germany. Volume 4, pp. 126–150.

Sandercock, B.K., K. Martin, and S.J. Hannon. 2005. Life history strategies in extreme environments: comparative demography of arctic and alpine ptarmigan. Ecology. 86: 2176-2186.

For an extended list of references on the species see Potapov and Flint (1989) and Hannon et al. (1998). All publications referred to in the text are listed in the References section.

Table 3.4: Willow ptarmigan *Lagopus lagopus* Linnaeus, 1758

Country	Red list[1]	Legal protection[2]				Hunting[3]	Population[4]		Threats[5]								Conservation measures[6]						
		TP	PP	NT	IT		Size	Trend	S	F	H	P	E	D	C	O	S	M	H	C	R	E	O
Belarus	x	x					100-200	-	x	x	x				x							x	x
Canada	-	x	x	x		L, S, R	>1 Million	0		x	x		x	x			x	x	x				
China	x	x		x	x	?	?	?															
Estonia	x	x					200	-	x	x	x	x					x		x				
Finland			x	x		L, R, S	180000	0		x	x							x				x	
Ireland	-		x			L, S	2000-10000	-		x	x			x			x		x			x	
Latvia	x	x		x			10	-	x			x			x								
Lithuania	x	x					<100	?	x														
Mongolia			x	x	x	L,S	1000	?															
Norway	-		x			L, S	>1 Million	0							x			x				x	
Russia	-					L,P,R,S	18 Million	0		x	x		x										
Sweden	-		x			L, S	20000-800000	0															
UK	-		x	x		L, S	1 Million	-		x	x	x						x	x				
Ukraine	-					?	?	?															
USA	-					L, S	> 1 Million	0		x	x		x				x	x	x				
Non-range countries																							
Portugal		x		x																			

1 Red list: x listed as threatened species at the national level, - not listed

2 Legal Protection: TP total protection, PP partial protection, NT possession and/or national trade prohibited or regulated, IT international trade prohibited or regulated

3 Hunting: L legal, P poaching (illegal), R regionally restricted, S restricted hunting season, M males only

4 Population size (order of magnitude): estimated number of individuals in spring;

Population trend (during the past 10 years): + increasing, 0 stable, - declining, ? unknown

5 Threats (factors suspected to cause significant, longer-term population declines and extinction): S small population size, F habitat loss/fragmentation, H habitat degradation, P predation, E exploitation, D disturbance by tourism/leisure activities, C climate change, O other threats

6 Conservation measures (ongoing at the time of reporting): S surveys, M monitoring, H habitat management, C captive breeding, R restocking/reintroduction, E education, O other measures

3.5 Rock Ptarmigan

Scientific name:	*Lagopus muta*	Montin, 1776
Synonyms:	*Lagopus mutus, Tetrao alpinus*	
Common names:	Yan lei niao	Chinese
	Rock ptarmigan	English
	Kiiruna	Finnish
	Lagopède alpin, Perdrix blanche	French (Europe)
	Lagopède des rochers	French (Canada)
	Alpenschneehuhn	German
	Rjúpa	Icelandic
	Pernice bianca	Italian
	Raicho	Japanese
	Fjellrype	Norwegian
	Tundryanaya kuropatka	Russian
	Belka	Slovenian
	Perdiz nival	Spanish
	Fjällripa	Swedish

3.5.1. Conservation Status

IUCN 2006 (http://www.redlist.org/): Lower risk (near threatened).
CITES 2005 (http://www.cites.org/eng/append/appendices.shtml): not listed in Appendices.
EU Birds Directive: Annex I
National Red Data books: listed in China, Japan and some European countries.

3.5.2. Taxonomy

Rock ptarmigan show considerable geographic variation in size and plumage, and numerous subspecies have been described by various authors; their validity is uncertain. Johnsgard (1983) lists 23, Potapov and Flint (1989) recognise 25, and del Hoyo et al. (1994) suggest 30 subspecies worldwide; Holder and Montgomerie (1993) describe 14 subspecies for North America. Given the breadth of habitats used and probable differences in life history traits, the taxonomy of this species merits careful evaluation, especially between continents and with respect to latitude. Genetic analyses to examine the evolutionary history and divergence of rock ptarmigan subspecies are under way (e.g. Holder et al. 2004).

3.5.3. Distribution

Circumpolar. Arctic and alpine tundra of North America and northern Eurasia. Most of the Arctic coast and islands are inhabited by the species; it retreats from the northernmost Arctic regions during winter. The northernmost populations inhabit northern Greenland at 83°N. and beyond; the southernmost populations are at 49°N. in the Rocky Mountains of North America, at 42°N in the Pyrenees in Europe, and at 45°N in the Altai Mountains of central Asia. Only recently, the species has been discovered in Bulgaria (Miltschew and Georgiewa 1998). A single report from the Pamir Mountains of Tadjikistan (Pfeffer 1997) has not been confirmed since. The subspecies Evermann's Rock Ptarmigan *L.m.evermanni* that has only occurred on Attu Island in the western Aleutian Islands, Alaska, has recently been re-established on Agattu Island (C.E. Braun, personal comm. 2005). Rock ptarmigan are migratory in large areas

Photo 3.5a Rock ptarmigan *(Photo Hans Aschenbrenner)*

of the northern Arctic; in winter they are often nomadic in large flocks. Seasonal migrations of up to 500km have been described from Arctic Russia and up to more than 1000km from coastal Greenland and North America. The rock ptarmigan has the widest latitudinal distribution of all grouse species and occurs over a range of >40° latitude. (See Potapov and Flint 1989, Holder and Montgomerie 1993).

Map 3.5a Rock ptarmigan distribution in North America.

3.5.4. Population Size and Trend

The species still occupies most of its original range; it is relatively secure because of the inaccessibility of its habitat. Some range contractions with local extinctions are known, e.g. from the UK due to global warming or excessive sheep grazing, and in Siberia in the surroundings of human settlements. Population densities vary greatly and often in

Map 3.5b Rock ptarmigan distribution in Eurasia

approx. 10-year cycles; reported figures range between <1 and >60 birds per km_. The total population size in North America has been estimated to vary between 2.1 and 8.4 million birds in spring and between 3.7 and 24.3 million in autumn (see Potapov and Flint 1989, Holder and Montgomerie 1993, Flint 1995). There is a steady decline in Iceland (4% per year since 1981) for unknown reasons.

Photo 3.5b Rock ptarmigan in their typical alpine habitat. ***(Photo Hans Aschenbrenner).***

3.5.5. Habitat and Ecology

The rock ptarmigan inhabits dry tundra and alpine habitats with rocky ridges or outcrops and relatively sparse vegetation dominated by grasses, lichens and mosses. The rock ptarmigan selects wintering areas that allow access to the ground vegetation, e.g. windswept ridges and slopes. Some populations, e.g. in British Columbia, spend the winter on or close to the breeding habitat; others winter in shrubby areas at or above the treeline or in forest edge habitats. Long-distance southward winter migrations are common for high-latitude populations (see Potapov and Flint 1989, Holder and Montgomerie 1993). Where both species are sympatric, the rock ptarmigan generally occurs at higher elevations and in drier habitats with sparser vegetation than the willow grouse *L. lagopus*. In North America the white-tailed ptarmigan *L. leucura* lives in habitats characteristic of the rock ptarmigan in central Europe.

3.5.6. Hunting and Cultural Importance

The species is hunted in many parts of its range, except for China, Japan and some areas of Europe. Because of its lower densities and its less accessible habitats, the rock ptarmigan has always been less important as a game bird than the willow grouse. In North America, the rock ptarmigan historically was an important food source for native communities in the Arctic; it is still hunted for food by indigenous people and populations of rock ptarmigan may be exterminated in the surroundings of Arctic communities (see Holder and Montgomerie 1993). Similar effects are described for settlements in the Russian Arctic (Potapov and Flint 1989). Annual hunting bags in the early 1990s in Russia were estimated at 140,000 birds (Grabuzov 1995, Flint 1995).

3.5.7. Principal Threats

In general, the species is well protected by its wide distribution in areas with low human population density. Threats to local populations are mostly related to overhunting and tourism development.

Exploitation. Rock ptarmigan are susceptible to overharvesting, especially if hunted in spring, e.g. in the vicinity of settlements. Extinction due to overharvesting, however, is a localised threat.

Habitat degradation. Loss and degradation of habitats due to tourism developments, such as expansion or upgrading of ski-resorts, have been reported as threats to populations in Japan and in Europe (Alps, Pyrenees) (Ménoni and Magnani 1998, Zeitler and Glänzer 1998). Direct disturbance related to human presence may displace the birds from wintering areas and may be threatening populations in Japan and in Europe (Alps; Zeitler and Glänzer 1998, Pyrenees; Ménoni and Magnani 1998); generalist predators subsidised by ski resorts may cause serious declines in local populations (Watson and Moss 2004). Negative impacts on habitat quality have been reported from Iceland (erosion of heathlands due to sheep grazing) and China (cattle grazing).

Collisions with cables. Mortality due to collisions with cables around ski-stations has been reported as a threat in the Alps and the Pyrenees.

3.5.8. Research Needs

Clarification of the taxonomic relationships within the species is desirable. The causes of cyclic population fluctuations are still not fully understood. Little is known about the status, trends and life history traits of the species in the Alps and in the Pyrenees, and the ability to detect changes in status is limited. As with the other *Lagopus* species, a better understanding is needed of migration and dispersal behaviour in relation to landscape patterns and their effects on population and metapopulation dynamics. Data are lacking on survival of young from autumn to next spring. Research into the effects of hunting on population dynamics is ongoing in Iceland.

3.5.9. Current Conservation Measures

Legal protection. In most of the range, setting of hunting seasons and bag limits is the only management activity. There are no hunting restrictions for North American indigenous peoples. The species is protected in some European countries, Japan and China. Only a minor proportion of the species´ range is covered by protected areas; the correspondents considered the role of reserves for the survival of the species to be generally low, with the exception of some countries at the edge of the range (Andorra, China, France, Spain) where reserves were believed to play an important role for habitat preservation.

Surveys and monitoring. In most of the range, surveys and monitoring are restricted to local scales.

Reduction of human disturbance. A programme to limit the effects of human disturbance on grouse by ski-touring has been initiated in Germany. The major approaches are public awareness campaigns, re-routing of hiking and ski trail networks, and designation of core areas closed to the public (Zeitler and Glänzer 1998).

Habitat management. Only reported in Newfoundland and Labrador (burning).

Re-introduction. Subspecies *L.m.evermanni* reintroduced to Agattu Island (Aleutian Islands, Alaska, USA) after extirpation by introduced foxes. Released birds were translocated from neighboring Attu Island. See http://alaskamaritime.fws.gov/whatwedo/bioprojects/restorebiodiversity/ptarmigan.htm

3.5.10. Priority Conservation Measures

Due to the vast range and secure status of the species, conservation needs are mostly local. Population monitoring to ensure the sustainability of exploitation is recommended in areas with potentially high hunting pressures. In mountain ranges with high tourism pressure, measures should be initiated to minimise spatial and temporal overlap between important habitats and recreational activities, and their effectiveness monitored. In this context, activities that may increase the numbers of generalist predators (e.g. those that exploit garbage around ski-stations) need to be controlled.

3.5.11. Recent changes

Populations poorly monitored and trends unknown in large parts of the range. Reintroduced population of subspecies *L.m.evermanni* from Attu Island in Agattu Island (Aleutian Islands, Alaska, USA; translocation). Regionally in North America (e.g. Northwest Territory and Nunavat), there is concern that rock ptarmigan may be declining. Locally to regionally, some are concerned about disturbance by snowmobiles and all-terrain vehicles (Canada). The impact of climate change is unknown, but may play a role long-term, particularly with regard to changes in winter weather and habitat. In Iceland, as a response to the steady decline (4% decline per annum since 1981), the rock ptarmigan was red-listed as vulnerable in 2003, and hunting banned in 2003 and 2004. In Sweden, there are reports of decreasing numbers due to overgrazing of reindeer in parts of the mountains.

Male rock ptarmigan on Attu Island, Alaska. (Photo Michael A. Schroeder)

Table 3.5 Rock ptarmigan *Lagopus muta* Montin, 1776

Country	Red list[1]	Legal protection[2]				Hun-ting[3]	Population[4]		Threats[5]							Conservation measures[6]						
		TP	PP	NT	IT		Size	Trend	S	F	H	P	E	D	C	O	S	M	H	C	R	E	O
Andorra	-	x				P	1500	?	x	x	x			x			x	x					
Austria	-	x	x	x		L, S, R	50000	?			x	x		x	x	x	x	x				x	
Bulgaria	-						?	?															
Canada	-		x	x	x	L, S	>1 million	0?							x		x	x					
China	x	x		x	x		?	0			x								x				
Finland	-		x	x		L, S	6000	0?	x			x	x									x	
France	-		x	x	x	L, S, R	<20000	0 / -	x	x	x			x			x	x				x	
Greenland	-		x			L, S	0.1-1 million	0?															
Germany	x			x	x		<500?	0?	x	x				x								x	
Iceland	x		x			L, S	0.1-05 million	-		x	x		x					x				x	x
Italy	x		x	x		R, L, S	10000-12000	-		x			x	x	x			x				x	
Japan	x	x		x	x		3000	0/-?	x	x	x	x		x			x	x					
Kazakhstan	-					?	2500	0															
Liechtenstein	-		x			L, S	?	0															
Mongolia	-		x	x	x	L	500-1000	0															
Norway	-		x			L, S	0.4-1 million	0							x			x				x	
Portugal	x	x		x			?	?															
Russia	-					L,P,S	2,8 million	0 (+,-)							x								
Slovenia	x	x					250-450	0/-?	x	x	x	x		x									
Spain	x	x		x	x	P	1200	-?	x		x	x	x	x	x			x					
Sweden	-		x			L, S	80000-160000	0															
Switzerland	-		x	x		L, S, R	12000-15000	0			x			x	x		x	x					
Tadjikistan	-						presence uncertain																
UK	-					L, S	20000	0										x					
USA (Alaska)	-		x	x	x	L, S	>1 million	0?							x		x	x					
Non-range countries																							
Australia	x		x																				
Ref. to L. m. japonicus																							

1 Red List: x listed as threatened, - not listed

2 Legal Protection: TP total protection, PP partial protection, NT possession and/or national trade prohibited or regulated, IT international trade prohibited or regulated

3 Hunting: L legal, P poaching, R regionally restricted, S restricted hunting season, M males only

4 Population size: estimated number of individuals in spring; trend: + increasing, 0 stable, - declining, ? trend unknown

5 Threats: S small population size, F habitat loss/fragmentation, H habitat degradation, P predation, E exploitation, D disturbance by tourism/leisure activities, O other threats

6 Conservation measures: S surveys, M monitoring, H habitat management, C captive breeding, R restocking/reintroduction, E education, O other measures

3.5.12. Correspondents

1999: Ariane Bernard-Laurent, Massimo Bocca, Ayurzanyn Bold, Miran Cas, Javier Castroviejo, Laurence Ellison, Michael Fasel, Yuzo Fujimaki, David Jenkins, Wolfgang Kantner, Harto Lindén, Christian Marti, Kathy Martin, Ann Matschke, Pierre Mollet, David Mossop, Olafur Nielsen, Roald Potatpov, Torstein Storaas, Ilse Storch, Adam Watson, Yue-Hua Sun, and Albin Zeitler

2004: David Martin Boertmann (Greenland), Susan Hannon (Canada, Alaska), Hans-Christian Pedersen (Norway), Roald Potapov (Russia), Yue-Hua Sun (China), Pierre Mollet (Switzerland), Takaaki Sakanakura (Japan), Miran Cas (Slovenia), Jacob Höglund, Pär Jacobsson (Sweden), Marc Mossoll Torres (Pyrenees), Claude Novoa (France) Pekka Helle (Finland), Ólafur K. Nielsen (Iceland), David Boertmann (Greenland), Scott Wilson and Kathy Martin (USA, Canada), Rainer Ploner and Lucca Rotelli (Italy), Adam Watson, Albin Zeitler (Germany)..

3.5.13. Key Publications

Holder, K. and Montgomerie, R. 1993. Rock ptarmigan. *The birds of North America*, No. 51. The birds of North America, Inc., Philadelphia, PA.

Holder, K., R. Montgomerie and V.L. Friesen. 2004. Genetic diversity and management of nearctic rock ptarmigan (*Lagopus mutus*). Canadian Journal of Zoology 82: 564-575.

Potapov, R. L. and Flint, V. E. 1989. *Handbuch der Vögel der Sowjetunion. Band 4 Galliformes, Gruiformes.* Ziemsen Verlag Wittenberg Lutherstadt, Germany. 427 pp. (ISBN 3-7403-0027-2)

For an extended list of references on the species see Potapov and Flint (1989) and Holder and Montgomerie (1993). All publications referred to in the text are listed in the References section

3.6 White-tailed Ptarmigan

Scientific name:	*Lagopus leucura*	Richardson,
Synonym:	*Lagopus leucurus*	1831
Common names:	White-tailed ptarmigan	English
	Lagopède à queue blanche	French
	Lagopodo coliblanco	Spanish

Photo 3.6a Male and female white-tailed ptarmigan on Loveland Pass, Colorado *(Photo Robert E. Bennetts).*

3.6.1. Conservation Status

IUCN 2004 (http://www.redlist.org/): Lower risk (near threatened).
CITES 2005: (http://www.cites.org/eng/append/appendices.shtml): not listed in Appendices.
Provincial red data books: Subspecies *L. l. saxatilis* listed in British Columbia, Canada, as vulnerable or sensitive.

3.6.2. Taxonomy

Five subspecies are recognised; the validity of the races needs to be evaluated (Braun et al. 1993, del Hoyo et al. 1994). The subspecies *saxatilis* is restricted to Vancouver Island.

3.6.3. Distribution

Western North America. More or less contiguous distribution from south central Alaska and the Yukon south to Washington; further south the range is highly disjunct with scattered populations in the Rocky Mountains from Montana to northern New Mexico. Isolated populations on Vancouver Island (British Columbia) and Mont Rainier (Washington). Introduced populations in California, Colorado, New Mexico and Utah (see Braun et al. 1993).

3.6.4. Population Size and Trend

Breeding densities fluctuate between years and places; numbers range between 2-10 birds per km_. In the long term, most populations are probably stable and secure. However, with global warming, some populations may be at risk of extirpation. Because its alpine habitats remain relatively undisturbed, the species still occupies most of its original range (see Braun et al. 1993).

3.6.5. Habitat and Ecology

Alpine habitats above or at the treeline with a preference for rocky areas, krummholz and moist vegetation near snowfields and streams; avoids boggy areas and tall vegetation. Both summer and winter distribution is influenced by the availability of willows *Salix* spp. or alder *Alnus* spp. Much of the winter food consists of catkins of willow, alder and birch *Betula* spp.. In the snow-free seasons, buds, leaves, flowers and fruits of willows and various herbs and ericaceous shrubs are taken; insects are important for chicks. In parts of the range, e.g. Colorado, white-tailed ptarmigan tend to move between high elevation habitats in summer and lower elevations in winter. Seasonal movements between 1 and >30km have been recorded. In other parts of the range, e.g. on Vancouver Island, they maintain altitude but move to preferred winter habitats such as upper montane forest parkland. Where all three *Lagopus* species co-occur, e.g. in the Yukon, Alaska and parts of British Columbia, the white-tailed ptarmigan is found at the highest elevations (see Braun 1984, Braun et al. 1993).

Map 3.6 White-tailed ptarmigan distribution. *(Source: courtesy Kathy Martin).*

Photo 3.6b White-tailed ptarmigan in summer. *(Colorado, USA. Photo Ilse Storch).*

3.6.6. Hunting and Cultural Importance

The white-tailed ptarmigan is hunted in Canada, except for Vancouver Island, and in the US in California, Colorado and Utah, with varying seasons and bag limits. Hunting pressure varies widely between years and areas, e.g. between 4-68% of the autumn population in Colorado is taken by hunters, but generally hunting pressure is low and localised to areas with roads in the alpine zone. Due to its low densities, secretive habits and remote habitats, the species has never been an important game bird compared to other ptarmigan and grouse (see Braun et al. 1993).

3.6.7. Principal Threats

Habitat alteration. Locally the white-tailed ptarmigan is affected by man-made habitat changes due to road construction, mining, snow catchment fences, ski area development, pollution near urban areas and overgrazing by domestic livestock. These factors affect the abundance and distribution of winter food. On a large scale, however, the species seems to be well protected by its inaccessible alpine habitat and cryptic behaviour. Populations appear to be able to persist in areas frequented by visitors, such as the Rocky Mountain National Park (US). Hiking in early summer can affect nesting success because both hikers and ptarmigan select snow-free patches. Developments that result in an increased abundance of generalist corvid, canid and mustelid predators, can have a large impact on the number of juveniles.

Exploitation. White-tailed ptarmigan are vulnerable to overhunting because of their low population densities and their habit of flocking in late summer in traditional areas. Because the species is often hunted by specialised hunters, bag limits are important despite the generally low hunting pressure.

3.6.8. Research Needs

Research is currently being carried out on population dynamics and on connectivity of habitats and populations in parts of the range. More information is needed on juvenile dispersal and its role for spatial population structure and metapopulation dynamics and persistence. Subspecific designations need to be validated; in particular, the taxonomic status and trends of the populations in Utah, Washington and California need to be assessed.

3.6.9. Current Conservation Measures

Legal protection. The white-tailed ptarmigan is partially protected throughout its range; hunting is regulated by defined seasons and bag limits. Hunting is not permitted in parts of the range, e.g. Vancouver Island.

Surveys and monitoring. Population densities and trends in relation to different kinds of alpine and subalpine habitat types.

Translocation. In the past, white-tailed ptarmigan have been successfully translocated into various parts of North America (Braun 1984, Starling 1991).

3.6.10. Priority Conservation Measures

Habitat preservation and protected areas. To avoid loss of winter habitat, wintering sites should be identified and protected before allowing urban developments or skiing operations.

3.4.11. Recent changes

No major changes in status and trends reported. In alpine ranges for both North America and Europe, there is growing concern related to increased recreation in rock ptarmigan habitats. A study on the relationship between habitat selection and genetic structure is under way (Canada).

3.6.12. Correspondents

2000: Clait E. Braun, Kathy Martin, and Fred Zwickel

2005: Clait E. Braun, Kathy Martin

3.6.12. Key Publications

Braun, C.E. 1988. Biological investigations of white-tailed ptarmigan in Colorado, USA – a review. Pp 131-147 in: Lovel. T.W.I (ed). *Proceedings International Symposium on Grouse* 3, World Pheasant Association, Reading, UK.

Braun, C.E., Martin, K. and Robb, L. A. 1993. White-tailed ptarmigan. *The birds of North America*, No. 68. The birds of North America, Inc., Philadelphia, PA.

Martin, K. and K. L. Wiebe. 2004. Coping mechanisms of alpine and arctic breeding birds: extreme weather and limitations to reproductive resilience. *Integrative and Comparative Biology* 44:177-185.

Sandercock, B.K., K. Martin, and S.J. Hannon. 2005. Life history variation in extreme environments: comparative demography of arctic and alpine ptarmigan. *Ecology*.

For an extended list of references on the species see Braun et al. 1993. All publications referred to in the text are listed in the References section

Table 3.6. White-tailed ptarmigan *Lagopus leucura* Richardson, 1831

Country	Red list[1]	Legal protection[2]				Hunting[3]	Population[4]		Threats[5]								Conservation measures[6]						
		TP	PP	NT	IT		Size	Trend	S	F	H	P	E	D	C	O	S	M	H	C	R	E	O
Canada	-		x			L, S, R	>100,000	0?		x	x			x	x		x	x				x	
USA	-	x		x	x	L, S, R	<100,000	0	x	x	x			x	x		x	x	x		x	x	

1 Red List: x listed as threatened, - not listed

2 Legal Protection: TP total protection, PP partial protection, NT possession and/or national trade prohibited or regulated, IT international trade prohibited or regulated

3 Hunting: L legal, P poaching, R regionally restricted, S restricted hunting season, M males only

4 Population size: estimated number of individuals in spring; trend: + increasing, 0 stable, - declining, ? trend unknown

5 Threats: S small population size, F habitat loss/fragmentation, H habitat degradation, P predation, E exploitation, D disturbance by tourism/leisure activities, O other threats

6 Conservation measures: S surveys, M monitoring, H habitat management, C captive breeding, R restocking/reintroduction, E education, O other measures

3.7 Black Grouse

Scientific name:	*Tetrao tetrix*	Linnaeus, 1758
Synonyms:	*Lyrurus tetrix*	
Common names:	Hei qin ji	Chinese
	Tetrivek obecn_	Czech
	Urfugl	Danish
	Korhoen	Dutch
	Black grouse	English
	Teeri	Finnish
	Tétras-lyre, Petit coq de bruyère	French
	Birkhuhn, Spielhahn	German
	Lyropetinós	Greek
	Fagiano di monte	Italian
	Orrfugl	Norwegian
	Cietrzev	Polish
	Teterev	Russian
	Gallo lira	Spanish
	Ru_evec	Slovenian
	Orre	Swedish

3.7.1. Conservation Status

IUCN 2006 (http://www.redlist.org/): Lower risk (near threatened).
CITES 2005 (http://www.cites.org/eng/app/index.shtml): not listed in Appendices.
EU Birds Directive: Annex I, Annex II/2, Annex III/2
National Red Data books: listed in western and central European countries.

3.7.2. Taxonomy

There are currently seven (del Hoyo et al. 1994) or eight (Potapov 1985, Potapov and Flint 1989) subspecies recognised, based on geographic variation in morphological traits (colour patterns of males and females and development of onthogenesis). Only the British subspecies *T. t. britannicus* is geographically separated.

3.7.3. Distribution

Northern Eurasia. Continuous distribution in the boreal forest from Scandinavia to south-eastern Siberia (approx. 140° E.); the western and southern parts of the range are fragmented as major range contractions and declines have occurred during the 20th century (see Klaus et al. 1990, Bergmann and Klaus 1994, Lindström et al. 1998).

3.7.4. Population Size and Trend

Population densities may strongly fluctuate, particularly in the northern parts of the range where 4-10 year population cycles are common. Except for these short-term fluctuations, black grouse populations are considered to be more or less stable throughout the contiguous range, and are not particularly endangered, although negative population trends are reported for parts of Fennoscandia (Lindén & Helle 2003). In western and central Europe, black grouse numbers have been declining rapidly during the 20th century, and particularly since the 1970s. Many lowland populations have disappeared and the remaining ones are mostly small (<100-200 birds) and isolated (e.g., Klaus et al. 1990, Holst-Jörgensen 1995, 2001; Loneux and Ruwet 1997, Kamieniarz 2000, 2003, Ten Den and Niewold 2000, Loneux et al. 2004, Prüter and Wübbenhorst 2004, Niewold et al. 2005). In central Europe, the largest and still mostly stable population is found in the Alps (see Klaus et al. 1990; Lindström et al. 1998).

Photo 3.7a Black grouse males displaying. ***(Finland, Photo Gilbert Ludwig).***

Photo 3.7b Black grouse female. ***(Finland, Photo Gilbert Ludwig).***

3.7.5. Habitat and Ecology

The black grouse has one of the broadest habitat requirements of all the grouse. In boreal regions, the black grouse is a bird of forest edge habitats and of early stages of forest succession. Outside the boreal forest, black grouse are found in structurally similar habitats such as moorland and heaths, young and open regenerating conifer forests after disturbances such as fire, storm or clearcutting, treeline habitats and alpine pastures in mountainous areas, as well as fields and meadows, and military training grounds. Black grouse generally avoid closed tree cover. The birds feed opportunistically but selectively on a variety of food items. The hens require a protein and energy-rich food source in the pre-laying period in spring, and utilise the inflorescences of cotton grass *Eriophorum* spp., buds of *Larix, Alnus, Betula* spp., and leaves, buds and flowers of ericaceous shrubs and herbs such as *Ranunculus* spp. and *Caltha palustris*. In summer, black grouse need habitats with abundant invertebrates for chicks, preferably larvae and ants, and utilise wet flushes. In winter, black grouse feed on shrubs such as *Vaccinium, Calluna* and *Juniperus* and, if these are snow-covered, they can rely on catkins, buds, twigs and needles of various tree species, especially birch *Betula*, alder *Larix*, ash *Sorbus* and willow *Salix*, but also spruce *Picea* and pine *Pinus*.

The quality, size, and distribution of suitable habitat patches explain most of the observed variation in black grouse abundance. Black grouse population dynamics are characterised by greater fluctuations and greater mobility compared to other woodland grouse species. Therefore, exchange between neighbouring populations and the

Map 3.7 Black grouse distribution

colonisation of new habitats, may be more likely than in capercaillie or hazel grouse. Although new telemetry (Caizergues and Ellison 2002) and genetic (e.g. Höglund et al. 2004) studies have started to clarify the spatial population ecology of black grouse, there is still a lack of data to test this hypothesis, and more research on the spatial dynamics of black grouse populations is needed.

3.7.6. Hunting and Cultural Importance

The courtship display of the male black grouse has long fascinated humans e.g. it is mimicked in traditional alpine folk dances and today attracts bird-watchers and wildlife photographers to the leks. Throughout most of its range, the black grouse has a long history as a game bird, and so is of great cultural and, at least regionally, economic importance. After willow ptarmigan and hazel grouse, it is the most numerous grouse species in the bag of Fennoscandian and Russian hunters (see Potapov and Flint 1989, Klaus et al. 1990). For Russia the annual hunting bag of black grouse has been estimated as 120,000 in the early 1990s (Flint 1995, Grabuzov 1995); more recent bag records are not available.

In the northern and eastern parts of the range, black grouse are mostly hunted in winter, often with the help of dummies to attract flocks. There are also several kinds of traps for black grouse. The species is hunted for both sport and food in northern Europe, and primarily for meat in Eastern Europe and Russia. Recently, trophy-hunting by westerners is gaining increasing economic importance in eastern Europe. In central Europe, trophy-hunting used to be the black grouse hunter's major motivation and males were shot in spring at the lek. This kind of hunting carries a high chance of disturbing the social system at the lek and may result in reduced reproductive success. In some areas, hunting may have contributed to a rapid decline of black grouse populations. Since the 1970s, black grouse hunting has been banned in some central European countries, but bans did not reverse the negative population trends. A present-day modification of the traditional hunt is the attractiveness of black grouse leks to nature photographers and bird-watchers, who locally may cause significant disturbance. Because of the pronounced, often unpredictable fluctuations of black grouse populations, attempts at harvesting a maximum yield can easily lead to overshooting. Data on current stocks and annual reproductive success can minimise this problem (see Potapov and Flint 1989, Klaus et al. 1990, Ellison 1991).

3.7.7. Principal Threats

Habitat degradation. In western and central Europe, habitat loss due to changes in human land-use, and particularly the intensification of agriculture, is the major cause of black grouse declines (e.g. Niewold 1990, Loneux and Ruwet 1997). Drainage and destruction of moorland, fertilisation or afforestation of heathland and sheep pastures, and the declining use and maintenance of alpine summer pastures by grazing and mowing, are common causes of the black grouse habitat deterioration. Destruction of ground vegetation and the associated invertebrate communities due to heavy grazing by livestock or deer, can also have negative effects on black grouse populations (Baines 1994, 1996; Calladine et al. 2002).

Small population size. In western and central Europe, deterioration and fragmentation of habitats have resulted in isolated populations, many of which are now threatened by small size (Loneux and Ruwet 1997). Small populations of e.g. <100 birds are generally vulnerable and show a high risk of extinction due to chance demographic or environmental events, such as unsuitable weather, and possibly also reduced genetic variability (Westemeier et al. 1998). Habitat preservation measures need to be initiated well before a population is on the verge of extinction. The size and spatial distribution of suitable habitats at a landscape scale needs much more attention than they have received in the past.

Predation. Related to large-scale land-use changes, predation pressure on black grouse seems to have significantly increased during the past three decades. Forest fragmentation, farmland fertilisation, availability of garbage as a food source and declining persecution have resulted in increasing densities of small and medium-sized mammalian and avian predators (Reynolds 1990). In addition, large-scale vaccination of foxes against rabies in central Europe since the 1980s may have contributed to constantly high fox

populations (Vos 1995). Locally, increasing populations of wild boar have perhaps become a major cause of grouse nest losses (Klaus 1994).

Human disturbance. Tourism and leisure activities such as hiking, skiing, mountain-biking, etc. may pose serious threats to local black grouse populations. Many black grouse wintering habitats overlap with popular skiing areas, particularly in the mountainous regions of western and central Europe (see e.g. Meile 1982, Ménoni and Magnani 1998, Zeitler and Glänzer 1998).

Exploitation. In some countries (Austria, China, Greece, Romania, Switzerland, Ukraine) exploitation by legal and illegal hunting was reported as a potential threat to black grouse populations.

Collisions. In Scandinavia, collisions with high-tension power lines may kill significant numbers of black grouse, e.g. ≥26,000 deaths annually have been estimated in Norway (Beveranger 1995). In Scotland, many birds die from collisions with deer fences (Baines and Summers 1997).

Climate change. Some researchers suggest that longer-term climate trends may partly explain recent declines of the species, particularly the negative effect on breeding success (e.g. Loneux et al. 1997, Loneux 2001; 2003, Loneux & Vandiepenbeeck 2003, Ludwig et al. in prep).

3.7.8. Research Needs

In general, the biology, food habits, habitat and spatial requirements, behaviour and mating system of the black grouse are well understood (see Baines 1995, Lindström et al. 1998). Because black grouse are still widely hunted, a greater understanding of population dynamics and the effects of harvesting is desirable. More information is needed about the effects of habitat fragmentation and patch isolation. Information is almost completely lacking on dispersal rates and distances, and their role for population connectivity, and population dynamics and persistence. Larger-scale habitat relationships and population dynamics can be considered as the research topics with the greatest relevance to conservation in regions where the species is endangered. Experiments in management are a great research need.

3.7.9. Current Conservation Measures

Legal protection. The degree of legal protection varies among the range countries. In general, the species is fully and effectively protected in western and central European countries with small and declining populations. In other countries, e.g. Austria, Italy and France, hunting is strictly regulated and only allowed in certain areas and during limited hunting seasons. Illegal hunting still appears to be a problem in some regions.

Protected areas. Only a minor proportion of the species´ range is covered by protected areas and most are probably too small to support self-sustaining, viable populations. The role of protected areas for black grouse conservation is generally considered to be limited. Locally, however, reserves are seen as vital for black grouse conservation: in Belgium, the Netherlands and Germany (except for the Alps), most remaining populations are in nature reserves (or military training grounds, which have similar properties), which are considered to be critical for their survival. In regions where poaching is seen as a problem, e.g. China and Greece, reserves are also believed to be important for black grouse conservation.

Surveys and monitoring. In Europe, regular surveys or monitoring are common as a means of harvest planning e.g. in Austria, Fennoscandia, France and the UK, and in regions with small remnant populations, e.g. in Belgium, The Netherlands and parts of Germany. Monitoring techniques include counts of cocks at leks, brood counts with pointing dogs and transects counts.

Habitat preservation. Habitat management is considered the most important conservation measure for black grouse. In most regions, the major challenge is to integrate land-use practices with the species´ habitat requirements. Measures include habitat improvement by maintaining the open habitats of early succession stages.

Reduction of human disturbance. Disturbance by tourism and leisure activities such as hiking, skiing, mountain-biking, snow-shoeing and snow-machines, are viewed as a serious threat to local populations. Disturbance can be critical in winter habitats, particularly at the lek and during brood rearing (see Human Disturbance; Chapter 2). In some regions of Europe, programmes to limit the effects of human disturbance on black grouse have been initiated, with more or less success (e.g. Austria, France, Germany, Switzerland, Belgium). The major approaches are public awareness campaigns, re-routing of hiking and ski-trail networks, and the designation of core areas closed to the public (see e.g. Ménoni and Magnani 1998, Zeitler and Glänzer 1998, Zeitler 2001, Suchant and Schäfer 2002).

Photo 3.7c. Black grouse male displaying *(Finland, Photo Gilbert Ludwig).*

Predator control. In most regions of Europe with small and highly endangered populations, predation is experienced as the major proximate threat to the black grouse, and to many conservation practitioners, predator control seems to be desirable. A significant reduction of predators will probably result in improved black grouse survival (see e.g., Marcström et al. 1988, Reynolds 1990, Kauhala et al. 2000, Summers et al. 2004). To maintain low predator densities on a large scale, however, is technically difficult and ethically questionable, and not easily accepted by the public. Therefore, in most areas, predator control cannot be a sustainable approach to black grouse conservation (Ellison et al 1991). An exception is Great Britain, where extensive predator control by professional game keepers has a long tradition.

Captive breeding and release. Captive breeding of black grouse has made significant progress since the 1970s. However, this has not resulted in successful re-stocking and reintroductions. In Germany, four different captive breeding and release projects have been undertaken and none were successful. Their failure was mainly due to high mortality from predation among newly released birds, which may be

partly related to rearing and releasing techniques. However, major losses, fragmentation and/or degradation of habitats, preceded all cases of serious population declines or extinctions of black grouse in central Europe; in addition, predation pressure has significantly increased during the past few decades. The prospects for re-establishing lowland populations in central Europe appear to be limited mainly by the small size of habitat patches and high predation pressure, and only secondarily by suboptimal rearing and release techniques (see Klaus 1997, 1998; Seiler et al. 2001).

3.7.10. Priority Conservation Measures

Habitat management. Preservation and restoration of the habitat is the major approach for the conservation of endangered black grouse populations. In areas with ongoing habitat degradation, integration of land-use practices with the species´ habitat requirements is essential.

Maintaining spatial connectivity. In the south-western part of the range where black grouse habitats are spatially fragmented, maintaining or restoring spatial connectivity among the populations, e.g. in the Alps, seems to be vital. The recent history of black grouse in central Europe teaches us that once populations have become small and isolated in an intensively farmed landscape, the chances for population restoration are poor (see Loneux and Ruwet 1997, Westemeier et al. 1998). Preventative measures are needed for the remaining larger populations and metapopulation systems.

Reduction of human disturbance. In areas with small, declining or threatened populations, human disturbance due to sport and leisure activities should be minimised, particularly where wintering, display, moult and brood habitats are limited.

Monitoring. Where the species is endangered, sound monitoring programmes of populations and habitats should be established to document population trends and responses to management actions.

Law enforcement. Locally, where the species appears to be threatened by poaching, better law enforcement is needed (see above).

3.4.11. Recent changes

In 2002, the species was discovered in the north of South Korea (Rhim et al. 2003), which is the southernmost (38° N) known location of the species. The situation in China and Mongolia is unclear, but field surveys in Hebei Province indicate dramatic declines, possibly due to poaching for food. In western and central Europe, declines continue. After the extinction of black grouse in Denmark in the mid 1990s (Holst Jorgensen 1995), populations are down to <50 birds in both Belgium and the Netherlands, and in Germany and Poland, many local populations have disappeared. Conservation measures are ongoing, including habitat restoration, predator control, and reintroduction projects. Also in the UK, captive breeding and reintroduction programmes have started on the southern edge of the range in England. Strong declines since the 1990s have also been suggested for the south of Sweden.

Locally, increasing black grouse numbers have been reported. In parts of the Alps, this may be related to favourable chick rearing conditions in recent years. In parts of Poland, conservation activities (habitat management and predator control) were followed by increasing population numbers (M. Kazsuba pers. comm..). Similarly, increasing populations have been reported from Romania as a result of a conservation-motivated hunting ban.

Wind farms for wind-power production have been identified as a new potential threat to the species, particularly in mountainous areas (e.g., Czech Republic, Austria, Germany). Negative effects of wild farms on black grouse are seen mostly in disturbance of birds and destruction of habitats, although scientific studies on the effects of wind farms on grouse are still lacking.

3.7.12. Correspondents

2000: David Baines, Ariane Bernard-Laurent, Massimo Bocca, Ayurzanyn Bold, Miran Cas, Roman Dziedzic, Volodymyr Domashlinets, Laurence Ellison, Michael Fasel, David Jenkins, Bo Holst-Jörgensen, Lazlo Kalaber, Wolfgang Kantner, Siegfried Klaus, Woo-Shin Lee, Harto Lindén, Freek Niewold, Alexander Mikityuk, Pierre Mollet, Roald Potatpov, Shin-Jae Rhim, Jean-Claude Ruwet, Athanassios Sfougaris, Torstein Storaas, Ilse Storch, Yue-Hua Sun, Ene Vith, Anne Westerberg, and Albin Zeitler.

2004: David Baines, Miran Cas, Gabriel Bogdan Chisamera, Pär Jacobsson and Jacob Höglund, Pekka Helle, Michal Kaszuba, Michèle Loneux, Petra Malkova, Yann Magnani, Pierre Mollet, Freek Niewold, Tatiana Pavlushchick, Rainer Ploner and Lucca Rotelli, Shin-Yae Rhim, Roald Potapov, Ilse Storch, Yue-Hua Sun, Ene Vith, Per Wegge, Hubert Zeiler, and Albin Zeitler.

3.7.13. Key Publications

Baines, D. 1995. Habitat requirements of black grouse. *Proc. Int. Symp*. *Grouse* 6:147-150.

Bergmann H. H. and Klaus, S. 1994. Distribution, status and limiting factors of black grouse in central Europe, particularly in Germany, including an evaluation of reintroductions. - *Gibier Faune Sauvage* 11:99-124.

Caizergues, A. and Ellison, L.N. 2002. Blackwell Science Ltd. Natal dispersal and its consequences in

Klaus, S., Bergmann, H.-H., Marti, C., Müller, F., Vitovic, O. A., and Wiesner, J. 1990. Die Birkhühner. Die Neue Brehm-Bücherei. Westarp Wissenschaften, Magdeburg, Germany.

Lindström, J., Rintamäki, P. T. & Storch, I. 1998. Black grouse. - BWP Update. The journal of birds of the Western Palearctic (Oxford University Press, Oxford, UK) 2: 173-191.

Loneux, M. and Ruwet, J.C. 1997. Evolution des populations du Tétras lyre en Europe. *Cahiers d´Ethologie* 17: 287-343.

Marjakangas, A. 1986: On the winter ecology of the black grouse, *Tetrao tetrix*, in central Finland. – Acta Universitatis Ouluensis, Series A 183. Biol. 29. 87 pp.

For an extended list of references on the species see Loneux and Ruwet 1997 and Lindström et al. 1998. All publications referred to in the text are listed in the References section.

Table 3.7 Black grouse *Tetrao tetrix* Linnaeus, 1758

Country	Red list[1]	Legal protection[2]				Hun-ting[3]	Population[4]		Threats[5]								Conservation measures[6]						
		TP	PP	NT	IT		Size	Trend	S	F	H	P	E	D	C	O	S	M	H	C	R	E	O
Austria	x		x			L, R, S, M	26,000	0	x	x	x	x		x	x	x	x	x	x			x	x
Belarus	-		x			L, P, S	40-54,000	0		x	x						x	x	x			x	
Belgium	x	x		x		-	<50	-	x	x	x	x		x	x		x	x	x			x	x
China	x	x		x	x	P	present	-		x	x	x	x				x			x			
Czech Rep.	x	x		x	x	P	1500-2000	-	x		x		x	x		x		x		x	x		
Denmark	x						recently extinct																
Estonia	-		x				15,000	-			x	x						x					
Finland	-		x	x		L, R, S	800,000	-		x	x	x						x	x			x	
France	-		x	x	x	L, R, S, M	20,000	-		x	x			x			x	x	x			x	
Germany	x	x	x	x	x		2,000	-/0	x	x	x	x		x				x	x	x	x		
Greece*	-	x		x	x	P	?	?	x	x	x		x										
Italy	x		x	x		L, R, S, M	30-35,000	-/0		x	x		x	x	x			x	x			x	
Kasakhstan	-					L,P	>200,000?	-					x		x								
Kyrgystan	x					?	>200,000?	0(+,-)-					x		x								
Latvia	x			x	x	L, S	15-30,000	+			x	x	x	x									
Liechtenstein	-		x			L, S, M	200	+			x			x				x					
Lithuania*	x	x				?	4-6,000**	?															
Mongolia	?		x	x	x	?	present	?															
Netherlands	x	x				-	35	-	x			x					x	x	x			x	
Norway	-					L, S	>300,000	0				x					x	x					
North Korea	?					?	present	?															
Poland	x	x		x	x	-	2000-2500	-/+	x	x	x	x		x			x	x	x	x	x	x	x
Romania	x	x				P	90 - 200	+	x	x	x	x					x	-	x	-	-	x	
Russia	-		x			L,P,S,M	9.6 Million	0 (+,-)					x		x			x					
Slovakia	x	x		x	x	P	400-600	-	x	x	x	x					x	x	x			x	
Slovenia	x	x				-	2,500	0, -	x	x	x	x		x									
South Korea	x	x				P	<50	-	x	x	x	x		x			x						
Sweden	-		x			L, S	300,000	0/-															
Switzerland	-		x	x		L, R. S, M	7-10,000	-/0			x		x	x			x	x					
UK	x		x	x		L,S	13,400	-	x	x	x	x					x	x	x	x	x	x	
Ukraine	-					L, P	15,000	-		x	x		x	x	x								
Non-range countries																							
Spain		x		x	x																		
Portugal		x		x																			

1 Red List: x listed as threatened, - not listed

2 Legal Protection: TP total protection, PP partial protection, NT possession and/or national trade prohibited or regulated, IT international trade prohibited or regulated

3 Hunting: L legal, P poaching, R regionally restricted, S restricted hunting season, M males only

4 Population size: estimated number of individuals in spring; trend: + increasing, 0 stable, - declining, ? trend unknown

5 Threats: S small population size, F habitat loss/fragmentation, H habitat degradation, P predation, E exploitation, D disturbance by tourism/leisure activities, O other threats

6 Conservation measures: S surveys, M monitoring, H habitat management, C captive breeding, R restocking/reintroduction, E education, O other measures

** Info from 2000 Action Plan. ** data from BirdLife International Birds in Europe 2004.*

3.8 Caucasian Black Grouse

Scientific name:	*Tetrao mlokosiewiczi*	Taczanowski, 1875
Synonyms:	*Lyrurus mlokosiewiczi*	
Common names:	Kovkasian mayrehav	Armenian
	Caucasian black grouse	English
	Tétras du Caucase	French
	Rotcho	Georgian
	Kaukasusbirkhuhn	German
	Kawkasskij teterev	Russian
	Gallo-lira caucasiano	Spanish
	Dag horozu, ('cockerel of the mountain') or Hus Tavugu ('birch chicken')	Turkish

3.8.1. Conservation Status

IUCN 2006 (http://www.redlist.org/): Data deficient.
CITES 2005: not listed in Appendices. (http://www.cites.org/eng/append/appendices.shtml)
Red Data Book of European Vertebrates 1997: Insufficiently known.
National Red Data books: listed in all range countries (Armenia, Azerbaijan, Iran, Georgia, Turkey, and Russia).

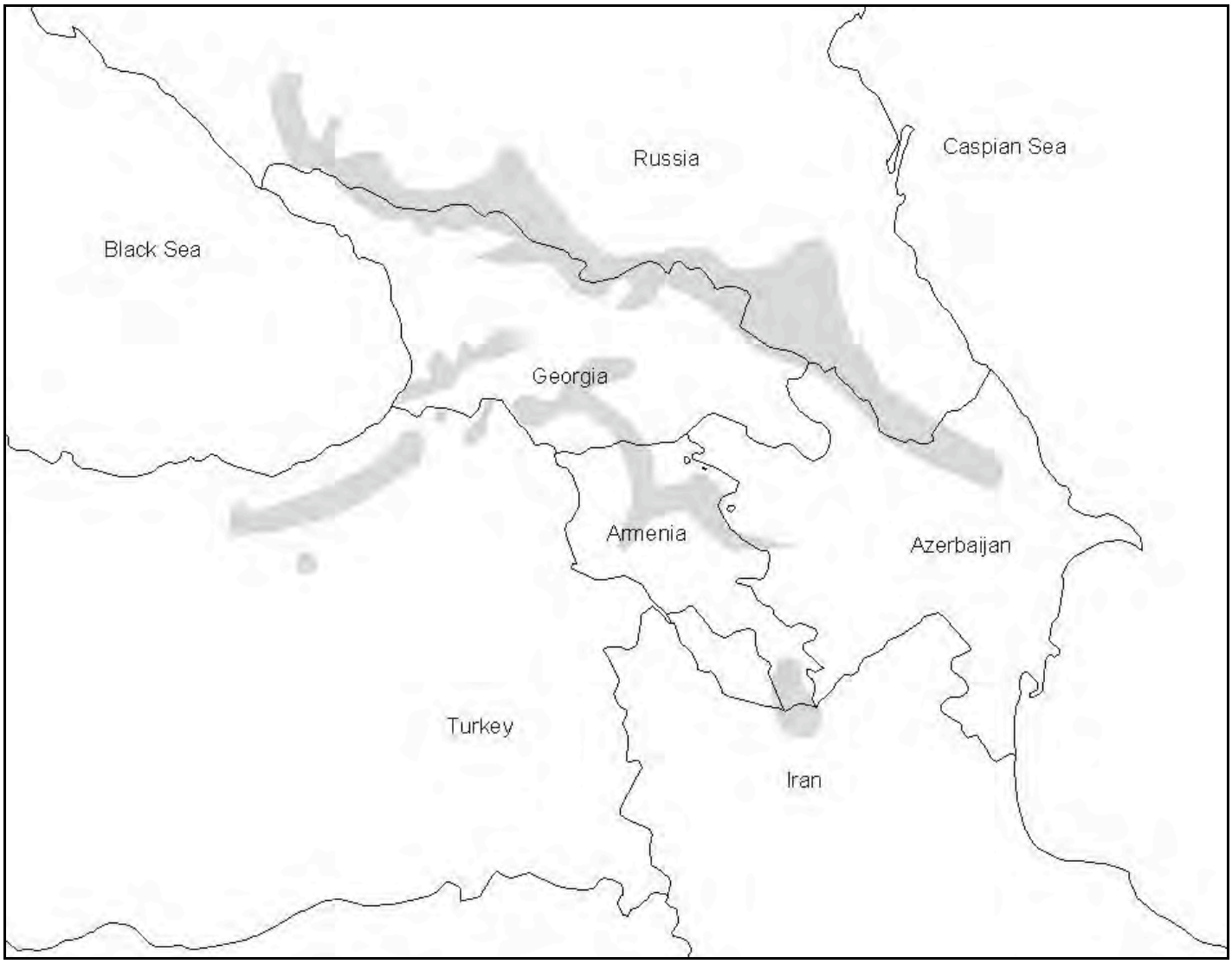
3.8.2. Taxonomy

Monotypic; no subspecies recognised (del Hoyo et al. 1994).

Photo 3.8 Caucasian Black grouse, male ***(Photo Siegfried Klaus).***

3.8.3. Distribution

Endemic to the Caucasus. Between the Black Sea and the Caspian Sea in the Great and Little Caucasus mountains in Russia, Georgia, Armenia and Azerbaijan, and south into north-eastern Turkey and north-western Iran; the major part of the range is in Russia and Georgia. The species has the smallest distribution of all grouse (Kutubidze 1961, Potapov & Flint 1989, Flint 1995, Baskaya 1997, Adamian & Klem 1999).



Map 3.9 Caucasian black grouse distribution.

3.8.4. Population Size and Trend

Population size and trend are insufficiently known. Current estimates are in an order of 80,000-90,000 birds (see table 3.8). The species has probably been declining since at least the 1980s and has disappeared from some mountains at the limits of its range. In undisturbed areas, such as the 800km^2 Teberda state reserve in Russia, 1.5 birds per km^2 have been estimated, based on lek counts (Klaus et al. 1990a,b); but local spring densities reached up to 3.8 birds/km^2 (Vitovich 1986).

3.8.5. Habitat and Ecology

Caucasian black grouse inhabit treeline habitats of the transition zone between the upper mountain forests and subalpine meadows at 1500-3000 m altitude. The major items in the winter diet are birch *Betula* buds and catkins, juniper *Juniperus* fruits and needles, shoots of willows *Salix* and *Vaccinium* and *Rhododendron* shrubs, and rosehips *Rosa*. From spring to autumn, the diet diversifies according to availability of buds, leaves and fruits of a wide variety of herbs, grasses and shrubs, and also insects. The Caucasian black grouse is a typical lek-breeding species with traditional display grounds in open habitats someway above the treeline. Whereas alpine pastures used for livestock grazing have negative effects on Caucasian black grouse habitats, meadows for hay production, from which livestock are carefully excluded, form ”reserves” with great importance for reproduction (see Kutubidze 1961, Vitovich 1986, Klaus et al. 1990a,b, Baskaya 1997).

3.8.6. Hunting and Cultural Importance

Traditionally, hunting of Caucasian black grouse has never played an important cultural or economic role. Since the 1980s, however, illegal sport hunting has developed into a serious threat, particularly in the little Caucasus.

3.8.7. Principal Threats

Habitat degradation. Cattle grazing and shepherding have increased throughout the range and led to vegetation change and erosion in the summer habitats of Caucasian black grouse. In many areas, livestock are brought up the mountains at the beginning of the lekking and incubation period. In spring, cattle preferably use the areas adjacent to the treeline, where leks and brood habitats are located. Serious effects the on reproduction of Caucasian black grouse due to habitat changes, disturbance and trampling are likely. Locally, as suggested for Armenia, reductions in livestock numbers may result in recovery of the species.

Predation by dogs. Feral dogs, which have become numerous, particularly in the vicinity of larger cities and tourist resorts, and the many shepherd-dogs are believed to cause considerable losses among nests, chicks and adult birds.

Exploitation. Since the 1980s, illegal sport hunting has developed into a serious threat, particularly in the little Caucasus.

Small population size. Due to its treeline habitats, the species is patchily distributed and has always occurred in distinct local populations. Habitat loss may interrupt the contact between these populations. Small and isolated populations are generally vulnerable and show a high risk of extinction due to chance demographic or environmental events and the loss of genetic heterogeneity (Westemeier et al. 1998; see Small Population Size; Chapter 2). The disjunct spatial distribution of the species may strongly affect its viability.

3.8.8. Research Needs

Surveys. Thorough surveys should be launched to clarify the distribution, population size and trend, and status of the species throughout the range, especially in its southern parts. So far, surveys have only been conducted locally, although efforts are being made in several countries to clarify the species´ distribution.

Habitat relationships. Ecological field studies are needed to better understand the habitat-relationships of the species and the effects of human land use on population dynamics and trends. The first radio-telemetry study is under way in Georgia (see http://www.gccw.org).

Parasitology. Georgian birds have long been reported to host quite a number of intestine parasites (helminths). These parasites may lead to reduced survival of Caucasian black grouse and are probably distributed by domestic sheep and cattle. However, the number of helminths in wild ungulates has also increased (A. Gavashelishvili pers. comm., 1999).

3.8.9. Current Conservation Measures

Legal protection. The species is totally protected throughout its range. However, hunting pressure still exists, at least at a local scale, and so better law enforcement is needed.

Protected areas. There are several protected areas in the species´ range in Turkey (Artvin-Savsat-Balikli and Maden Wildlife Protection Areas), Armenia, Georgia, Azerbaijan and Russia. In total, an estimated 20-25% of the total range is within nature reserves (Russia 15-20%, Armenia 1-2%, Azerbaijan 1-2% (A. Solokha, pers. comm), Georgia 3-4% (A. Gavashelishvili pers. comm., 1999) and Turkey 1% (S. Baskaya pers. comm., 1999)). In all range countries, well-managed reserves are considered to be critical for the survival of the species; their present effectiveness is believed to be moderate in Russia and Georgia and low in the other countries. Due to the large size of these reserves, the species is probably relatively well protected in the Russian state reserves (zapovedniki) (S. Klaus, pers. comm). In Georgia, an extended network of national parks is presently being planned.

Surveys and monitoring. In recent years, surveys have been initiated in Azerbaijan, Georgia and Turkey. Some new field observations have also been reported from Armenia and Iran.

Habitat preservation. Measures to preserve or improve the habitat have been reported from all parts of the range but are almost completely restricted to the existing protected areas.

3.8.10. Priority Conservation Measures

The Caucasian black grouse is listed as data deficient, but will probably soon be reclassified as Near Threatened on the basis of suspected declines in the near future. Here, a short summary of recommended conservation measures is given. Recommendations for research and conservation priorities for the Caucasian black grouse are described in greater detail in Chapter 4.

Population surveys. The Caucasian black grouse is limited in its distribution and its range is highly fragmented. The distribution of the species is insufficiently known; even less is known about connectivity among the various parts of the range. Recent surveys have started to improve knowledge. However, there is still a lot of field work needed to establish the distribution and conservation status of Caucasian black grouse and its habitats, and to identify concrete threats and conservation needs.

Management plans. After the distribution, population status, threats and conservation needs have been identified, management plans should be developed and implemented throughout the range, preferably with cooperation between the range countries. Intentions exist in several of the range countries.

Habitat preservation. Caucasian black grouse habitat needs to be preserved at least seasonally from disturbance and degradation by cattle, burning for pasture mitigation and locally perhaps also from recreation. Lekking areas should be free from any grazing throughout the species' range. Grazing should be controlled in the subalpine zone (especially in patches of Rhododendron and birch on the slopes). Habitat preservation must be a major aim of any management plan for this species.

Control of illegal hunting. Field studies are needed to assess the role of poaching in population dynamics in parts of the range, especially Armenia, in order to develop measures and approaches to control poaching.

Protected areas. New reserves for Caucasian black grouse have been proposed in several of the range countries (Armenia, Azerbaijan and Georgia).

Conservation education and ecotourism. In most parts of the range of the Caucasian black grouse, education regarding its status and threats are considered an important approach to reduce human pressure on the species (poaching) and its habitats (shepherding). Measures may include reports in the mass media, the production of posters and other information materials, and the development of eco-tourism for bird watchers. Public involvement also plays a role in the projects currently ongoing in Azerbaijan, Georgia and Turkey.

3.4.11. Recent changes

In recent years, a growing number of biologists and conservationists from the Caucasus region have become interested in field studies on the Caucasian black grouse. In Azerbaijan, a grant from the Chicago Zoological Society's Endangered Species Fund allowed surveys in various parts of the country to collect basic information on habitat, status, trends and threats. In Georgia and Turkey, Caucasian black grouse projects are ongoing within the Baku-Tbilisi-Ceyhan Pipeline Company Environmental Investment Programme. In Georgia, a research, monitoring and conservation project is working to build up knowledge and capacity on Caucasian black grouse to enable appropriate management http://www.gccw.org/index.php?a=activities-cbg. In Turkey, surveys and habitat modelling are being carried out in an attempt to improve the conservation status of the species. Interest in field studies has also been expressed by researchers in Armenia and Iran.

Table 3.8 Caucasian black grouse *Tetrao mlokosiewiczi* Taczanowski, 1875

Country	Red list[1]	Legal protection[2]				Hun-ting[3]	Population[4]		Threats[5]								Conservation measures[6]						
		TP	PP	NT	IT		Size	Trend	S	F	H	P	E	D	C	O	S	M	H	C	R	E	O
Armenia	x	x				P	>300?	?	x	x	x		x				x						
Azerbaijan	x	x				P	1500-3500	-	x	x	x	x	x				x					x	
Georgia	x	x				P	40-50000	-			x	x	x				x		x			x	
Iran	x	x		x	x	P	100?	-	x		x		x				x						
Russia	x	x				P	25-30000	0/-					x		x		x	x				x	
Turkey	x	x		x	x	P	>7500	-/?	x	x	x	x	x			x	x	x	x			x	

1 Red List: x listed as threatened, - not listed

2 Legal Protection: TP total protection, PP partial protection, NT possession and/or national trade prohibited or regulated, IT international trade prohibited or regulated

3 Hunting: L legal, P poaching, R regionally restricted, S restricted hunting season, M males only

4 Population size: estimated number of individuals in spring; trend: + increasing, 0 stable, - declining, ? trend unknown

5 Threats: S small population size, F habitat loss/fragmentation, H habitat degradation, P predation, E exploitation, D disturbance by tourism/leisure activities, O other threats

6 Conservation measures: S surveys, M monitoring, H habitat management, C captive breeding, R restocking/reintroduction, E education, O other measures

3.8.12. Correspondents

1999: Martin S. Adamian, Sagdan Baskaya, Alexander Gavashelishvili, Siegfried Klaus, Alexander Solokha, and Peter Saenger.

2004: Roald Potapov, Siegfried Klaus, Elchin Sultanov, Geoff Welch, Sam Khosravifard, Mehdi Nabian, Sagdan Baskaya, Ramaz Gokhelashvili, Vasil Ananian.

3.8.13. Key Publications

Baskaya, S. 2003. Distribution and principal threats to Caucasian black grouse *Tetrao mlokosiewiczi* in the Eastern Karadeniz Mountains in Turkey, Wildlife Biology, 9(4): 377-383.

Gokhelashvili, R., Kerry P. Reese and Lexo Gavashelishvill. 2003. How much do we know about the Caucasian Black Grouse *Tetrao mlokosiewiczi*? Sandgrouse 25: 32-40.

Klaus, S., Bergmann, H.-H., Marti, C., Müller, F., Vitovic, O. A., and Wiesner, J. 1990. *Die Birkhühner*. Die Neue Brehm-Bücherei. Westarp Wissenschaften, Magdeburg, Germany.

Potapov R.L. 1994. Caucasian Black Grouse. In Tucker G.M., Heath M.F. Birds in Europe: their conservation status. Cambridge. 206-207.

Vitovich, O.A. 1986. Ecology of the Caucasian Black Grouse. *Trudy Teberd. Gos. Zapov*. 10:165-309 (in Russian).

For an extended list of publications see references lists in these papers. All publications referred to in the text are listed in the References section.

3.9 Western Capercaillie

Scientific name:	*Tetrao urogallus*	Linnaeus 1758
Common names:	Song ji	Chinese
	Veliki tetrijeb	Croatian
	Tetrev hlu_ec	Czech
	Tiur	Danish
	Capercaillie	English
	Metso (male), koppelo (female)	Finnish
	Grand tétras; grand coq de bruyère	French
	Auerhuhn	German
	Agriokourkos	Greek
	Gallo cedrone	Italian
	Storfugl, Tiur (male), røy (female)	Norwegian
	Gluszec	Polish
	Glukhar	Russian
	Divji Petelin	Slovenian
	Urogallo	Spanish
	Tjäder	Swedish

3.9.1. Conservation Status

IUCN 2006 (http://www.redlist.org/): Lower risk (near threatened).
CITES 2005 (http://www.cites.org/eng/app/index.shtml): not listed in Appendices.
Bern Convention: *T. u. cantabricus* (Appendix II)
EU Birds Directive: Annex I, Annex II/2, Annex III/2
National Red Data books: listed in western, central and south-eastern European countries.

The subspecies *T. u. cantabricus*, the Cantabrian capercaillie (Castroviejo 1967, 1975, Castroviejo et al. 1974), qualifies to be listed as Endangered according to the IUCN Red List Categories under criteria EN; C1 and C2a (Storch et al. 2006). The subspecies at present inhabits an area of 1,700 km^2 in the Cantabrian Mountains of northern Spain. Compared to a historic range of 3,500 km^2, the area of occupancy has declined by >50% (Quevedo et al. 2006). The range is severely fragmented and separated from its nearest neighbouring population in the Pyrenees (*T. u. aquitanus*) by a distance of more than 300km. A 60-70% decline in the number of males at leks since 1981 has been estimated (Pollo et al. 2003). The current population is probably <1000 birds, although reliable estimates are lacking. The decline appears to continue (Storch et al. 2006).

3.9.2. Taxonomy

There are 12 subspecies recognised (Potapov and Flint 1989, del Hoyo et al. 1994); two are geographically isolated, *T. u. cantabricus* in the Cantabrian Mountains of Spain (Castroviejo 1967, 1975) and *T. u. aquitanus* in the Pyrenees of France and Spain. Recent phylogenetic studies indicate that *T. u. cantabricus* forms a clade different from other European capercaillies (Rodríguez Muñoz et al. 2007) and qualifies it to be considered as an Evolutionarily Significant Unit (Moritz 2002). Cantabrian and European clades contact in the Pyrenees (Rodríguez Muñoz et al. 2007).

3.9.3. Distribution

Eurasia. Contiguous distribution in the boreal forest from Scandinavia to eastern Siberia (approx. 125° east); the south-western part of the range in western and central Europe is fragmented, primarily due to the patchy distribution of montane forests and secondarily due to habitat loss (see Storch 2001).

Photo 3.9a Western capercaillie male.

Photo 3.9b Western capercaillie female.

Photo 3.9.c Western capercaillie female chick, about four weeks old. *(All three photos Ilse Storch)*

The capercaillie still occupies most of its original range, although serious declines in western and central Europe have resulted in local extinctions. In central Europe, many populations have disappeared; most of the remaining ones are small (<200 birds) and probably isolated. The Cantabrian subspecies of the capercaillie may become extinct in the near future. In the boreal forests of Fennoscandia and western Russia, capercaillie numbers dropped following the beginning of intensive clearcutting. In general, the species is listed as threatened in western, central and southeastern Europe, but still occurs in considerable numbers throughout most of its boreal range from Scandinavia to eastern Siberia. However, even in some parts of the boreal forest, e.g. Finland, the species regionally is considered vulnerable (Storch 2001).

Map 3.9 Western capercaillie distribution.

3.9.5. Habitat and Ecology

The capercaillie is a typical species of boreal climax forests. Along its southern distribution limit, however, capercaillie show remarkable plasticity with regard to inhabited forest types. Its primary habitat is a landscape dominated by old-growth forest, intermixed with bogs and patches of younger successional stages following natural disturbance, such as wind-blow, snow-break and fire. Capercaillie habitats are characterised by coniferous trees, open structure with moderate canopy cover, and rich ground vegetation dominated by bilberry *Vaccinium myrtillus* and other ericaceous shrubs. The birds feed almost exclusively on conifer needles in winter but on leaves, buds, flowers and fruits of various herbs and shrubs in summer. Young capercaillie chicks rely on invertebrates, especially caterpillars on *Vaccinium*. In the temperate zone, e.g. in central Europe, Capercaillie habitats are restricted to montane regions. Capercaillies depend on particular habitat structures, but are rather flexible with regard to tree species and forest age. In most areas, old, natural or semi-natural conifer-dominated forests are the capercaillie's stronghold. However, if the structure of the vegetation is suitable, the species may use young and commercial forests as well (see Klaus et al. 1989, Potapov and Flint 1989, Storch 2001). The capercaillie is often referred to as an indicator species of healthy old forest communities in montane and boreal ecosystems (e.g. Suter et al. 2002).

Exceptions to the close association of capercaillie with conifers are the Cantabrian Mountains of Spain, where the birds live in purely deciduous forests throughout the year and feed on buds in winter (Rodriguez and Obeso 2000), and the southern Urals, where the birds were reported to extend their summer ranges into steppe woodlands of old mature oak (see Klaus *et al.* 1989, Potapov and Flint 1989) and show seasonal movements of a migratory character. This population in the southern Urals may have disappeared due to logging (T. Pavlushchick, pers. comm. 2005).

3.9.6. Hunting and Cultural Importance

The capercaillie has a long history as a game bird (Klaus et al. 1989, Potapov and Flint 1989) since the Middle Ages and even before. In central Europe, the capercaillie has received particular attention as a highly-valued hunting trophy. At times, e.g. since the 18th century, the capercaillie hunt was reserved for aristocrats. In its central European strongholds, the capercaillie has been a traditional element of local folklore until the present day. Despite its great cultural importance, however, capercaillie hunting has generally played a minor economic role in central Europe.

Throughout central Europe, capercaillies have been hunted mostly in spring at the lek, with hunters preferring to shoot supposedly high-ranking cocks. An often-discussed problem related to the spring hunt, is that it may disturb mating and result in reduced reproductive success. In Scotland, the Pyrenees, Fennoscandia and Russia, capercaillies of both sexes are mostly hunted in autumn. The autumn hunt is often considered to be less critical in terms of population dynamics, because leks are not disturbed and because hunting losses are assumed to be at least partly compensated by reduced winter mortality among the survivors. Thorough tests of this latter assumption, however, are still lacking.

Whereas trophy hunting and taxidermy are the major motivation for hunting capercaillie in western and central Europe, the species is hunted for food and sport in northern Europe and mostly for food in eastern Europe and Russia. In recent times, however, trophy hunting by westerners is gaining economic importance in Eastern Europe. In the boreal forest, grouse hunting has long played a major economic role and is still culturally important. In Russia, the hunting bag of capercaillie during the early 1990s was estimated at 700,000 birds annually (Grabuzov 1995, Flint 1995).

Since the 1970s, capercaillie hunting has been restricted or banned in all western and central European countries, but this did not successfully reverse the negative population trend (Klaus et al. 1989). There are several countries where capercaillies are still hunted although the species is listed as endangered in the national Red Lists (e.g. Austria and Bulgaria). There is growing opposition to this practice from conservationists and the anti-hunting movement. Moderate, strictly controlled hunting, however, may have a positive overall effect on capercaillie conservation. For example, in

parts of Austria, where the hunting rights belong to small, private land owners, the chances to sell a capercaillie cock to guest hunters every other year appears to be a significant incentive for active habitat preservation.

3.9.7. Principal Threats

***Habitat degradation*.** Loss and deterioration of habitats are assumed to be the major causes of declining capercaillie numbers. Habitat changes occur at various levels of spatial scale. As a habitat specialist, the Capercaillie is sensitive to changes in habitat structure, i.e. features at forest stand level. Due to its large spatial requirements the Capercaillie is also susceptible to changes at the landscape scale, such as forest fragmentation (e.g. Rolstad and Wegge 1989, Rolstad 1991, Ménoni et al 1997, Storch 1997a,b) and forestry practices that have a major influence on populations. In the boreal forest, capercaillie numbers declined parallel to the onset of intensive clearcutting (Rolstad and Wegge 1989, Rolstad 1991). In Russia and some other eastern European countries, political and socio-economic developments will influence future forestry practices and poaching intensities, and thus have the potential to create significant threats to the capercaillie and other old-forest species. In central Europe, capercaillie abundance was highest at times when human land-use practices, e.g. collection of forest litter and cattle grazing, favoured open forest structures with a rich ground vegetation. During the past decades, increasing standing timber volumes throughout central Europe were paralleled by declining capercaillie numbers. Forestry practices are probably the one major limiting factor of capercaillie numbers (Klaus et al. 1989, Rolstad and Wegge 1989, Rolstad 1989, 1991, Storch 2001). In the UK, however, the major threat in recent years has been mortality from striking fences (Baines and Andrew 2003).

***Small population size*.** In western and central Europe, deterioration and fragmentation of habitats has resulted in isolated populations, many of which are now threatened by small size. Small populations, e.g. <100 birds, are generally vulnerable and show a high risk of extinction due to chance events, or loss of genetic variation (Klaus 1994, Loneux and Ruwet 1997, Westemeier 1998; see Small Population Size; Chapter 2). Measures to preserve habitats need to be initiated well before a population is at the edge of extinction. The size and spatial distribution of suitable habitats at a landscape scale needs much more attention than it has received in the past (Rolstad 1991, Ménoni et al. 1997, Storch 1997a, b, Storch 2002).

Pollution. In parts of central Europe, large-scale pollution through wind and rain resulted in soil eutrophication and thus vegetation changes which are disadvantageous for the ericaceous shrubs preferred by capercaillie (see Klaus and Bergmann 1994).

***Predation*.** Predation pressure on capercaillie seems to have significantly increased during the past three decades. Changes in land-use, e.g. forest fragmentation and agricultural fertilisation, and declining persuasion of predators have resulted in increasing densities of small and medium sized mammalian and avian predators (Reynolds 1991). In addition, large-scale vaccination of foxes against rabies in central Europe is contributing to constantly high fox populations (Vos 1995). Regionally, increasing populations of wild boar may have become a major cause of nest losses.

Human disturbance. Disturbance by tourism and leisure activities such as hiking, skiing, mountain-biking, etc. are viewed as a serious threat to local capercaillie populations. In some regions of Europe, programmes to limit the effects of human disturbance on capercaillie and other grouse have been initiated (e.g. Austria, France, Germany, Switzerland) (e.g. Ménoni and Magnani 1998, Zeitler and Glänzer 1998).

Collisions. Regionally, e.g. in Fennoscandia, collisions with high-tension power lines may be responsible for killing significant numbers of capercaillie; ≥20,000 mortalities annually have been estimated in Norway (Beveranger 1995). Locally, collisions with deer fences may cause significant mortality among capercaillie. Fences that are erected in relation with woodland management schemes to exclude deer, have become a serious threat for capercaillie in Scotland and account for an estimated 50% of the annual mortality (Baines and Andrew 2003).

Exploitation. Some poaching may occur throughout the range. Especially in eastern Europe, birds may be shot in excess of the legal hunting bags or outside the season; this is partly related to poor law enforcement and the tight economic situation in some regions. Poaching for food was reported to greatly affect populations in Ukraine.Poaching, sport and trophy hunting was reported to have serious effects on the population dynamics of the capercaillie in Spain, and moderate effects in Greece. Hunting is illegal in these countries and better law enforcement is desirable. Legal and illegal hunting was also felt to greatly influence the declining populations in Andorra, Bulgaria and Romania; correspondents felt that legal protection and law enforcement need to be improved. The lek mating system generally makes the species susceptible to over-exploitation, because displaying males are an easy target and known leks may be destroyed with little effort, as reported from Russia.

Climate change. Some researchers suggest that long-term climate trends may partly explain recent declines of the species, particularly by negatively affecting breeding success (Moss et al. 2001). These effects may be most relevant in Atlantic climates, such as the Cantabrian Mountains, Pyrenees and Scotland. However, this hypothesis still lacks rigurous testing.

Photo 3.9d. Cantabrian capercaillie *(Photo Bernard Bellon, Spring 2006).*

3.9.8. Research Needs

Biology, food habits, habitat requirements, spatial requirements, behaviour and mating system are generally well studied. The book by Klaus et al. (1989) provides an extended review. However, information on biology and ecology of the Cantabrian subspecies is lacking and research should be urgently promoted. Several case studies have explored the effects of landscape-scale habitat features such as habitat fragmentation on capercaillie populations (e.g. Rolstad 1989, Gjerde 1991, Ménoni 1991, Storch 1997a,b, 2002). Although genetic studies have confirmed that central and western European capercaillie show metapopulation patterns (e.g. Segelbacher et al. 2003), information is almost completely lacking on juvenile dispersal rates and dispersal distances (Storch and Segelbacher 2000), and their roles in population genetics, dynamics and persistence. Larger-scale habitat relationships, predation patterns and population dynamics, minimum requirements in population size (Grimm and Storch 2000) and in habitat area and connections can be considered research topics with the greatest relevance to conservation in those regions where the species is endangered. Small and isolated populations should be assessed for potential inbreeding depression effects (see Westermeier et al. 1989).

3.9.9. Current Conservation Measures

Legal protection. The degree of legal protection for the capercaillie varies among the range countries. In general, the species is fully and effectively protected in western and central European countries which have small and declining populations. In other countries, e.g. Austria, Italy and France, hunting is strictly regulated and only allowed in certain areas and during limited hunting seasons. In some eastern (e.g. Bulgaria, Romania) and southern (Andorra, Spain, Greece) European countries, illegal hunting may have serious effects on capercaillie populations; here, rigorous law enforcement is urgently needed.

Protected areas. Only a minor proportion of the species´ range is covered by protected areas and most are too small for self-sustaining, viable populations. The role of protected areas for capercaillie conservation is generally considered to be limited. In Greece, Spain and Andorra, where habitat degradation and poaching appear to threaten the remaining populations, protected areas are believed to be critical for the survival of the species; however, law enforcement appears to be generally insufficent. Protected areas may effectively maintain a capercaillie population if the area is large enough (> 100km² see Storch 1995), if the habitat is and remains suitable, and if utilisation and disturbances are strictly regulated and controlled. This, however, is rarely the case. Although large parts of the capercaillie range within the EU countries of central and western Europe are now covered by the Natura 2000 network, effective protection of capercaillie and their habitats is not granted because major commercial land uses, such as forest exploitation, will continue.

Surveys and monitoring. In Europe, regular surveys or monitoring are common as a tool in planning harvests (e.g. Austria, Fennoscandia, France, UK), and in regions with small remnant populations (e.g. parts of Germany, Switzerland). Whether lek or autumn counts are conducted is largely related to regional hunting traditions. The reliability of lek counts is questionable because larger leks are difficult to overlook, the spatial organisation and attendance of a lek may change over the season, and small leks and individually displaying cocks may be missed. Lek counts are usually done by hunters or game-keepers who may have their own agenda; the method has a great potential for misuse and involves a high risk of disturbance. However, if properly organised, lek counts may provide a spring population index for males. Well-organised autumn counts, e.g. the Finnish wildlife triangle scheme (Lindén et al. 1996), generally give reliable estimates of population structure and trends. Transect counts of indirect capercaillie signs, such as feathers and droppings, may provide a population index suitable for monitoring and regional comparisons in areas with at least moderate population densities (Storch unpubl.).

Habitat preservation. Habitat management is considered the most important conservation measure. In most regions, the major challenge is to integrate forestry practices with capercaillie habitat requirements. In this context, the argument that the capercaillie is an indicator of a healthy old forest ecosystem is helpful. In parts of Europe, recent policy changes, at least by the state forest agencies towards increasing ”naturalness” of the forest, may be favourable to capercaillie habitat conservation. An encaouraging example of capercaillie habitat management is ongoing in Scotland within the EU-Life programme (http://www.capercaillie-life.info/htm/bird_importance.php).

Predator control. In most regions of Europe with small and highly endangered populations, predation is experienced as the major proximate threat to the capercaillie, and, to many conservation practitioners, predator control seems to be desirable (e.g. Kaphegyi 1998). A significant reduction of predators will probably result in improved capercaillie survival (Marcström et al. 1988, Reynolds 1990, Kauhala et al. 2000, Summers et al. 2004). Maintaining low predator densities on a large scale, however, is technically difficult and morally questionable, and not easily accepted by the public (see Messmer et al. 1999) and the conservation community. Therefore, in most areas predator control cannot be a sustainable approach to capercaillie conservation.

Captive breeding and release. Captive breeding of capercaillies has made significant progress over the past two decades, and the release of capercaillies reared in captivity has become a common, but unsuccessful, conservation tool in central Europe. Newly released birds suffer great mortality from predation, and although since the 1970s about 5000 birds have been released in >10 different projects in Germany alone, there is still not a single example of a self-sustaining capercaillie population established from birds reared in captivity. The prospects for translocations, i.e. release of birds caught in the wild elsewhere, might be better; however, a recent attempt with Russian birds translocated into Thuringia, Germany, failed in stabilising the remnant population. Experience with capercaillie release projects have been summarised by Klaus (1998). The prospects for stabilizing or re-establishing capercaillie populations in central Europe appear to be limited mainly by small size and poor quality of habitat patches and high predation pressure, and only secondarily by suboptimal rearing and release techniques. Clearly, the GSG strongly disencourages reintroduction attempts as an approach to safeguard threatened capercaillie populations. Costs are immense, while chances of success are remote. Reintroduction attempts are likely to divert attention and resources away from priority work, such as habitat preservation and restoration.

Education. Capercaillie conservation measures are frequently accompanied by information and education of land owners and foresters regarding habitat needs, and of tourist and sport organisations, such as skiing and alpine clubs, regarding the avoidance of disturbance in grouse habitats (e.g. Zeitler and Glänzer 1998).

Photo 3.9e Young brood (chicks 1-3 days old) and hen western capercaillie *(Photo Ilse Storch).*

3.9.10. Priority Conservation Measures

On a global scale, the Cantabrian capercaillie, the only subspecies that is globally endangered, has highest priority for capercaillie conservation. Recommendations concerning the Cantabrian capercaillie are described in Chapter 4. Below, general conservation needs for the capercaillie are listed; their order of priority however may vary between different parts of the range.

***Habitat preservation*.** Integrating forestry and capercaillie conservation is most important where industrial forestry is introduced and where populations are declining. The major goal is maintaining on a large scale a relatively open forest structure with well developed ground vegetation and insect abundance. Also, tourism, sport and urban development, road construction, wind parks and mining activities should be banned from capercaillie habitats where populations are threatened.

***Maintaining spatial connections*.** Measures are needed to prevent further declines of the still existing larger populations of western and central Europe. Maintaining or restoring spatial connection among these populations, e.g. in the Alps, seems to be vital. The recent history of capercaillie in central Europe teaches us that once populations have become small and isolated, the chances for population restoration are poor. Preventive measures are needed for the remaining larger populations and metapopulation systems. Landscape scale aspects of capercaillie habitats need to be considered where capercaillie populations are spatially structured, e.g. in the Alps and Pyrenees (e.g. Ménoni et al. 1997, Storch 1997b, 2002).

***Reduction of human disturbance*.** In areas with small, declining or threatened populations, human disturbance due to sport and leisure activities should be minimised, particularly where wintering, display and brood habitats are limited.

***Reduction of collision mortality*.** *Collisions* with linear obstactles such as power lines, ski lift cables and deer and sheep fences can be significantly reduced by removal, relocation and visualization by marking (see e.g. Baines & Andrew 2003).

***Monitoring*.** Where the species is endangered, sound monitoring programmes of populations and habitats should be established to assess population trends and the success of conservation measures.

***Law enforcement*.** Locally, where the species appears to be threatened by poaching, better law enforcement is needed (see above).

3.9.11. Recent changes

Overall negative population trends at the southwestern edge of the distribution are ongoing. In the Alps, e.g. in Italy, lower elevations are no longer regularly used by capercaillie, probably related to the denser forests present being more intensively utilized by humans. Populations in Atlantic climates (UK, Pyrenees, Cantabrian Mountains) may suffer from wetter conditions during chick rearing in early summer. In the boreal forest, the major long term trend is continued decrease due to modern forestry practices. In the UK, a major EU-supported capercaillie conservation programme shows good success and, together with favourable spring weather, led to a doubling of the remnant population from 1000 birds in 1999 to 2000 birds in 2004 (Kenny Kortland, pers. comm.).

3.9.12. Correspondents

2000: David Baines, Massimo Bocca, Ayurzanyn Bold, Jordi Canut Bartra, Miran Cas, Javier Castroviejo, Roman Dziedzic, Volodymyr Domashlinets, Michael Fasel, Marijan Grubesic, David Jenkins, Lazlo Kalaber, Wolfgang Kantner, Siegfried Klaus, Harto Lindén, Antonio Lucio, Christian Marti, Ann Matschke, Emmanuel Ménoni, Alexander Mikityuk, Pierre Mollet, Jimmy Oswald, Tatjana Pavlushchick, Roald Potatpov, José Ramón Obeso, Athanassios Sfougaris, Peter Shurulinkov, Torstein Storaas, Ilse Storch, Yue-Hua Sun, Ene Vith, and Albin Zeitler.

2004: Mariajo Banuelos, Miran Cas, Gabriel Bogdan Chisamera, Pär Jacobsson and Jacob Höglund, Pekka Helle, Siegfried Klaus, Kenny Kortland, Roald Potapov, Sun Yue-Hua, Petra Malkova, Pierre Mollet, Marc Mossoll Torres, Emmanuel Ménoni, Robert Moss, Tatiana Pavlushchick, Rainer Ploner and Lucca Rotelli, Mario Quevedo, Ronaldo Rodriguez, Hysen Shabanaj, Attila D. Sándor, Ilse Storch, Yue-Hua Sun, Ene Vith, Per Wegge, and Albin Zeitler.

Photo 3.9f Western capercaillie droppings *(Photo Ilse Storch)*

Table 3.9. Western capercaillie *Tetrao urogallus* Linnaeus, 1758

Country	Red list[1]	Legal protection[2]				Hun-ting[3]	Population[4]		Threats[5]								Conservation measures[6]						
		TP	PP	NT	IT		Size	Trend	S	F	H	P	E	D	C	O	S	M	H	C	R	E	O
Albania	?	x					?	?															
Andorra	-	x				P	600	?			x			x			x	x					
Austria	x	x	x			L, R, S, M	25000	0/(-)	x	x	x	x	x	x			x	x	x			x	x
Belarus	-		x			L, P, S,M	5-7000	0/-		x	x	x	x	x	?		x						-
Bosnia/Herceg	-					L, P	?	-?		x	x		x					x				x	
Bulgaria	x					L, P	2000	-	x	x	x		x	x					x			x	
China	-	x					? (few)	?	?	?	x	?	?	?	?								
Croatia	-	x					300-400	0	x	x	x	x		x			x	x	x			x	
Czech Rep	x	x		x	x		150-200	?	x	x	x		x	x				x		x	x		
Estonia	x	x					3000	-		x	x	x					x	x	x				
Finland	-		x	x		L, R, S	400000	-		x	x	x	x					x	x			x	
France	-	x	x	x	x	L, R, S, M, P	3500-6000	-/0	x	x	x	x	x	x	x	x	x	x	x			x	x
Germany	x	x	x	x	x		2000-4000	-/0	x	x	x	x		x			x	x	x	x	x	x	x
Greece	x					P	350-500	-	x	x	x		x				x						
Italy	x	x					4000-6000	-/0	x	x	x			x	x			x	x			x	
Kazakhstan	-					L	>10000?	-		x	x		x										
Liechtenstein	x	x					few	0/?	x	x	x												
Latvia	x			x	x	L, P, S, M	3000-5000	?		x	x	x	x	x			x		x			x	x
Lithuania	x	x					?	?															
Mongolia	-		x	x	x	?	?	?															
Norway	-					L, S	>150000	-		x	x	x					x	x					
Poland	x	x		x	x		550-750	-	x		x	x			x	x	x	x	x	x	x	x	x
Romania	-	x	x			L, P, M	10000	?			x	x	x				x					x	
Russia	-		x	x		L, P	4 million	0,-,+		x							x	x		x		x	
Serbia-Monte.		x		x	x	L, R, S	230	0	x						x			x	x				
Slovakia	x	x		x	x	P	500-700 leks	-	x	x	x	x		x			x		x			x	
Slovenia	x	x				-	1200	0/ -	x	x	x	x		x	x	x	x	x	x	x	x		
Spain	x	x	x	x	x	P	2000	-	x	x	x	x		x	x		x		x			x	
Sweden	-					L, S	160000-220000	-		x	x												
Switzerland	x	x	x	x	x		1000	-	x		x			x			x	x	x			x	
UK	x	x		x	x		2000	-	x	x	x	x		x	x	x	x	x	x			x	x
Ukraine	x	x				P	<4000	-	x	x	x		x										

1 Red List: x listed as threatened, - not listed

2 Legal Protection: TP total protection, PP partial protection, NT possession and/or national trade prohibited or regulated, IT international trade prohibited or regulated

3 Hunting: L legal, P poaching, R regionally restricted, S restricted hunting season, M males only

4 Population size: estimated number of individuals in spring; trend: + increasing, 0 stable, - declining, ? trend unknown

5 Threats: S small population size, F habitat loss/fragmentation, H habitat degradation, P predation, E exploitation, D disturbance by tourism/leisure activities, O other threats

6 Conservation measures: S surveys, M monitoring, H habitat management, C captive breeding, R restocking/reintroduction, E education, O other measures

3.9.13. Key references

Borchtchevski V. 1993. Population biology of the capercaillie. Principles of the structural organisation. *Izdatelstvo Tsnil ochotnitshjego chosjaistva i zapovednikov, Moscow, 268 pp. (ISBN 5-87560-011-X)*

Gjerde I. 1991. Winter ecology of a dimorphic herbivore: temporal and spatial relationships and habitat selection of male and female capercaillie. Ph.D. thesis, University of Bergen, Norway.

Klaus S., Andreev A.V., Bergmann H.-H., Müller F., Porkert J. and Wiesner J. 1989. *Die Auerhühner*. Die Neue Brehm-Bücherei. Band 86. Westarp Wissenschaften, Magdeburg, Germany.

Ménoni E. 1991. Écologie et dynamique des populations du Grand Tétras dans les Pyrénées, avec des références spéciales à la biologie de la reproduction chez les poules et quelques applications à sa conservation. Ph.D. thesis, Université de Toulouse, France.

Moss R., Oswald J. and Baines, D. 2001. Climate change and breeding success: decline of the capercaillie in Scotland. Journal of Animal Ecology 70: 47-61

Rodríguez-Muñoz R., P. M. Mirol, G. Segelbacher, A. Fernández, T. Tregenza. (2007) Genetic differentiation of an endangered capercaillie (*Tetrao urogallus*) population at the Southern edge of the species range. *Conservation Genetics* 8:3, 659

Rolstad J. 1989. Habitat and range use of capercaillie in southcentral Scandinavian boreal forests. Ph.D. thesis, Agric. Univ., As, Norway.

Segelbacher G., Höglund J. and Storch I. 2003. From connectivity to isolation: genetic consequences of population fragmentation in capercaillie across Europe. Mol. Ecology 12: 1773-1780.

Storch I. 2001. Capercaillie. BWP Update. The journal of birds of the Western Palearctic. Oxford Univ. Press, Oxford UK 3(1): 1-24.

Storch I., Bañuelos M.J. Fernández-Gil A., Obeso J.R., Quevedo M., Rodríguez-Muñoz R. 2006. Subspecies Cantabrian capercaillie Tetrao urogallus cantabricus endangered according to IUCN criteria. Journal of Ornithology: 147:653–655

Suter W., Graf R.W. and Hess R. 2002: Capercaillie (*Tetrao urogallus*) and avian biodiversity: testing the umbrella-species concept. Conservation Biology 16: 778-788.

For extended lists of references on the species see Klaus et al. (1989) and Storch (2001). All publications referred to in the text are listed in the References section.

3.10 Black-billed Capercaillie

Scientific name:	*Tetrao parvirostris*	Bonaparte 1856
Synonyms:	*Tetrao urogalloides*	Middendorff 1851
Common names:	Black-billed capercaillie	English
	Hei zui song ji	Chinese
	Steinauerhuhn	German
	Tétras à bec noir	French
	Kamennyi glukhar	Russian
	Urogallo piquinegro	Spanish

3.10.1. Conservation Status

IUCN 2006 (http://www.redlist.org/): Lower risk (near threatened).
CITES 2005: not listed in Appendices. (http://www.cites.org/eng/append/appendices.shtml).
National Red Data books: China.

3.10.2. Taxonomy

Authors disagree about the scientific name of the species. Here, we follow Sibley and Monroe (1990, 1993) and del Hoyo et al. (1994). Andreev (1991), Klaus et al. (1989), and S. Klaus (pers. comm., 1999), however, favour the earlier name *T. urogalloides*.

A distinct and geographically isolated subspecies *T. p. kamschatikus* on the Russian peninsula of Kamtchatka is generally recognised. The distinction of subspecies within the mainland distribution range has been more ambiguous; now both Potapov and Flint (1989) and del Hoyo et al. (1994) recognise three subspecies; two on the mainland, *T. p. parvirostris* and *T. p. stegmanni*, and one on Kamtchatka, *T. p. kamtschatikus*.

3.10.3. Distribution

North-east Asia. The major part of the range is in Russia, smaller parts are in Mongolia and China. From the Japanese Sea, the Kamtchatka Peninsula and the island of Sachalin west up to approx. 90°E; north up to 70°N and locally beyond, and south to about 45°N in Northern Mongolia and China. The range largely corresponds with that of the larch species *Larix dahurica* and *L. gmelinii*. In the west of the range, some overlap and hybridisation with the capercaillie *T. urogallus* occurs (see Klaus et al. 1989, Potapov and Flint 1989).

3.10.4. Population Size and Trend

The distribution of the species is still largely limited by natural factors (A. Andreev pers. comm., 1999). The reported population densities are highly variable, from 1-5 to >100 males per 100km^2. Locally, particularly in the southern parts of the range, the species has declined dramatically in relation to human population growth, road construction and increasing accessibility of the habitats. Intensive hunting at the leks may be a major cause of population declines (A. Andreev and S. Klaus, pers. comm). The total population size was estimated as 670,000 in the early 1990s (Flint 1995); earlier estimates had been higher (Klaus et al. 1989). Larger-scale population trends are insufficiently known.

3.10.5. Habitat and Ecology

Compared to the western capercaillie, the black-billed capercaillie appears to be generally adapted to more open habitats. Its distribution is closely related to larch taiga forest, both in lowland and mountainous areas, extending from wooded tundra in the north to woody steppes in the south. On Kamtchatka the species is also found in stands dominated by birch *Betula ermani*. Black-billed capercaillies are well known to significantly influence and modify their habitats by creating so-called park forests or capercaillie gardens (Klaus et al. 1989, Andreev 1991). By seasonally trimming small larch trees, the birds suppress vertical growth, transforming the trees to a dwarf form. As a result of annual trimming, the dwarf larches are prevented from growing upwards (Andreev 1991). Larch and birch twigs, shoots and rosehips are major food items in winter. From spring to summer, a wide variety of herbs, grasses and invertebrates are eaten, but ericaceous shrubs play a prominent role in the diet. In the course of the year, black-billed capercaillie use different habitats in relation to food availability. Undirectional movements between seasonal habitats, a few >15km, have been described. Locally, the birds form temporal winter flocks (see Klaus et al. 1989, Potapov and Flint 1989).

Photo 3.10. Black-billed capercaillie - male, display *(Photo Siegfried Klaus)*

Map 3.10. Black-billed capercaillie distribution.

3.10.6. Hunting and Cultural Importance

The species is an important game bird in Russia. In accessible areas close to roads and settlements, intensive hunting at the leks is common, and may be a major cause of the recent population declines.

3.10.7. Principal Threats

Exploitation. Increasing accessibility of the forests and growing human populations in parts of the range, particularly in the south, have led to increasing hunting pressure. Poaching is common and may lead to dramatic declines.

Habitat degradation. The insecure socio-economic situation in Russia may pose significant threats to forest habitats. The demand for resources is great, both by the state and by local inhabitants. Uncontrolled timber exploitation is going on in many parts of Russia. Habitat loss and deterioration related to forest exploitation may become major threats to the black billed capercaillie. In China, habitat degradation is already the major threat in addition to small population size; however, only a minor part of the range is outside Russia.

3.10.8. Research Needs

Better understanding is needed of the species´ population dynamics and regulating factors.

3.10.9. Current Conservation Measures

At present, no specific conservation measures for the black-billed capercaillie are known. The species occurs in a number of protected areas (Zapovedniki) in Russia; at present, however, these reserves probably do not effectively reduce illegal exploitation.

3.10.10. Priority Conservation Measures

Legal protection. A revision and enforcement of hunting regulations is needed. The hunting season should be limited to October-January (Potapov and Flint 1989), because spring hunting on the leks can easily lead to unsustainable hunting bags.

Surveys. At least locally, dramatic declines related to exploitation and habitat degradation have been reported. Regular surveys are recommended to better observe the population trend in areas settled and exploited by people. The rate of loss and fragmentation of the habitats of the Siberian grouse should be assessed, e.g. using remote census techniques, to re-assess its Near-Threatened conservation status.

3.10.11. Recent changes

From Russia, where most of the population is found, threats have increased; most important of which are deforestation, human caused forest fires on a large scale, illegal hunting and legal overhunting during display.

3.10.12. Correspondents

Alexander Andreev, Siegfried Klaus, Roald Potapov

3.10.13. Key Publications

Andreev A. V. 1991 Winter habitat segregation in the sexually dimorphic Black-billed capercaillie. *Ornis Scandinavica* 22:287-291.

Klaus S., Andreev A.V., Bergmann H.-H., Müller F., Porkert J. and Wiesner J. 1989. *Die Auerhühner*. Die Neue Brehm-Bücherei. Band 86. Westarp Wissenschaften, Magdeburg, Germany, pp. 221-280.

Potapov R. L. and Flint V. E. 1989. *Handbuch der Vögel der Sowjetunion. Band 4 Galliformes, Gruiformes*. Ziemsen Verlag Wittenberg Lutherstadt, Germany. 427 pp. (ISBN 3-7403-0027-2).

Table 3.10 Black-billed capercaillie *Tetrao parvirostris* Bonaparte, 1856

Country	Red list[1]	Legal protection[2]				Hunting[3]	Population[4]		Threats[5]								Conservation measures[6]						
		TP	PP	NT	IT		Size	Trend	S	F	H	P	E	D	C	O	S	M	H	C	R	E	O
China	x	x		x	x	P	?	-		x	x		x				x			x			
Mongolia	-		x	x	x	L	?	?															
Russia	-		x			L,P,S	1.8 Million	0,-	x				x		x			x						

1 Red list: x listed as threatened species at the national level, - not listed

2 Legal Protection: TP total protection, PP partial protection, NT possession and/or national trade prohibited or regulated, IT international trade prohibited or regulated

3 Hunting: L legal, P poaching (illegal), R regionally restricted, S restricted hunting season, M males only

4 Population size (order of magnitude): estimated number of individuals in spring;

Population trend (during the past 10 years): + increasing, 0 stable, - declining, ? unknown

5 Threats (factors suspected to cause significant, longer-term population declines and extinction): S small population size, F habitat loss/fragmentation, H habitat degradation, P predation, E exploitation, D disturbance by tourism/leisure activities, C climate change, O other threats

6 Conservation measures (ongoing at the time of reporting): S surveys, M monitoring, H habitat management, C captive breeding, R restocking/reintroduction, E education, O other measures

3.11 Hazel Grouse

Scientific name:	*Bonasa bonasia*	Linnaeus 1758
Synonyms:	*Tetrastes bonasia,* *Tetrao bonasia*	
Common names:	Lesharka	Bulgarian
	Hua wie zhen ji	Chinese
	Jerábek lesní	Czech
	Hjerpe	Danish
	Hazel grouse	English
	Lanepüü	Estonian
	Pyy	Finnish
	Gelinotte des bois	French
	Haselhuhn	German
	Agriokota	Greek
	Császármadár	Hungarian
	Francolino di monte	Italian
	Ezo-raicho	Japanese
	Jerpe	Norwegian
	Jarzabek	Polish
	Ryabchik	Russian
	Gozdni jereb	Slovenian
	Grevol	Spanish
	Järpe	Swedish

3.11.1. Conservation Status

IUCN 2006 (http://www.redlist.org/): Lower risk (near threatened).
CITES 2005 (http://www.cites.org/eng/app/index.shtml): not listed in Appendices.
EU Birds Directive: Annex I
National Red Data books: some central and southern European countries; China.

3.11.2. Taxonomy

There are currently 11 (Potapov and Flint 1989) or 12 (del Hoyo et al. 1994) subspecies recognised based on morphological traits. Only the western and most easterly subspecies are geographically separated (see Bergmann et al. 1996).

3.11.3. Distribution

Eurasia. Boreal montane and temperate forests from France and Scandinavia, and east to Japan. The northern limit of the range coincides with the edge of the taiga forest; the northernmost populations are at approx. 70°N in Lapland and Siberia. The southern limit of the species mostly parallels the southern border of the boreal forest; in central Europe and parts of eastern Asia, the hazel grouse also occurs in deciduous temperate forests and montane forests south of the boreal zone. The species is missing in an area in North-eastern Siberia along the river Indigirka, which is probably related to the absence of alder *Alnus* spp. (see Potapov and Flint 1989, Bergmann et al. 1996).

3.11.4. Population Size and Trend

In the boreal forest, the hazel grouse still occupies most of its historical range and is generally common. In western and central Europe, major declines and range contractions have occurred during the past century and before; most remaining populations are restricted to mountainous areas and many are scattered and small. Some range contractions, partly occurring in historical times, have occurred in China and Mongolia due to large-scale deforestation. In Japan, a dramatic decline occurred in the 1970s (see Potapov and Flint 1989, Fujimaki 1995, Bergmann et al. 1996).

Photo 3.11. Hazel grouse male. ***(Photo Hans Aschenbrenner).***

3.11.5. Habitat and Ecology

Hazel grouse inhabit mostly mixed coniferous-deciduous forests. They show fairly narrow requirements for habitat structure; availability of relatively dense coniferous or deciduous cover from the ground to about seven metres in height seems to be critical. Hazel grouse are found in a wide variety of habitat types that provide this structural requirement; these can be old growth as well as managed deciduous or coniferous forests of different harvest regimes and successional stages. In pure coniferous forests, e.g. in the Alps, hazel grouse may occur in low densities as long as small deciduous patches are provided, e.g. along streams. During snow, hazel grouse feed on the catkins and buds of deciduous trees such as *Alnus, Betula, Corylus, Sorbus, Fagus*, *Salix* and *Chosenia*. Close interspersion of feeding trees and cover is crucial. In snowfree times, the birds feed on a variety of shrubs, herbs and grasses. Hazel grouse avoid open areas and seem to be particularly vulnerable to forest fragmentation (see Swenson 1991, 1995, Åberg 1996, Bergmann et al. 1996, Montadert and Leonard 2003, 2006).

3.11.6. Hunting and Cultural Importance

The hazel grouse is a popular game species throughout most of its range. European hunters mostly attract the birds by imitating their calls with special grouse whistles in spring and autumn. This kind of hunting is still practised in Scandinavia and Russia. In the boreal zone, however, hazel grouse are more commonly hunted with pointing dogs in autumn. In Russia, the greatest hunting bags of hazel grouse result from snaring and trapping.

Hazel grouse hunting no longer plays any economic role in central Europe. Only a few birds are taken and hunting is banned in several countries. In part of the boreal region, hazel grouse shooting remains economically important. After the willow ptarmigan, the hazel grouse is the most numerous of all grouse, and probably of all small game species, in the bag of Fennoscandian and Russian hunters. The species is hunted for both sport and food in northern Europe. In Russia

Map 3.11. Hazel grouse distribution.

it is primarily hunted for food, but is also used as bait for trapping mustelids. The Russian hunting bag of hazel grouse probably still exceeded 2 million birds per year in the early 1990s (Grabuzov 1995); present hunting bags are unknown. In Japan, sport hunting of hazel grouse is popular, but shooting bags have dropped from 50,000 in the late 1960s to 5,000 in 1991 and <1000 in 2003, because of a decline in the population (Fujimaki 1997, Fujimaki pers. comm., 2005).

3.11.7. Principal Threats

Habitat degradation. Habitat loss, fragmentation and degradation related to changes in human land use or silvicultural practices are the most important threats to the hazel grouse. Habitat degradation due to high numbers of wild ungulates plays a role in some areas (Belgium). Deforestation (parts of Asia), loss of a dense understorey in industrial forests (central and southern Europe, Fennoscandia), and clearcutting (boreal forest) may result in declining hazel grouse numbers.

Predation. A dramatic decline in hazel grouse numbers in Japan coincided with an increase in red foxes. In parts of Europe, increasing numbers of generalist predators and wild boar are believed to result in reduced survival and nesting success.

Exploitation. Poaching continues to affect hazel grouse in Korea, particularly in areas where road construction aids the accessibility of the habitat (Shin-Jae Rhim, pers. com. 2005).

3.11.8. Research Needs

Long-term counts, preferably with measures of reproductive success, are needed to estimate a minimal viable population size and minimum spatial habitat requirements for population and metapopulation persistence. Information is needed on population dynamics and colonisation, and extinction in habitat patches in relation to the size, quality and isolation of that patch. Comparative approaches from various parts of the range with different landscape patterns and disturbance regimes should be continued.

3.11.9. Current Conservation Measures

Legal protection. The degree of legal protection varies between countries. In general, the species is fully protected in countries with small and declining populations, e.g. in central Europe and China. Illegal hunting was reported from several countries but nowhere was it believed to greatly influence population dynamics.

Protected areas. Protected areas cover a minor proportion of the species contiguous range and their role for grouse conservation is generally considered to be limited. In a few countries at the limits of the range, however, reserves are seen as critical for long-term survival of hazel grouse populations (Greece, Hungary, Japan, Mongolia and Belgium).

Surveys and monitoring. In Fennoscandia, monitoring is common as a means of harvest planning. In other parts of the range, mostly regionally restricted and irregular surveys and monitoring of some populations have been reported. In parts of Bohemia (Czechia), hazel grouse have been monitored for >30 years (Klaus 1995, Klaus & Sewitz 2000). In the French Jura Mountains, three 500-1000 ha sites are monitored for hazel grouse by summer drive counts: Since 1983 in Risoux Forest in Jura department, since 1995 in Risol Forest in Doubs department and since 1993 in Champfromier forest in Ain department. Further monitoring sites in the French Alps are under development (M. Montadert, pers. comm. 2005).

Habitat preservation. Habitat management for hazel grouse has been initiated in some parts of Europe with small or declining populations. Measures include maintaining coppice woodlands, favouring deciduous trees and shrubs within coniferous forests and planting patches of conifers for cover within extensive deciduous forests. Because many capercaillie habitats are also suitable for hazel grouse, both species can simultaneously benefit from silvicultural practices promoting multi-layered, but not too dense, forests.

3.11.10. Priority Conservation Measures

Habitat preservation. Integrating forestry practices and habitat conservation appears to be most important where industrial forestry is introduced, where silvicultural practices change forest structure in a way unfavourable to the species, and where populations are declining. From some countries, protected areas have been suggested as a means of habitat protection (e.g. Bulgaria, Greece, Hungary, Japan).

Landscape scale aspects of hazel grouse habitats need to be considered where populations are spatially structured. Regarding the sensitivity of the species to habitat fragmentation, maintaining or restoring spatial connectivity among scattered populations seems to be vital, e.g. in western and central Europe.

Surveys and monitoring. Population monitoring is recommended to track potential declines and to ensure sustainability of exploitation, primarily in those parts of the range where the species is potentially threatened or declining, or in regions with a high hunting pressure.

Law enforcement. Better law enforcement is required in some countries where the species is threatened and illegal hunting appears to be common, e.g. Bulgaria and Greece.

3.11.11. Recent changes

In northeastern China, a ban on guns has reduced illegal hunting on hazel grouse. However, habitat degradation is becoming more and more serious, at least at Changbaishan, Jilin province (see Sun *et a. 2003).* In various parts of the Alps, increases of hazel grouse populations have been perceived, e.g. in France (expanding populations), Italy (expanding towards the West) and Germany (possibly related to changes in forest structure). However, along the western edge of the range, the species continues to decline (e.g. Belgian and French Ardennes, Black Forest).

Table 3.11 Hazel grouse *Bonasa bonasia* Linnaeus, 1758

Country	Red list[1]	Legal protection[2]				Hunting[3]	Population[4]		Threats[5]								Conservation measures[6]						
		TP	PP	NT	IT		Size	Trend	S	F	H	P	E	D	C	O	S	M	H	C	R	E	O
Albania	?					?	?	?															
Austria	x		x			L, R, S, M	>50,000	?		x	x	x	x				x	x	x			x	
Belarus	-		x			L, S	80-95,000	-		x	x	x					x						
Belgium	x	x		x	x		<60	-	x	x	x	x		x			x		x				x
Bosnia/Herceg.	?					?	Very low	?	x	x	x												
Bulgaria	x	x		x		P	?	-	x	x	x		x				x	x	x			x	
China	x	x		x	x	P	?	0		x	x		x				x						
Croatia	-	x					?	?	x	x	x	x		x									
Czech Rep	x	x		x	x		4-8,000	?										x					
Estonia	-					L	30,000?	0/-			x	x			x			x					
Finland	-		x	x		L, R, S	800,000	0		x	x							x	x			x	
France	-		x			L, R,S,M	10,000	+/0/-	x	x	x	x					x	x	x				
Germany	x	x		x	x		2-4000	0/-/+	x	x	x								x	x	x		
Greece	x	x				P	?	0/- ?	x	x	x		x				x						
Hungary	x	x		x	x		160-180	-	x	x	x	x											
Italy	x	x		x		P	10-12,000	0/+		x	x				x								
Japan	x		x			L,S	?	0				x		x									
Kazakhstan	-					?	150,000?	?															
Latvia	-			x	x	L, S	30-60,000	?				x		x									
Liechtenstein	x	x					low	0/+															
Lithuania	-					?	?	?															
Luxemburg	?						<60	-															
Macedonia	-		x			L, P, S	3-15,000	0?		x	x		x										
Mongolia	-		x	x	x	L, S	80,000	0/?	x	x	x						x						
North Korea	?					?	?	?															
Norway	-					L, S	>75,000	?										x					
Poland	-		x		x	L	35-45,000	-/+			x	x		x			x						
Romania	-		x			L, P	18-24,000	-/0		x	x		x	x								x	
Romania	-			x	x	L,.P	10-13,000	0		x	x		x	x									
Russia	-					L,P,S	>30 Million	+,0,-					x	x	x			x					
Serbia/Montenegro	x	x		x	x	P	3,200-5,300	+	x	x	x			x	x		x	x	x				
Slovakia	x					L	6-10,000	-		x	x	x						x					
Slovenia	x	x					?	-	x	x	x	x											
South Korea	x	x				P	?	-	x	x	x						x						
Spain	x	x		x	x		Presence uncertain																
Sweden	-					L, S	200,000	0															
Switzerland	x	x		x			7-9,000	-			x						x					x	
Ukraine	-	x				P	15,000	-	x	x	x		x										

1 Red list: x listed as threatened species at the national level, - not listed

2 Legal Protection: TP total protection, PP partial protection, NT possession and/or national trade prohibited or regulated, IT international trade prohibited or regulated

3 Hunting: L legal, P poaching (illegal), R regionally restricted, S restricted hunting season, M males only

4 Population size (order of magnitude): estimated number of individuals in spring;

Population trend (during the past 10 years): + increasing, 0 stable, - declining, ? unknown

5 Threats (factors suspected to cause significant, longer-term population declines and extinction): S small population size, F habitat loss/fragmentation, H habitat degradation, P predation, E exploitation, D disturbance by tourism/leisure activities, C climate change, O other threats

6 Conservation measures (ongoing at the time of reporting): S surveys, M monitoring, H habitat management, C captive breeding, R restocking/reintroduction, E education, O other measures

3.11.12. Correspondents

1999: Andras Baldi, Massimo Bocca, Ariane Bernard-Laurent, Hans-Heiner Bergmann, Ayurzanyn Bold, Miran Cas, Roman Dziedzic, Volodymyr Domashlinets, Laurence Ellison, Michael Fasel, Yuzo Fujimaki, Marijan Grubesic, Lazlo Kalaber, Wolfgang Kantner, Siegfried Klaus, Woo-Shin Lee, Harto Lindén, Alexander Mikityuk, Pierre Mollet, Tatjana Pavlushchick, Roald Potapov, Shin-Jae Rhim, Athanassios Sfougaris, Peter S. Shurulinkov, Torstein Storaas, Ilse Storch, Sun Yue-Hua, and Ene Vith.

2004: Miran Cas, Gabriel Bogdan Chisamera, Yuzo Fujimaki, Pekka Helle, Pär Jacobsson and Jacob Höglund, Michal Kaszuba, Siegfried Klaus, Patrick Leonard, Michèle Loneux, Petra Malkova, Pierre Mollet, Marc Montadert, Rainer Ploner and Lucca Rotelli, Shin-Yae Rhim, Tatiana Pavlushchick, Roald Potapov, Slobodan Puzovic, Attila D. Sándor, Hysen Shabanaj, Ilse Storch, Yue-Hua Sun, Metodija Velevski, Ene Vith, Per Wegge, Albin Zeitler.

3.11.13. Key Publications

Bergmann, H.-H., Klaus, S., Müller, F., Scherzinger, W., Swenson, J.E., Wiesner, J. 1996. Die Haselhühner, Westarp Wissenschaften, Magdeburg, Germany. 278 pp.

Montadert, M. 2005. Fonctionnement démographique et sélection de l'habitat d'une population en phase d'expansion géographique. Cas de la Gélinotte des bois dans les Alpes du Sud, France. PhD Thesis, Department of environmental biology Besançon-Montbéliard, University of Franche-Comte, France.

Montadert, M. & Léonard, P. 2006. Post-juvenile dispersal of Hazel grouse Bonasa bonasia in an expanding population of the southeasten French Alps. - Ibis 148: 1–13.

Swenson, J. E. 1991. Social organisation of hazel grouse and ecological factors influencing it. PhD Thesis, Univ. of Alberta, Canada.

Swenson, J. E. 1995. Habitat requirements of hazel grouse. In: Jenkins, D. (ed.: Proc. Intern. Symp. Udine, Italy, 1993. Grouse 6: 155-162. Udine, Italy, 1993

Sun, Y.H., Zh.J. Piao & J. E. Swenson 2003. Occurrence of hazel grouse Bonasa bonasia in a heavily human-impacted landscape near Changbai Mountains, northeastern China. Wildlife Biology 9 (4): 371-375.

For an extended list of references on the species see Bergmann et al. 1996 and Montadert and Leonard 2006. All publications referred to in the text are listed in the References section.

3.12 Chinese Grouse

Scientific name:	*Bonasa sewerzowi*	Przewalski, 1876
Common names:	Ban wei zhen ji	Chinese
	Chinese grouse, Severtzov´s grouse, Black-breasted hazel grouse	English
	Gelinotte de Severtzow	French
	China-Haselhuhn	German
	Grevol chino	Spanish

Photo 3.12a Chinese grouse male *(Photo Siegfried Klaus).*

Photo 3.12b Chinese grouse male in autumn *(Photo S. Klaus).*

3.12.1. Conservation Status

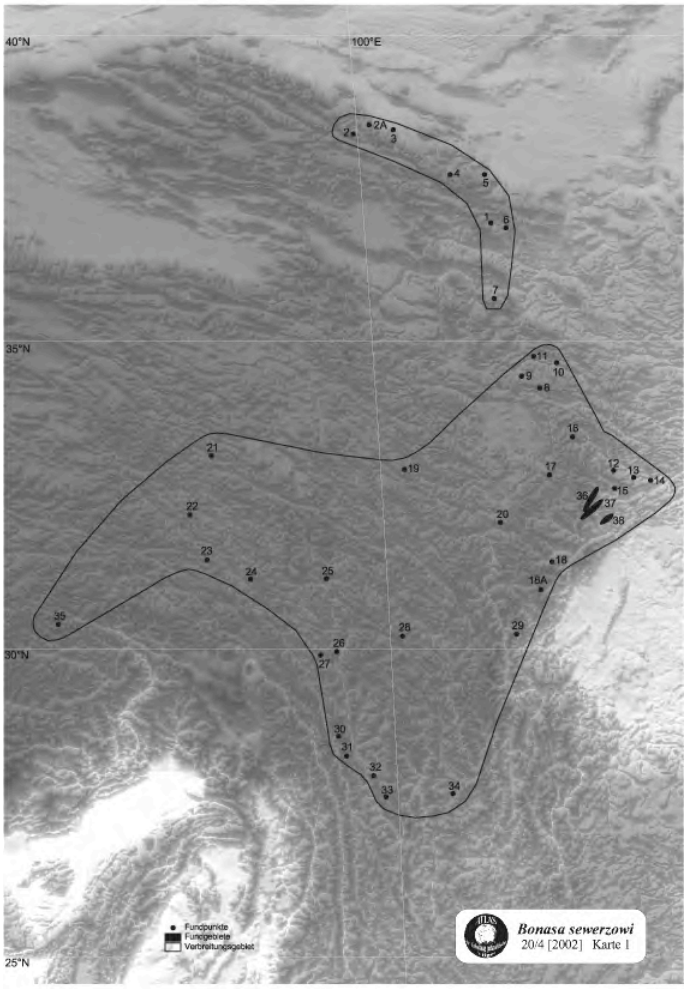
IUCN 2006 (http://www.redlist.org/): Lower risk (near threatened).
CITES 2005: not listed in Appendices. (http://www.cites.org/eng/append/appendices.shtml):
National Red Data books: China (Wang 1997).

3.12.2. Taxonomy

Some authors consider the species to be monotypic (Johnsgard 1983, del Hoyo et al. 1994), whereas others distinguish two subspecies *B. s. sewerzowi* and *B. s. secunda*, which are separated by a distance of 250 km (Potapov cit. in Bergmann et al. 1996; Li 1996).

3.12.3. Distribution

Central China, from central Gansu and southern Qinghai provinces to Tibet, nothwest Yunnan and most of Sichuan.
The western distribution limit seems to be uncertain; recently the species has been confirmed in the westernmost portion of the Tibetan forest at approx. 93°E (Lu 1997). For an updated distribution map see Klaus & Sun (2003). The total range extent has been estimated as 12,400 km^2 in Gansu and Quinghai, occupied by nominate form *B. s. sewerzowi*, plus 303,000 km^2 mostly in Sichuan, Eastern Tibet and north Yunnan, occupied by *B. s. secunda*.



Map 3.12a Detailed map from Klaus & Sun (2003), with permission.

3.12.4. Population Size and Trend

The range of the Chinese grouse has probably become greatly reduced since the advent of large scale forest clearances in historic times; however, the original range of the species is uncertain. In recent times, the habitat has become more and more fragmented, and the species has disappeared from parts of its range. Population densities have been estimated at 9 birds per km^2 in Yunnan and ≤2 birds in Sichuan and may exceed 12 adults per km^2 (Klaus et al. 1996). The range is still contracting and numbers are declining, but the rate of this change is unknown. The total population size has been estimated at ~10,000 birds (Sun pers. comm., 2004). The conservation status is not sufficiently clarified (see Bergmann et al 1996, Klaus et al. 1996, Li 1996).

Map 3.12b. Chinese grouse distribution

3.12.5. Habitat and Ecology

The Chinese grouse inhabits conifer-rich mixed montane forests from the valley bottoms to the treeline. In most areas, conifer-dominated habitats are restricted to the higher elevations and the wetter northern exposures. The species occupies a similar niche to its close relative, the hazel grouse *B. bonasia*. Chinese grouse select patches with willow *Salix*, birch *Betula* and other deciduous species in close interspersion with conifers for cover. The dominating conifer species are spruce *Picea* spp. and fir *Abies* spp.. In the newly discovered Tibetan distribution area, juniper *Juniperus* is the only conifer (S. Klaus pers. comm., 1999). Preferred habitats are dense and multi-layered forests; in summer, the birds also use krummholz and subalpine shrub habitats above the treeline. Mainly feeds on buds and leaves of willow and birch, spruce seeds as well as flowers, leaves and shoots of other shrubs and herbs. Twigs and buds of willow and birch are the major winter food (see Bergmann et al. 1996, Sun 1995, 1996).

3.12.6. Hunting and Cultural Importance

Illegal hunting and egg collecting may be locally common. Some forestry workers in Zhuoni County, Gansu, said that they hunted 60-80 birds each year and did not know the birds were a protected species (Sun, pers. comm., 1999). The overall cultural and economic roles of the species are unclear, but probably not important.

Photo 3.12c Chinese grouse in autumn 2006 (Photo S. Klaus).

3.12.7. Principal Threats

***Habitat loss and fragmentation*.** High demands for farmland, timber and firewood are the reasons for the ongoing destruction of forests in the range of the Chinese grouse and elsewhere in China. The effects are continuing loss and fragmentation of the habitat. Many populations have become isolated in the remaining small forest islands. Reforestation can only partly compensate for these losses.

***Climatic change*.** The effects of anthropogenic habitat loss are enhanced by climatic changes towards increasing aridity. This has both natural causes related to the ongoing raising of the Himalayas and anthropogenic causes related to large-scale deforestation. In many areas, a lack of precipitation allows forest vegetation to grow only on the wetter northern slopes.

***Exploitation*.** Some illegal hunting and egg collecting are reported. The effects of poaching on the population are considered to be low, at least where the species has been recently studied. In other areas, particularly outside protected areas, exploitation may have significant effects on populations (Sun 1995, Sun pers. comm., 1999).

3.12.8. Research Needs

Since 1995, the Chinese grouse has been studied at Lianhuashan Natural Reserve in Gansu Province. Radio telemetry revealed insights into habitat-relationships, spacing patterns and behaviour (Sun et al. 2003). Further studies into population dynamics are needed.

***Effects of forestry practices*.** Chinese grouse are known to occur in some second-growth habitats although grouse numbers seem to decrease after logging (Sun 2000). However, the effects of various silvicultural practices on grouse population dynamics are not well understood. In most of the bird's present range, the predominating silvicultural technique is selective cutting of different intensities (Sun pers. comm). According to forestry regulations, a maximum of 40% of the trees may be logged; however, in practice the cutting rate often exceeds this limit. To assess the effects of various forestry practices on the persistence and population density of Chinese grouse, a series of surveys are suggested in different types of managed forests with different cutting regimes, including newly cut primary habitats as well as second-growth forests; populations should also be monitored before and after cutting. The results will enable important advice to be given to the forestry administration on how to integrate forestry operations and grouse habitat conservation.

***Landscape ecology*.** Throughout its range, the remaining habitats of the Chinese grouse are highly fragmented. Habitat fragmentation patterns (patch size and isolation, distance between patches, existence of potential movement corridors between patches, and distribution ranges) can be assessed with the help of satellite images and other remote sensing techniques. The presence and population density of Chinese grouse should be surveyed in the field in relation to fragmentation patterns. Research into the effects of habitat fragmentation on population dynamics and persistence of the Chinese grouse has been started by Sun Yue-Hua of the Chinese Academy of Sciences at Beijing (Sun et al. 2003) and should be extended.

***Dispersal*.** Knowledge about dispersal is vital in understanding how Chinese grouse can cope with fragmented habitats. Further radiotracking studies, particularly of broods and juveniles, and population genetic studies are desirable to understand dispersal behaviour, dispersal rates and distances. The closely related hazel grouse is known to be a poor disperser that is very reluctant to cross open land between forest patches (see Swenson 1991).

***Population structure and dynamics*.** More work is needed on reproductive biology to better understand the basic parameters of population dynamics, such as brood and chick survival, and sex- and age-related mortality rates.

3.12.9. Current Conservation Measures

***Legal protection*.** The species is totally protected throughout its range. As a species listed in category I of the China Red Data Book of Endangered Animals, it has the potential to play a prominent role in Chinese conservation policy.

***Protected areas*.** There are several protected areas within the species´ range and the Chinese grouse has been confirmed as resident in some of these reserves; for others, its presence is yet to be confirmed. Reserves are considered to be critical for the survival of the species; their present effectiveness is judged to be high.

***Habitat preservation*.** The Chinese government banned the cutting of virgin forest in Sichuan and Gansu Provinces in 1998 after a big flood in the summer (Sun pers. comm., 1999). Although the primary purpose of this measure is flood prevention, preservation of these forests will also favour population persistence of Chinese grouse.

***Surveys*.** Surveys of Chinese grouse populations have been limited to restricted areas in different parts of the range.

3.12.10. Priority Conservation Measures

The Chinese grouse is listed as a globally near threatened species and so its conservation has high priority. Here, a short summary of recommended conservation measures is given. Recommendations for research and conservation priorities for the Chinese grouse are described in greater detail in Chapter 4.

***Assess, maintain, and restore the connections between local populations*.** Fragmentation of habitats and isolation of populations is a major threat to the Chinese grouse. The rate of loss and fragmentation of the habitats should be assessed, e.g. using remote census techniques, to re-assess its Near-Threatened conservation status. Connectivity and exchange between the populations is vital for the long-term persistence of the species and needs to be restored. Three steps are recommended: Surveys to assess the distribution and status of the species throughout its range; habitat and genetic studies to assess the connectivity between local populations; and extension of the protected area network by creating new reserves and habitat corridors to connect isolated populations. (see Research needs: landscape ecology.)

***Integrate forestry practices and habitat conservation*.** As a first step towards integrating sylvicultural practices with Chinese grouse conservation, the effects of various cutting regimes on Chinese grouse populations should be assessed by comparing populations in different types of managed forest and by monitoring population dynamics before and after cutting (see Research needs). This knowledge should then be used to formulate guidelines for grouse habitat preservation. Finally, the guidelines should be applied in forest management by the state forestry administration.

***Captive breeding*.** Up to now, no attempts at captive breeding of Chinese grouse have been conducted; to develop captive breeding and rearing techniques is not an urgent priority in Chinese grouse conservation. Building up a captive stock of Chinese grouse, however, may be suggested as a longer-term activity.

3.12.11. Recent changes

The first studies of the species´ population biology (Sun et al. 2003), population genetics (Larsson et al. 2003), and landscape ecology (Sun et al. 2003) were presented in 2003. In 1998, the Chinese government stopped logging the natural forest within Gansu and Sichuan provinces for flood prevention. This may have helped to, at least locally, stabilize Chinese grouse population trends. However, studies have been restricted to minor parts of the distribution range, and more surveys are needed to clarify the species´ entire range status. Most probably, ongoing deforestation, fragmentation and erosion continue to affect the species in

large parts of the range. Rates of habitat loss and population decline need to be clarified.

Photo 3.12d. Chinese grouse in August 2002 (9th IGS excursion, Photo M. Loneux).

3.12.12. Correspondents

1999 and 2004: Yue-Hua Sun, Siegfried Klaus

3.12.13. Key Publications

Bergmann, H.-H., Klaus, S., Müller, F., Scherzinger, W., Swenson, J.E., Wiesner, J. 1996. Die Haselhühner, Westarp Wissenschaften. Magdeburg, Germany. Pp 210-276.

Klaus, S. & Y.-H. Sun (2003): Bonasa sewerzowi (Przewalski, 1876) Chinahaselhuhn. Atlas der Verbreitung paläarktischer Vögel. Lieferung 20, edited by J. Martens, S. Eck and Y.-H. Sun. 6 p.

Larsson, J. K., Y.H. Sun, Y. Fang, G. Segelbacher & J. Höglund J. 2003 Microsatellite variation in a Chinese grouse population: signs of genetic impoverishment? Wildlife Biology 9 (4): 261-266.

Lu, Xin 1997. A new disribution area of the Chinese grouse in Tibet. Grouse News 14:18-20.

Sun, Y.-H. 1996. Winter ecological studies of Chinese Grouse. Acta Zoologica Sinica 42: 96-100.

Sun, Y.H. (2000) Distribution and status of the Chinese Grouse. Wildl. Biol. 6: 275-279.

Sun Y-H, J E Swenson, Y Fang, Klaus, S. & W Scherzinger (2003): Population ecology of the Chinese grouse in a fragmented landscape. Biology of Conservation 110: 177-184.

Yue-Hua Sun can be contacted for a list of publications in Chinese language (see Appendix 1).

All publications referred to in the text are listed in the References section.

Table 3.12 Chinese grouse *Bonasa sewerzowi* Przewalski, 1876

Country	Red list[1]	Legal protection[2]				Hunting[3]	Population[4]		Threats[5]								Conservation measures[6]						
		TP	PP	NT	IT		Size	Trend	S	F	H	P	E	D	C	O	S	M	H	C	R	E	O
China	x	x		x	x	P	>10,000?	-,0		x	x	x	x				x	x	x				

1 Red list: x listed as threatened species at the national level, - not listed

2 Legal Protection: TP total protection, PP partial protection, NT possession and/or national trade prohibited or regulated, IT international trade prohibited or regulated

3 Hunting: L legal, P poaching (illegal), R regionally restricted, S restricted hunting season, M males only

4 Population size (order of magnitude): estimated number of individuals in spring;

Population trend (during the past 10 years): + increasing, 0 stable, - declining, ? unknown

5 Threats (factors suspected to cause significant, longer-term population declines and extinction): S small population size, F habitat loss/fragmentation, H habitat degradation, P predation, E exploitation, D disturbance by tourism/leisure activities, C climate change, O other threats

6 Conservation measures (ongoing at the time of reporting): S surveys, M monitoring, H habitat management, C captive breeding, R restocking/reintroduction, E education, O other measures

3.13 Ruffed Grouse

Scientific name:	*Bonasa umbellus*	Linnaeus 1776
Common names:	Ruffed grouse	English
	Gelinotte huppée	French
	Grevol engolado	Spanish

3.13.1. Conservation Status

IUCN 2006 (http://www.redlist.org/): Lower risk (near threatened).
CITES 2005 (http://www.cites.org/eng/app/index.shtml): not listed in Appendices.
National Red Data books: not listed.

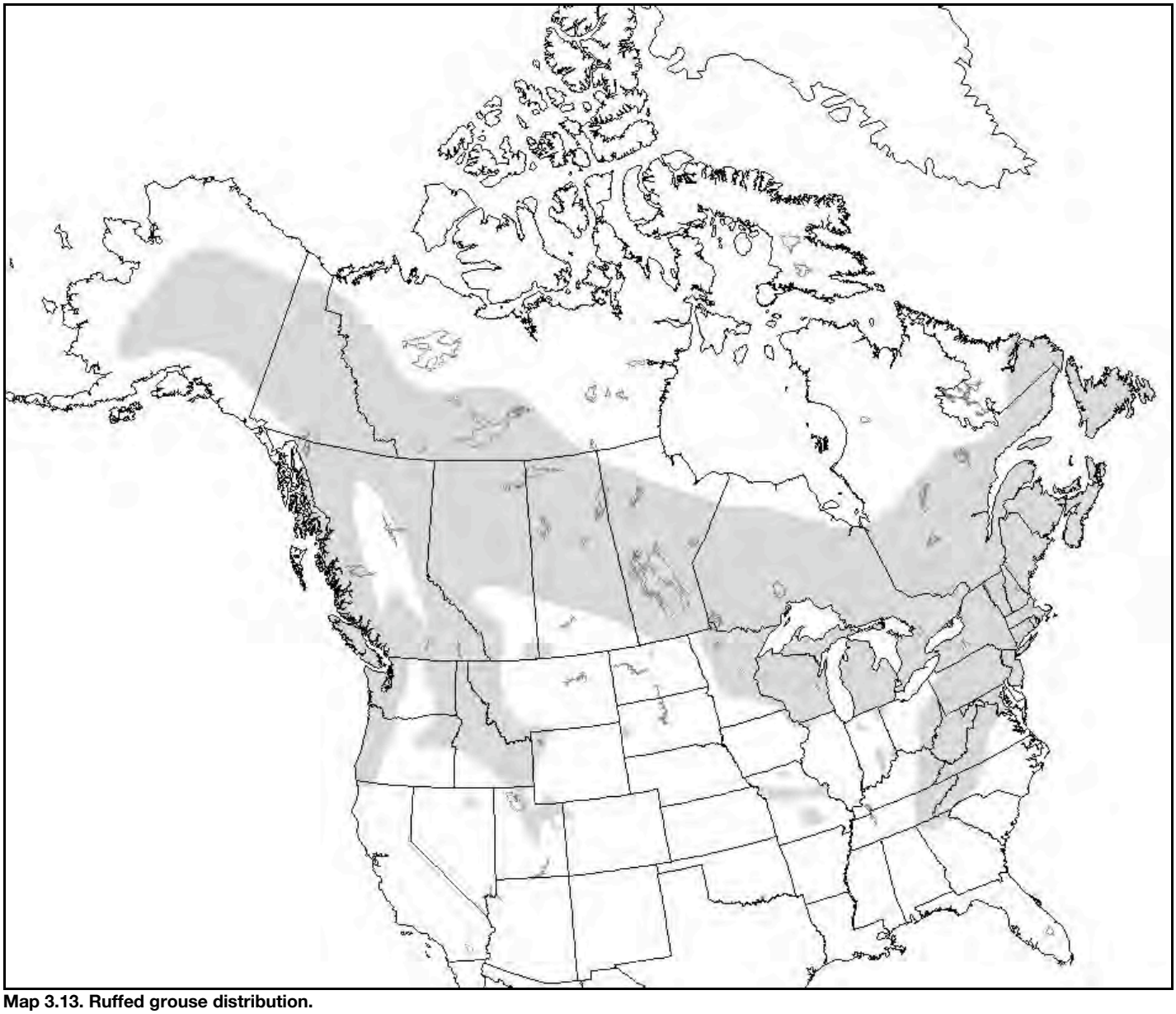
3.13.2. Taxonomy

Dependent on author. Johnsgard (1983) distinguishes 11, Attwater and Schnell (1989) list 12, and del Hoyo et al. (1994) recognise 14 subspecies. No subspecies is geographically isolated.

Photo 3.13. Ruffed grouse. ***(Photo Petra Kaczensky).***

3.13.3. Distribution

Widely distributed throughout temperate, boreal and montane forests of northern North America. The range is described in detail by Rusch et al. 1999.



Map 3.13. Ruffed grouse distribution.

3.13.4. Population Size and Trend

The ruffed grouse is widespread and fairly common throughout its original range. In general, ruffed grouse are numerous in the upper midwest, the northwest and the northeast of the range, whereas population numbers are relatively low in the southern and south-western parts. Some range contractions in the past have been partly compensated by translocating birds from elsewhere; in Missouri, populations have been successfully restored in major parts of the state, whereas in Illinois restocking success remained local. A new population was established in southern Idaho by translocation. Introduced into Newfoundland and locally into Nevada. Densities vary between forest types. Average recorded densities are about eight drumming males or 22 adult birds per km_, but good habitats are over-represented in these studies (Rusch et al. 1999). Northern populations show approximately 10-year cycles. Other populations can exhibit significant year-to-year variation, largely dependent upon spring weather and its effects on brood production. Except for these fluctuations and localised declines, ruffed grouse generally appear to be stable and secure in Canada and the western U.S., but numbers appear to be declining in the eastern U.S. (See Atwater and Schnell 1989, Rusch et al. 1999).

3.13.5. Habitat and Ecology

Ruffed grouse occur in a great variety of dense woodland habitats from boreal forest to Pacific coast rain forest to relatively dry deciduous forests, but always with some deciduous trees, especially aspen *Populus* spp. Except for parts of western North America, the species´ overall range corresponds to that of the quaking and bigtooth aspen, which are typical of regenerating boreal and montane forests following fire, logging and other disturbances. West of the Cascade and north coast mountains, ruffed grouse occur in riperian habitats where they take black cottonwood (*Populus trichocarpa*) for winter food (Brewer 1980); a common species not dependent on disturbances often associated with ruffed grouse habitat (F. Zwickel, pers. comm., 1999). Ruffed grouse depend upon early-successional stages of woody vegetation. Disturbances such as fire and logging often improve ruffed grouse habitat quality. For winter habitats, some conifer cover is advantageous. In winter, ruffed grouse feed on buds and twigs of various trees, particularly *Populus* spp.; in the snow-free seasons the diet diversifies according to accessibility of leaves, buds, flowers and fruits in the ground- and shrub-layer. Habitat quality for ruffed grouse may be increased by providing a suitable mosaic of forest age-classes. Optimally, stands of young and older forests are closely interspersed. (See Atwater and Schnell 1989, Rusch et al. 1999).
In oak *(Quercus*) and hickory *(Carya*) forests, clearcutting, shelterwood and two-age cutting can be used to provide early successional habitat and acorn producing oaks (Norman et al. 2004).

3.13.6. Hunting and Cultural Importance

The ruffed grouse is a highly valued game bird and is extensively hunted both for food and sport in most of its range. It is the most intensively hunted grouse species in North America. Ruffed grouse were commonly shot, trapped and snared for subsistence and sale through the early 1900s. The first hunting regulations with closed seasons date back to the early 1700s and early 1800s (Rusch et al. 1999). Annual hunting bags in the late 1970s and early 1980s were estimated at 6 million birds, and bags have only been increasing since the 1940s (see Rusch et al. 1999, Atwater and Schnell 1989). Except for some localised, heavily hunted areas, hunting is believed to have little effect on ruffed grouse numbers. The existence of influential hunter-conservationist organisations, such as the Ruffed Grouse Society, reflects the cultural importance of the species as a game bird.

3.13.7. Principal Threats

***Habitat loss and degradation*.** Fire suppression is a major cause of habitat degradation, fragmentation and loss. Some believe that current negative public attitudes towards even-age silvicultural prescriptions, especially clearcut regeneration harvests, negatively impact ruffed grouse populations (D. Dessecker, pers. comm., 1999). However, long-term sustainability of some forest management practices, such as clear cutting and its effects on soils and ecosystem functions, are questionable; even if short-term effects lead to increasing grouse numbers, long term effects of intensive habitat manipulation on ruffed grouse and the ecosystems they inhabit may be disadvantageous (F. Zwickel, pers. comm., 1999). The species will probably decline in the future as eastern deciduous forests mature. Locally, particularly in the east, urban and summer home development, and agriculture lead to habitat loss (see Rusch et al. 1999). In midwestern areas where ruffed grouse are restricted to riparian woodlands, grazing of herbaceous ground flora and browsing of understorey by cattle is a limiting factor, as is flooding of these restricted habitats during spring nesting (R. Applegate, pers. comm).

3.13.8. Research Needs

Little long-term research is currently being conducted. Ongoing efforts in the mountains of the eastern United States will add to the understanding of the ecology of ruffed grouse in this region. Little attention has been paid to the ecology in the forests of western North America. Data on the effects of harvesting on populations are generally lacking, although ongoing telemetry studies are addressing this issue.

***Effects of harvesting*.** Further research is needed on the effects of hunting on localised populations, especially in the western states and in northern regions with localised but heavy hunting pressure, where the birds are also cyclic.

***Effects of forest exploitation*.** Ruffed grouse response to silvicultural prescriptions, other than clearcut regeneration harvests, is poorly understood. More information is needed on the interaction of ruffed grouse populations and riparian management practices in the western US. Further research requirements concern the effects of forest change on ruffed grouse abundance in the southern limits of its range. Here, populations may be more sparse and patchily distributed, and changing lumber and pulp markets effect the harvesting of trees, especially aspen, by small, private landowners, in relation to measures of abundance.

Spatial ecology. Questions regarding the size, shape and connectivity of isolated tracts of habitat will become important for the conservation of the species in the eastern states (Rusch et al. 1999).

***Taxonomy*.** The intraspecific taxonomy of the ruffed grouse merits careful evaluation with modern genetic methods.

3.13.9. Current Conservation Measures

***Legal protection*.** The ruffed grouse is partially protected throughout its range; hunting is generally regulated by defined seasons, bag limits and area closures. The species

is not hunted in Alabama, Arkansas, Colorado, Illinois and Kansas.

Protected areas. Throughout their range, ruffed grouse live in a variety of protected areas, such as state and national parks, and state wildlife management areas. These reserves, however, are not considered critical for the species´ long-term survival.

Habitat management. In many parts of the range, habitat management programmes especially designed to favour ruffed grouse have been implemented; most are carried out by the forest products industry, local, state or federal resource management agencies, non-industrial private forest landowners or private organisations. Habitat management for ruffed grouse is often mostly motivated by hunting interests, but also the programmes generally have conservation value for various forest species.

Surveys and monitoring. Ruffed grouse counts are common practice throughout much of the species range, particularly in the United States. The most common population index is the drumming count; a standardised transect count of displaying males. Surveys of drumming males are undertaken each spring by state resource management agencies in the Great Lakes region and sporadically elsewhere. Annual autumn harvest numbers and age composition of the kill are obtained by resource management agencies in various states and provinces by hunter check stations, wing surveys and questionnaires sent to hunters. The Ruffed Grouse Society annually collects data from grouse harvested during a managed hunt in northern Minnesota. The species is not monitored, nor are harvests tracked, except crudely, throughout much of its northern (Canadian) range.

Translocations and restocking. The species has been successfully translocated in parts of the western and Midwestern US. There are no significant efforts ongoing at this time.

Non-government organisations. Several non-governmental organisations promote and support conservation of the ruffed grouse and its habitat, especially the Ruffed Grouse Society. This 25,000-member, non-profit organisation operates throughout North America and serves to provide public education about all forest wildlife, provide financial support for research and collaborate with large forest companies and small landowners on management programmes for ruffed grouse.

3.13.10. Priority Conservation Measures

Habitat preservation. Habitat corridors connecting populations need to be maintained. Habitat preservation measures, including riparian management, need to be integrated into forest management in western North America. Negative attitudes toward forest fire must be modified to ensure the long-term viability of ruffed grouse and other wildlife dependent upon habitats created through fire disturbance. Monitoring of ruffed grouse abundance in scattered, disjunct local populations that may fail or ebb because of declines in wood prices, is recommended.

3.13.11. Recent changes

In parts of the range, urbanization leads to habitat loss and fragmentation. Locally natural succession is leading to reduced habitat suitability for the species due to a lack of timber harvest.

3.13.12. Correspondents

2000: Roger Applegate, Jack Connelly, Dan Dessecker, Dan Keppie, and Fred Zwickel

2005: Dan Dessecker, Roger Applegate

3.13.13. Key Publications

Atwater, S. and Schnell, J. (eds.) 1989. *Ruffed grouse.* Stackpole Books, Harrisburg, PA. 370 pp.

Dessecker, D.R. and D.G. McAuley. 2001. Importance of early successional habitat to ruffed grouse and American woodcock. Wildl. Soc. Bull. 29:456-465.

Rusch, D., DeStefano, S., Reynolds, M.C. & Lauten, D. 2000: Ruffed grouse. - The birds of North AmericaNo. 515. The birds of North America, Inc., Philadelphia, Pennsylvania, USA.

For an extended list of references on the species see Rusch et al. 2000 and Atwater and Schnell 1989. All publications referred to in the text are listed in the References section.

Table 3.13. Ruffed grouse *Bonasa umbellus* Linnaeus, 1776

Country	Red list[1]	Legal protection[2]				Hunting[3]	Population[4]		Threats[5]								Conservation measures[6]						
		TP	PP	NT	IT		Size	Trend	S	F	H	P	E	D	C	O	S	M	H	C	R	E	O
Canada	-	X	x	x	x	L, S	>1 Million?	0		x							x	x	x			x	
USA	-		x	x		L, S	10 Million	0		x	x						x	x	x			x	

1 Red list: x listed as threatened species at the national level, - not listed

2 Legal Protection: TP total protection, PP partial protection, NT possession and/or national trade prohibited or regulated, IT international trade prohibited or regulated

3 Hunting: L legal, P poaching (illegal), R regionally restricted, S restricted hunting season, M males only

4 Population size (order of magnitude): estimated number of individuals in spring;

Population trend (during the past 10 years): + increasing, 0 stable, - declining, ? unknown

5 Threats (factors suspected to cause significant, longer-term population declines and extinction): S small population size, F habitat loss/fragmentation, H habitat degradation, P predation, E exploitation, D disturbance by tourism/leisure activities, C climate change, O other threats

6 Conservation measures (ongoing at the time of reporting): S surveys, M monitoring, H habitat management, C captive breeding, R restocking/reintroduction, E education, O other measures .

3.14 Greater Sage-grouse

Scientific name:	*Centrocercus urophasianus*	Bonaparte, 1827
Common names:	Greater sage-grouse	English
	Tétras des armoises	French
	Gallo de las Artemisas	Spanish

Photo 3.14a Greater sage-grouse, male displaying. *(Photo Hans Aschenbrenner).*

Photo 3.14b Greater sage-grouse, male displaying *(Photo Robert E. Bennetts).*

3.14.1. Conservation Status

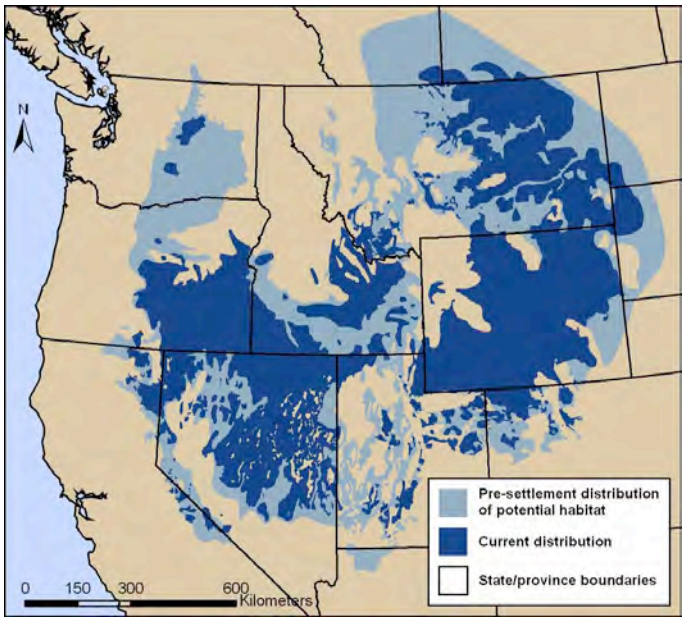
IUCN 2006 (http://www.redlist.org/): Lower risk (near threatened).
CITES 2005: not listed in Appendices. (http://www.cites.org/eng/append/appendices.shtml).
National Red Data books: listed in Canada and some US states.

3.14.2. Taxonomy

The sage-grouse has long been considered monotypic (del Hoyo et al. 1994). In 2000, the Gunnison sage-grouse (*Centrocercus minimus*, Young et al. 2000) of Colorado and Utah was recognized as a separate species based on distinct morphological, behavioural and genetic characteristics. Thereafter, the common name of *Centrocercus urophasianus* was modified to greater sage-grouse (instead of sage-grouse).

3.14.3. Distribution

Western North America. Originally, the greater sage-grouse occurred in 16 western states in the USA and three provinces in south-western Canada, largely sympatric with the distribution of sagebrush (*Artemisia spp*.). Populations have been reduced throughout the range and eliminated in Arizona, British Columbia, New Mexico, Nebraska and Oklahoma. Currently, greater sage-grouse are found in two provinces in south-western Canada and in 11 western states of the USA.



Map 3.14. Greater sage-grouse distribution. *(adapted from Schroeder et al. 2004; source M. Schroeder).*

3.14.4. Population Size and Trend

Because of extensive conversion and degradation of habitat throughout the species' range, greater sage-grouse numbers have been declineding throughout during much of the 20th century. 11 of 13 (85%) states and provinces had significant long-term declines in the size of active leks. Overall, sage-grouse populations declined at a rate of 2% per year from 1965 to 2003. The greatest change occurred from 1965-1985, when the population declined an average of 3.5% per year. From 1986 to 2003, the population declined at an annual rate of 0.37%. In the late 1960s and early 1970s, the North American population of sage-grouse was approximately 2-3 times greater than the population in the early 2000s. These declines are largely thought to be related

to habitat change caused by agricultural development, sagebrush eradication programs, fire and energy development. Although declines of greater sage-grouse populations have been particularly notable at the periphery of their distribution, declines have also been significant within core populations. Between the 1985 and 1994, most populations had declined by 20-50% (average 33%). This most recent decline is at least partially attributed to habitat loss and degradation by management actions for livestock and big game as well as unusually dry weather conditions in western North America. The greater sage-grouse is believed to be secure only in the central part of its range; populations of California, Colorado, North Dakota, South Dakota, Utah and Washington are considered to be at risk. During the late 1970s, annual harvest totalled about 280,000 birds. By 1998, the rangewide breeding population was estimated to be about 140,000 birds (see Connelly and Braun 1997 and Connelly et al. 2004 for additional information).

3.14.5. Habitat and Ecology

Greater sage-grouse inhabit a diversity of sagebrush *Artemisia* spp. ecosystems in western North America, including tall sagebrush, short sagebrush, forb-rich mosaics of low and tall sagebrush, riparian meadows, sagebrush savannahs and small quantities of cropland and planted grasses. Sagebrush constitutes the almost exclusive winter diet and at least two thirds of the adults' summer diet. Adults also consume insects and forbs; young chicks largely rely on insects. The presence of dominated sagebrush habitats with a healthy understorey of grasses and forbs is particularly important for successful nesting and brood-rearing. Greater sage-grouse lek on traditional display grounds in relatively open areas, adjacent to sagebrush habitats. These grouse show a high fidelity to seasonal habitats. Seasonal variation in habitat quality and availability is one explanation for migratory movements of up to >100km (Connelly et al. 1988). Populations are usually characterised by relatively high annual survival and low productivity compared to other grouse species.

Photo 3.14c. Greater sage-grouse habitat dominated with big sagebrush *(Washington State, Photo Michael Schroeder).*

3.14.6. Hunting and Cultural Importance

Sage-grouse were an important game species for Native Americans and European settlers. Market hunting and poaching may have had dramatic impacts on some populations during the late 1800s and early 1900s. During the late 1970s, annual hunting bags of greater sage-grouse totalled approx. 280, 000 birds. The species is no longer hunted in Canada and in parts of the US. In the US, the cultural importance of sage-grouse hunting for sport and food is still high. The influence of harvesting on population dynamics is generally considered to be minimal or moderate; however, the situation varies locally. As other prairie grouse, greater sage-grouse are currently receiving increasing attention from naturalists and bird watchers who appreciate the spectacular display of the birds on their strutting grounds.

3.14.7. Principal Threats

***Small population size*.** Due to habitat loss and fragmentation, some greater sage-grouse populations may have declined below the Minimum Viable Population (MVP) size. Such small and isolated populations are at a high risk of extinction due to demographic chance. They are also particularly susceptible to random environmental events, such as drought, that may lead to reduced brood habitat quality and breeding success. Small isolated populations may be vulnerable to declines in genetic heterogeneity and fertility, and subsequently to extinction (Westemeier et al. 1998).

Habitat degradation. Degradation due to overgrazing by livestock, wildfires, energy development, removal of sagebrush, and encroachment by noxious weeds and trees has reduced the quality of many remaining greater sage-grouse habitats. Reduction in habitat quality may reduce survival, and nesting and brood-rearing success. Livestock grazing is common on sagebrush rangelands, and grazing patterns and use of habitats vary depending on weather conditions. Excessive grazing and land treatments (mechanical, chemical and fire) can have negative impacts on greater sage-grouse habitats, such as winter, breeding, nesting and brood rearing habitat; grass height and cover influence nest site selection and success. The area and frequency of wild fire and prescribed burning have apparently increased in at least parts of the greater sage-grouse range (Connelly et al. 2004). Fire may negatively impact greater sage-grouse populations by eliminating or fragmenting relatively large blocks of wintering and nesting habitat. The overall effects of fire and grazing on greater sage-grouse habitat quality and population trends are still under debate.

Habitat loss. Large-scale conversion of prairie to cropland and development has resulted in the loss of greater sage-grouse in large portions of their original range, particularly on the periphery. Other impacts include increasing development, roads, powerlines, large-scale mining projects and increased recreational use in the sagebrush ecosystem.

Pesticides and herbicides. Pesticides may affect birds by directly poisoning them or indirectly reducing the abundance of invertebrates. Herbicide treatment of rangeland may result in the loss of cover for nesting, brood-rearing and loafing.

3.14.8. Research Needs

Currently in Idaho, research on survival and recruitment of chicks (young <8 weeks of age) and juveniles (young >8 weeks) are being completed. Work is also being conducted in several western states to better understand the quantity and quality of remaining greater sage-grouse habitats, as well as the effects of habitat fragmentation on this species (J. Connelly, pers. comm., 2005).

Monitoring and assessment. Information on sex ratio, lek attendance by males and females, and lek stability is needed so that lek surveys can be used to adequately monitor populations of greater sage-grouse throughout their range.

Population dynamics. The influence of habitat and predation on adult survival, nest success and survival of juveniles to the age of recruitment remains a poorly understood aspect of

greater sage-grouse life history. Further research is needed on predator-prey population dynamics and the effects of hunting.

Habitat management and restoration. Methodologies for restoration of nesting and brood rearing habitats need to be developed. The information necessary to adequately restore degraded habitats is insufficiently unavailable. In this context, further research on habitat recovery following disturbance and the influence of domestic and wild herbivore use on nesting, brood rearing and winter habitat is needed. Applied experiments are needed to evaluate the effects of habitat management and restoration on populations of greater sage-grouse.

Genetics and population connectivity. Further research is needed on genetic differences among populations and on juvenile recruitment and dispersal patterns in both fragmented and contiguous landscapes to ascertain information about population connectivity, gene flow, genetic diversity and genetic compatibility for population augmentations and re-introductions.

Population management. Methodologies for successful re-introductions and population augmentation need to be further investigated and refined.

3.14.9. Current Conservation Measures

Legal protection. Sage-grouse are legally protected throughout their range; regulated harvest is permitted in 10 states.

Monitoring. Survey and monitoring data are available from most range states and provinces. Data on breeding populations are generally obtained by monitoring lek attendance using standardised methods established by the Western States Sage and Columbian Sharp-tailed Grouse Technical Committee. Data on population structure and dynamics are primarily obtained from lek counts and from wings of harvested birds collected from hunters.

Habitat preservation and restoration. Most sage-grouse habitat in the US is federally owned and appropriate management practices are being developed in many areas. The Conservation Reserve Program may also increase sage-grouse habitat on private lands in some parts of the species' range. The Conservation Reserve Program (CRP), the US federal agricultural set-aside programme (Joyce et al. 1991, Dunn et al. 1993, Douglas and Schwartz 1993), has resulted in conversion of millions of hectares of cropland to potential habitat for sage-grouse, with mixed success in some areas. Manipulation of grazing by livestock, modification of fire regimes and planting of sagebrush are primary tools used to improve the quality of habitat. Because nesting and brood-rearing habitats are usually considered to be a limiting factor, most efforts are directed toward increasing the protective cover of shrubs and grasses.

Translocation. Re-introductions, transplants and augmentations of populations have been tried many times during the 1900s with mixed success. Success of translocations appears to be related to the quantity of adequate habitat at the release site and perhaps persistence of translocation efforts.

Predator control. Although predator control has been suggested as a method for increasing nesting success of sage-grouse, no compelling data are yet available to support this view. Additionally, the long-term effects of predator control on population viability are not known. Because the political ramifications of predator control are likely to be negative, predator control efforts should be directed toward manipulations of habitat.

Water provision. Water provision has not been shown to influence populations on a large scale.

3.14.10. Priority Conservation Measures

Conservation plans. Conservation plans for each population of sage-grouse should be designed with the aid of public and private landowners, and interested citizens. The conservation plans should include appropriate recommendations for habitat management, restoration, configuration and acquisition in order to maintain long-term population viability. Efforts should be made to apply management recommendations in conservation plans with reasonable speed.

Habitat preservation and restoration. Protect critical breeding, brood-rearing and winter habitat through land exchange programmes, conservation easements, and purchase of private lands and management of public lands to promote sage-grouse. Restore habitats in disturbed and, particularly, burned areas.

Habitat assessment. Document the quantity and quality of remaining habitats throughout the species range as a basis for species conservation and recovery programmes.

Monitoring. Continue both traditional methods of monitoring and implement long term radio-tracking monitoring programmes to assess population trends, with priority placed on fragmented areas and small populations.

Education. Educate both the public and management agencies about human impacts due to development, grazing, recreation and management land treatments.

3.14.11. Recent changes

Many sage-grouse populations increased over the last 5 years. Although causes of these increases are not well documented, they may be related to favourable spring precipitation patterns, increases in sagebrush cover in some farmland that has been retired under the U.S. Conservation Reserve Program, and a reduction in hunting pressure through more conservative seasons in most western states (J. Connelly, pers. comm.. 2006). Range-wide monitoring efforts increased since 2000 and a comprehensive range-wide conservation assessment for greater sage-grouse was completed in 2004 (Connelly et al. 2004).

3.14.12. Correspondents

2000: Jack Connelly, Mike Schroeder, and Jessica Young

2005: Jack Connelly, Mike Schroeder

3.14.13. Key Publications

Connelly, J. and Braun, C. E. 1997. Long-term changes in sage-grouse populations in western North America. *Wildlife Biology* 3: 229-234.

Connelly, J. W., K. P. Reese, E. O. Garton, and M. L. Commons-Kemner. 2003. Response of greater sage-grouse *Centrocercus urophasianus* populations to different levels of exploitation in Idaho, USA. Wildlife Biology 9: 335-340.

Connelly, J. W., M. A. Schroeder, A. R. Sands, and C. E. Braun. 2000. Guidelines to manage sage-grouse populations and their habitats. Wildlife Society Bulletin 28: 967-985.

Connelly, J. W., S. T. Knick, M. A. Schroeder, and S. J. Stiver. 2004. Conservation assessment of greater sage-grouse and sagebrush habitats. Western Association of Fish

and Wildlife Agencies Cheyenne, Wyoming, USA.

Schroeder, M. A., C. L. Aldridge, A. D. Apa, J. R. Bohne, C. E. Braun, S. D. Bunnell, J, W. Connelly, P. A. Deibert, S. C. Gardner, M. A. Hilliard, G. D. Kobriger, S. M. McAdam, C. W. McCarthy, J. J. McCarthy, D. L. Mitchell, E. V. Rickerson, and S. J. Stiver. 2004. Distribution of sage-grouse in North America. Condor 106: 363-376.

Schroeder, M. A., J. R. Young, and C. E. Braun. 1999. Sage-grouse (*Centrocercus urophasianus*). Pages 1-28 in A. Poole and F. Gill, editors. The birds of North America, Philadelphia, Pennsylvania, USA.

Young, J. R., Braun, C. E., Oyler-McCance, S. J., Hupp, J. W., and T. W. Quinn. 2000. A new species of Sage-grouse from Southwestern Colorado. Wilson Bulletin 112(4): 445-453.

All publications referred to in the text are listed in the References section.

Table 3.14. Greater sage-grouse *Centrocercus urophasianus* Bonaparte, 1827

Country	Red list[1]	Legal protection[2]				Hunting[3]	Population[4]		Threats[5]								Conservation measures[6]						
		TP	PP	NT	IT		Size	Trend	S	F	H	P	E	D	C	O	S	M	H	C	R	E	O
Canada	x	x					<1,000	-	x	X	x						x	x	x				
USA			x			L, S, R	250,000	0	x	X	x					x	x	x	x					x

1 Red list: x listed as threatened species at the national level, - not listed

2 Legal Protection: TP total protection, PP partial protection, NT possession and/or national trade prohibited or regulated, IT international trade prohibited or regulated

3 Hunting: L legal, P poaching (illegal), R regionally restricted, S restricted hunting season, M males only

4 Population size (order of magnitude): estimated number of individuals in spring;

Population trend (during the past 10 years): + increasing, 0 stable, - declining, ? unknown

5 Threats (factors suspected to cause significant, longer-term population declines and extinction): S small population size, F habitat loss/fragmentation, H habitat degradation, P predation, E exploitation, D disturbance by tourism/leisure activities, C climate change, O other threats

6 Conservation measures (ongoing at the time of reporting): S surveys, M monitoring, H habitat management, C captive breeding, R restocking/reintroduction, E education, O other measures

3.15 Gunnison Sage-grouse

Scientific name:	*Centrocercus minimus*	Young, Braun, Oyler-McCance, Hupp & Quinn 2000
Common names:	Gunnison sage-grouse	English

Photo 3.15a. Male and female Gunnison sage-grouse. *(Photo R. E. Bennetts).*

Photo 3.15b. Gunnison sage-grouse, male displaying *(Colorado, Photo R. E. Bennetts).*

3.15.1. Conservation Status

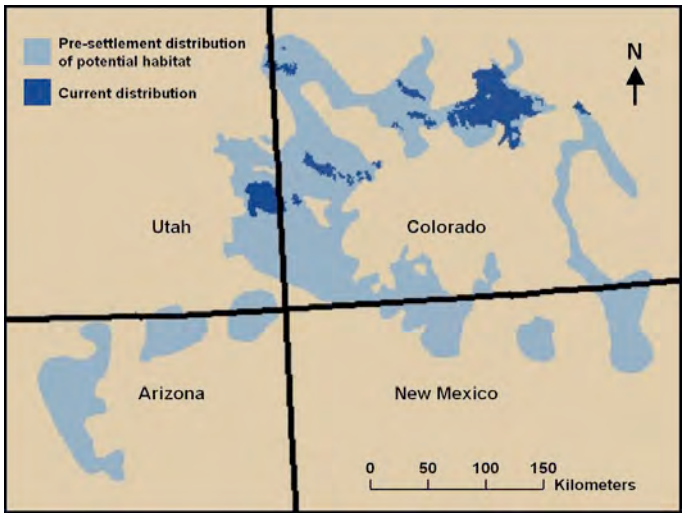
IUCN 2004 (http://www.redlist.org/): Endangered.
CITES 2005 (http://www.cites.org/eng/app/index.shtml): not listed in Appendices.
National Red Data books: listed as a candidate species under the US Endangered Species Act.

3.15.2. Taxonomy

In 2000, the Gunnison sage-grouse (*Centrocercus minimus,* Young et al. 2000) of Colorado and Utah was recognized as a separate species based on distinct morphological, behavioural and genetic characteristics. There are no subspecies recognised.

3.15.3. Distribution

The Gunnison sage-grouse occurs only in disjunct populations in southwestern Colorado and southeastern Utah (USA).



Map 3.15. Gunnison sage-grouse distribution. ***(from Schroeder et al. 2004; Source Michael Schroeder).***

3.15.4. Population Size and Trend

A recent range-wide conservation plan (2004) identifies eight populations ranging from two to 498 males counted during spring lek surveys and only one population estimated to contain over 500 individuals. Overall, population size declined during the 2000-2004 period and the rangewide plan estimates 3,198 individuals. Recent lek count estimates suggest that only one population may have increased in 2005.

3.15.5. Habitat and Ecology

Gunnison sage-grouse inhabit sagebrush (*Artemisia* spp.) ecosystems in western North America, including tall sagebrush, short sagebrush, forb-rich mosaics of low and tall sagebrush, riparian meadows, sagebrush savannahs, and small quantities of cropland and planted grasses. Sagebrush constitutes the almost exclusive winter diet and at least two thirds of the adults' summer diet. Adults also consume insects and forbs, which young chicks largely rely on. The presence of sagebrush dominated habitats with a healthy understory of grasses and forbs is particularly important for successful nesting and brood rearing. Sage-grouse lek on traditional display grounds in relatively open areas, adjacent to sagebrush habitats. Sage-grouse show a high fidelity to seasonal habitats. Seasonal variation in habitat quality and availability is one explanation for migratory movements of >100km (Connelly et al. 1988). Populations are usually characterised by relatively high annual survival and low productivity compared to other grouse species.

3.15.6. Hunting and Cultural Importance

Greater and Gunnison sage-grouse were an important game species for Native Americans and European settlers. Market hunting and poaching may have had dramatic impacts on some sage-grouse populations during the late 1800s and early 1900s. During the late 1970s, annual hunting bags totalled approx. 280, 000 birds. In the US, the cultural importance of sage-grouse hunting for sport and food is still high, and even well controlled, moderate harvest levels may negatively affect population tends. As other prairie grouse, Gunnison sage-grouse are currently receiving increasing attention from naturalists and bird watchers who appreciate the spectacular display of the birds on their strutting grounds. All hunting of Gunnison sage-grouse is currently prohibited.

3.15.7. Principal Threats

Small population size. Due to habitat loss and fragmentation, some sage-grouse populations have declined below Minimum Viable Population (MVP) size. Such small and isolated populations are at a high risk of extinction due to demographic chance. They are also particularly susceptible to random environmental events such as drought that may lead to reduced brood habitat quality and breeding success. Small, isolated populations may be vulnerable to declines in genetic heterogeneity and fertility, and subsequently, to extinction (Westemeier et al. 1998).

Lack of genetic diversity. Lekking species in general may show a reduction of genetic diversity. Investigations of Gunnison sage-grouse populations suggest that there is an overall lack of genetic diversity and in some regions it is particularly low (Kahn et al. 1999, Oyler-McCance 2005). A lack of genetic diversity may lead to a reduction in productivity and survival, as well as an inability to adapt to environmental changes such as disease and rapid habitat changes (Westemeier et al. 1998).

Habitat degradation. Degradation due to overgrazing by livestock, wildfires, removal of sagebrush, and encroachment by noxious weeds and trees has reduced the quality of most remaining sage-grouse habitats. Reduction in habitat quality may reduce survival and nesting and brood-rearing success. Livestock grazing is common on sagebrush rangelands, and grazing patterns and use of habitats vary depending on weather conditions. Excessive grazing and land treatments (mechanical, chemical and fire) have negative impacts on sage-grouse winter, breeding, nesting and brood rearing habitat; grass height and cover influence nest site selection and success. The size and frequency of wild fire and prescribed burning have increased in at least parts of the sage-grouse range. Fire negatively impacts sage-grouse populations by eliminating or fragmenting relatively large blocks of wintering and nesting habitat. Increasing recreation on public rangelands is a concern. The overall effects of fire and of grazing on sage-grouse habitat quality and population trends are under debate but appear to be negative.

Habitat loss. Large-scale conversion of sagebrush steppe to cropland and development has resulted in the loss of Gunnison sage-grouse in large portions of their range, particularly on the periphery. Other impacts include increasing development, roads, power lines, large-scale mining projects, and increased recreational use in the sagebrush ecosystem. Oil and gas exploration and mining activities are an increasing threat to habitat fragmentation and loss.

Pesticides and herbicides. Pesticides may affect birds by directly poisoning them or indirectly reducing the abundance of invertebrates. Herbicide treatment of rangeland may result in the loss of cover for nesting, brood rearing and loafing.

3.15.8. Research Needs

Ongoing research in Gunnison sage-grouse includes examination of microscale habitat use and dispersal, age specific mortality, landscape use, winter behaviour and genetic investigations (J. R. Young, pers. comm., 2005). Future research needs include evaluation of the effect of habitat quality and quantity on the seasonal movements, dispersal, survival and reproduction of the Gunnison sage-grouse. Important in understanding trends in populations, will be the development of better protocols for inventory and monitoring populations. Development of spatially explicit population models based on the above will help elucidate population persistence probabilities.

3.15.9. Current Conservation Measures

Legal protection. Gunnison sage-grouse are currently being considered for federal (USA) listing as a 'threatened' or 'endangered' species.

Conservation plans. Local communities throughout key areas of the Gunnison sage-grouse range have written conservation plans to help recover the species. A rangewide conservation plan was completed in 2005.

Monitoring. Survey and monitoring data are available from lek counts. Data on breeding populations are generally obtained by monitoring lek attendance using standardised methods established by the Western States Sage and Columbian Sharp-tailed Grouse Technical Committee.

Habitat preservation and restoration. Most (70%) sage-grouse habitat in the US is federally owned and appropriate management practices are being developed in some areas. Some private in-holdings have been acquired and conservation easements have been applied. The Conservation Reserve Program may also increase sage-grouse habitat on private lands in some parts of the species' range. The Conservation Reserve Program (CRP), the US federal agricultural set-aside programme (Joyce et al. 1991, Dunn et al. 1993, Douglas and Schwartz 1993), has resulted in the conversion of millions of hectares of cropland to potential habitat for sage-grouse, with mixed success in some areas. Manipulation of grazing by livestock, modification of fire regimes, and planting of sagebrush are primary tools used to improve the quality of habitat. Because nesting and brood-rearing habitat is usually considered to be a limiting factor, most efforts are directed toward increasing the protective cover of shrubs and grasses and in rehabilitation of severely degraded riparian systems.

Predator control. Predator control may increase nesting success of sage-grouse. However, the long-term effects of predator control on population viability are unknown. Because the political ramifications of predator control are likely to be negative, effort towards increasing habitat cover are encouraged.

3.15.10. Priority Conservation Measures

Conservation plans. Conservation plans for each population of Gunnison sage-grouse have been designed with the aid of public and private landowners and interested citizens. Where conflicts exist between the rangewide conservation plan and local plans, actions which are clearly to the benefit of the species, should be applied. The conservation plans should include appropriate recommendations for habitat management, restoration, configuration and acquisition to maintain long-term population viability. Efforts should be made to apply management recommendations in conservation plans with reasonable speed and to assess the effectiveness of the plans at regular intervals.

Habitat assessment. Map and monitor the quantity and quality of remaining habitats throughout the species range as a basis for species conservation and recovery programmes.

Habitat preservation and restoration. Continue to protect critical breeding, brood rearing and winter habitat through land exchange programmes, conservation easements, and purchase of private lands and management of public lands to promote sage-grouse. Restore habitats in areas that do not meet the habitat objectives outlined in local and rangewide plans.

Education. Educate both the public and management agencies about human impacts on Gunnison sage-grouse due to development, oil and gas exploration, grazing, recreation and land management treatments.

3.15.11. Recent changes

Major drought resulted in a > 25% population loss in recent years with some recovery observed in 2005 (J. R. Young, personal communication). West Nile virus has entered into the species range in 2003, and may pose an additional threat to the species. The Gunnison sage-grouse has been listed as a candidate species under the US Endangered Species Act, but still has no protection as threatened or endangered under national laws.

3.15.12. Correspondents

Jessica R. Young, Clait E. Braun, Michael Schroeder.

3.15.13. Key Publications

Connelly, J. W., M. A. Schroeder, A. R. Sands, and C. E. Braun. 2000. Guidelines to manage sage grouse populations and their habitats. Wildlife Society Bulletin 28:967-985.

Oyler-McCance, S.J., J. St-John, S.E. Taylor, A.D. Apa, and T.W. Quinn. 2005. Population genetics of Gunnison sage-grouse: implications for management. Journal of Wildlife Management 69(2): 630-637.

Oyler-McCance, S.J.; Burnham, K.P.; Braun, C.E. 2001. Influence of changes in sagebrush on Gunnison sage grouse in southwestern Colorado. Southwestern Naturalist, 46: 323-331

Young, J. R., Braun, C. E., Oyler-McCance, S. J., Hupp, J. W., and T. W. Quinn. 2000. A new species of Sage-grouse from Southwestern Colorado. Wilson Bulletin 112: 445-453.

Schroeder, M.A., C.L. Aldridge, A.D. Apa, J.R. Bohne, C.E. Braun, S.D. Bunnell, J.W. Connelly, P.A. Deibert, S.C. Gardner, M.A. Hilliard, G.D. Kobriger, S.M. McAdam, C.W. McCarthy, J.J. McCarthy, D.L. Mitchell, E.V. Rickerson, and S.J. Stiver. 2004. Distribution of sage grouse in North America. Condor 106: 363-376.

All publications referred to in the text are listed in the References section

Table 3.15. Gunnison sage-grouse *Centrocercus minimus* Young, Braun, Oyler-McCance, Hupp and Quinn, 2000

Country	Red list[1]	Legal protection[2]				Hunting[3]	Population[4]		Threats[5]								Conservation measures[6]						
		TP	PP	NT	IT		Size	Trend	S	F	H	P	E	D	C	O	S	M	H	C	R	E	O
USA	Not listed					S	2,600	-	x	x	x	x		x		x	x	x	x			x	

1 Red list: x listed as threatened species at the national level, - not listed

2 Legal Protection: TP total protection, PP partial protection, NT possession and/or national trade prohibited or regulated, IT international trade prohibited or regulated

3 Hunting: L legal, P poaching (illegal), R regionally restricted, S restricted hunting season, M males only

4 Population size (order of magnitude): estimated number of individuals in spring;

Population trend (during the past 10 years): + increasing, 0 stable, - declining, ? unknown

5 Threats (factors suspected to cause significant, longer-term population declines and extinction): S small population size, F habitat loss/fragmentation, H habitat degradation, P predation, E exploitation, D disturbance by tourism/leisure activities, C climate change, O other threats

6 Conservation measures (ongoing at the time of reporting): S surveys, M monitoring, H habitat management, C captive breeding, R restocking/reintroduction, E education, O other measures.

3.16 Sharp-tailed Grouse

Scientific name:	*Tympanuchus phasianellus*	Linnaeus, 1758
Synonyms:	*Pedioecetes phasianellus*	
Common names:	Sharp-tailed grouse	English
	Tétras à queue fine	French
	Gallo de las praderas rabudo	Spanish

Photo 3.16a. Male sharp-tailed grouse *(Photo Michael Schroeder).*

3.16.1. Conservation Status

IUCN 2004 (http://www.redlist.org/): Lower risk (near threatened).
CITES 2005 (http://www.cites.org/eng/app/index.shtml): not listed in Appendices.
National Red Data books: listed in some US states and Canadian provinces.

3.16.2. Taxonomy

Six extant and one extinct subspecies recognised (del Hoyo et a. 1994): Alaska sharp-tailed grouse (*T. p. caurus)*, northern sharp-tailed grouse (*T. p. phasianellus)*, north-western sharp-tailed grouse (*T. p. kennicotti)*, prairie sharp-tailed grouse (*T. p. campestris)*, plains sharp-tailed grouse (*T. p. jamesi)*, Columbian sharp-tailed grouse (*T. p. columbianus)*, and New Mexican sharp-tailed grouse (*T. p. hueyi)*. Their characteristics and distribution are described in Connelly et al. (1998).

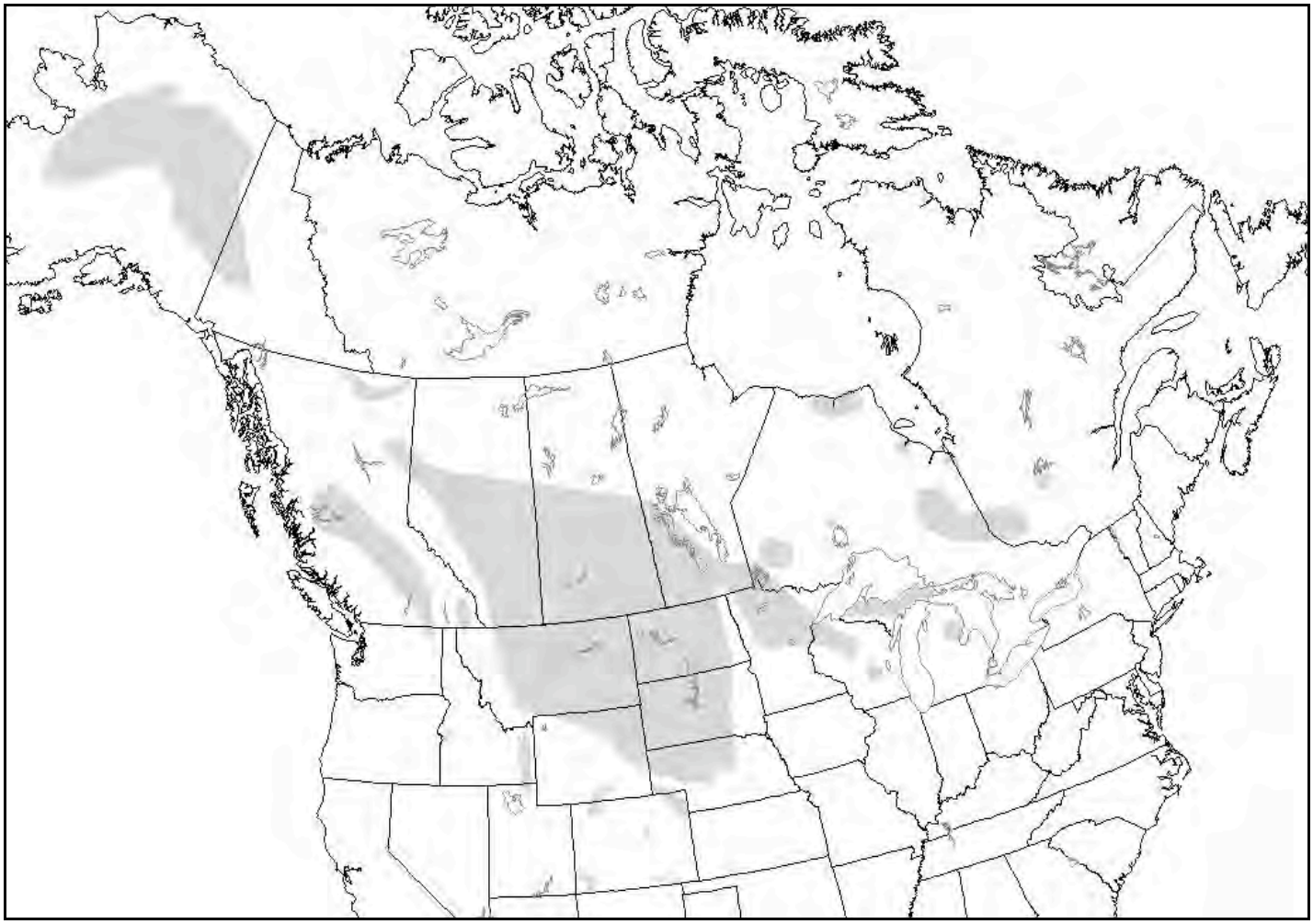
Photo 3.16b. Male sharp-tailed grouse displaying *(Photo Robert E. Bennetts).*

3.16.3. Distribution

North America. Formerly, the sharp-tailed grouse was widely distributed throughout steppe, grassland and mixed-shrub habitats of central and northern North America. Current range has been reduced and fragmented, primarily in southern and south-western portions. Occurs from Alaska east to South-western Yukon, west and central Canada, and western USA east to the Great Plains. The northernmost distribution in Canada is scattered and poorly known. In the south, there are several scattered populations in Utah, Idaho, Montana, Wyoming and Colorado. *T. p. columbianus* occupies 10-50% of its former range in the USA and 80% of its former range in British Columbia. Successful re-introductions to Oregon and portions of southern Idaho have helped to slow the declines (Connelly et al. 1998).

3.16.4. Population Size and Trend

Due to extensive changes in habitat related to agricultural development, sharp-tailed grouse now occupy only parts of their former range. The species is still fairly common in Canada. Compared to their historic range, the distribution has become greatly reduced and fragmented in the eastern (Great Lakes) and western (Rocky Mountain region) portions. The sharp-tailed grouse is extinct in eight states of the US and occupies <50% of its former range in the remaining nine states. In the populations south of central Canada, numbers have been stable to slightly declining since the 1950s, but have been increasing in Idaho and Utah since the 1980s (Connelly et al. 1998). There have been extensive changes in habitat of *T. p. campestris*, *T. p. jamesi*, and particularly of *T. p. columbianus*. Accordingly, declines of *T. p. columbianus* have been most pronounced; its total population size is estimated at 60-170, 000. Trends for *T. p. campestris* and *T. p. jamesi* have also been downward, but at a slower rate. Populations in the USA have been increasing thanks to the implementation of the Conservation Reserve Program (CRP) (R. Hoffman, pers. comm., 1999; J. Connelly, pers. comm., 2005; Joyce et al. 1991; Dunn et al. 1993; Douglas and Schwartz 1993) (see Habitat Management; Chapter 2 for details on CRP).



Map 3.16. Sharp-tailed grouse distribution.

3.16.5. Habitat an d Ecology

Sharp-tailed grouse inhabit steppe, shrub steppe, savannah, shrublands, aspen parklands and early successional forests. They use distinct seasonal habitats and migratory movements up to >30km have been documented between summer ranges in open prairie landscapes to winter ranges in woody habitats. Breeding habitats are dominated by relatively dense herbaceous cover and shrubs for nesting, brood rearing, and roosting throughout the range, but the key species of grasses and shrubs may vary considerably. Leks are situated within or close to breeding habitat and are often on sites with less vegetation. Lek locations are generally, but not necessarily, stable from year to year. Great structural diversity of the habitat, including grasses, shrubs and forbs, provides high-quality nesting areas; but sharp-tailed grouse may also nest in stubble fields. Broods depend on areas with abundant forbs, rich in insects. In winter, sharp-tailed grouse rely on riparian areas, deciduous hardwood shrub gullies, and deciduous and open coniferous woods. Deciduous trees and shrubs are important for feeding, roosting and escape cover, including aspen (*Populus tremuloides)*, snowberry (*Symphoricarpos occidentalis)*, sagebrush (*Artemisia),* willow *(Salix spp.)* and birch *(Betula spp.).* Sharp-tailed grouse eat a variety of fruits, seeds, grasses, forbs, herbs and insects in spring and summer, and fruits, grain, buds and catkins in autumn and winter. Although birds may feed in grain fields during autumn and winter when available, they require deciduous shrubs and trees for feeding during periods of continuous snow cover.

3.16.6. Hunting and Cultural Importance

Sharp-tailed grouse were an important food source for native Americans and early European settlers to the Great Plains and the western US and Canada. Its courtship display was mimicked in native American dances, and today, sharp-tailed grouse leks are a popular attraction for naturalists and bird-watchers as more people appreciate the spectacular display of the birds. Market hunting and poaching may have had dramatic impacts on some populations during the 1800s and early 1900s. The species continues to be hunted extensively in much of its range, but is protected in five US states. Autumn hunting seasons and bag limits are established based on tradition, public input and population trends, and regulations vary considerably among states (US) and provinces (Canada). Harvest rates vary between years and regions and there is little evidence that harvest negatively affects populations; although impacts may vary (Connelly et al. 1998, J. Connelly, pers. comm., 2005). In the late 1970s, about 700,000 birds were annually harvested.

3.16.7. Principal Threats

Habitat loss and degradation. Habitat loss due to large-scale conversion to cropland, pine plantations or urban development has resulted in the dramatic loss of sharp-tailed grouse in large portions of their original range. Habitat degradation due to overgrazing by livestock use, encroachment by noxious weeds and forest, and fire suppression has reduced the quality of many remaining prairie habitats; reduction in habitat quality may reduce survival, nesting and brood-rearing success.

Small population size. Related to loss and fragmentation of habitat, some local populations are threatened by being a small size. Small isolated populations may be vulnerable to declines in genetic heterogeneity and fertility, and subsequently to extinction (Westemeier 1998) (see Small Population Size; Chapter2).

Pesticides and herbicides. Experimental evidence indicates that sharp-tailed grouse may suffer increased mortality due to pesticides, either directly through poisoning or indirectly due to increased susceptibility to predation. Herbicide treatment of the rangeland may result in the loss of cover for nesting, brood-rearing and loafing.

Human disturbance. Leks are frequently used for population surveys and wildlife viewing. Although the birds tolerate some disturbances, continued human presence at the lek appears to limit reproductive success and may result in regional population declines (see Human Disturbance; Chapter 2).

3.16.8. Research Needs

Population dynamics. The influence of habitat and predation on adult survival, nest success and survival of juveniles to the age of recruitment, remains a poorly understood aspect of sharp-tailed grouse life history. Empirical research is needed on the effects of harvesting throughout the range.

Spatial population structure. Work is required on the effects of habitat fragmentation on dispersal behaviour, and on genetic relationships among individuals, leks and populations to improve the understanding of population and metapopulation structure, dynamics and viability.

Monitoring and assessment. Information on sex ratio, lek attendance by males and females, and lek stability is needed so that lek surveys can be used to adequately monitor populations of sharp-tailed grouse throughout their range.

Habitat management and restoration. Applied experiments are recommended to evaluate the long-term impacts of the Conservation Reserve Program (CRP) and other management practices (such as grazing, burning, cultivation, fragmentation, restoration and food plots) on populations of sharp-tailed grouse. The information required to adequately restore degraded habitats is largely unavailable.

Northern populations. Virtually all research on sharp-tailed grouse has been done on the three southern subspecies (*T. p. campestris*, *T. p. jamesi*, and *T. p. columbianus*); the habitat and ecology of the northern subspecies has not been adequately studied. There is an immediate need for baseline data on the sharp-tailed grouse in central, northern and western Canada.

3.16.9. Current Conservation Measures

Legal protection. Sharp-tailed grouse are legally protected throughout their range. Regulated harvest is permitted in 18 states and provinces; the species is totally protected on Prince Edward Island (Canada).

Surveys and monitoring. The sharp-tailed grouse's status is monitored and assessed on the basis of lek counts, harvest surveys and wing collections by state agencies, and several private organisations support the conservation and management of the species. However, monitoring efforts vary greatly in different parts of the range.

Habitat management. Sharp-tailed grouse generally respond to measures that increase or protect food sources, nesting cover and winter habitats. There are examples of how to develop and maintain grouse habitat successfully on cultivated land. For parts of the range, conservation strategies and management and recovery plans have been written, and habitat suitability index models have been developed (see refs. in Connelly et al. 1998). Manipulation of grazing by livestock and modification of fire regimes are primary tools used to improve the quality of habitat. Because nesting/brood-rearing habitat is usually considered to be a limiting factor, most efforts are directed towards increasing the protective cover of grasses and decreasing forest encroachment. The CRP, a US federal agricultural set-aside programme launched in 1985 (Joyce et al. 1991, Dunn et al. 1993, Douglas and Schwartz 1993), has resulted in the conversion of millions of ha of cropland to potential habitat for sharp-tailed grouse, with excellent success in some areas (J. Connelly, pers. comm., 2005; see Habitat Management; Chapter 2).

Translocation and reintroduction. First translocations of sharp-tailed grouse occurred in the 1800s and early 1900s. During the 1900s, re-introductions, transplants, and/or population augmentations were tried many times, with mixed success. Most attempts failed or established only small temporary populations, and were poorly documented. Some recent translocations have apparently been successful (Connelly et al. 1998). The success of a translocation appears to be related to the quantity of adequate habitat at the release site.

Food and water provision. Food and water provision have not been shown to influence populations on a large scale.

3.16.10. Priority Conservation Measures

Conservation plans. Conservation plans for each population of sharp-tailed grouse should be designed with the aid of public and private landowners and interested citizens. The conservation plans should include appropriate recommendations for habitat management, restoration, configuration and acquisition in order to maintain long-term population viability. Efforts should be made to apply management recommendations in conservation plans with reasonable speed. Effective management strategies and conservation plans appear to be particularly urgent for declining populations of the subspecies *columbianus* and *campestris.*

Habitat preservation. Habitats should be preserved and vegetation manipulation avoided within a 2km radius of lek sites, and in winter ranges. Sharp-tailed grouse habitat requirements should be integrated into land-use practices. The ongoing CRP programme (see above and Habitat Management; Chapter 2) has the potential to provide millions of hectares of habitat for sharp-tailed grouse throughout their range. The programme is currently designed to produce relatively high quality prairie with a diversity of native grass and forb species.

Monitoring. Wildlife agencies should monitor leks throughout the range and provide this information to the land management agencies.

Education. Resource managers and land owners should be educated about the habitat requirements of the species, and incentives should be developed for land owners to provide the correct habitat and food.

3.16.11 Recent Changes

A petition was submitted to the U.S. Fish and Wildlife Service asking that the Columbian subspecies be listed under the Endangered Species Act. Subsequently, the U.S. Fish and

Wildlife Service determined that listing was not appropriate. In 2005, a second petition was submitted and thus far the U.S. Fish and Wildlife Service has not addressed this second request for listing.

3.16.12. Correspondents

2000: Jack Connelly, Rick Hoffman, David Mossop, and Mike Schroeder

2005: Jack Connelly, Mike Schroeder

3.16.13. Key Publications

Connelly, J. W., Gratson, M. W., and Reese, K. P. 1998. Sharp-tailed grouse. *The birds of North America*, No. 354. The birds of North America, Inc., Philadelphia, PA.

Hanowski, J. M., D. P. Christian, and G. J. Niemi. 2000. Landscape requirements of prairie sharp-tailed grouse *Tympanuchus phasianellus campestris* in Minnesota, USA. Wildlife Biology 6: 257-263.

Schroeder, M. A., and R. K. Baydack. 2001. Predation and the management of prairie grouse. Wildlife Society Bulletin 29: 24-32.

Connelly, J. W., J. H. Gammonley, and J. M. Peek. 2005. Harvest management. Pages 658-690 in C. E. Braun, editor, Techniques for Wildlife Investigations and management. Sixth edition. The Wildlife Society, Bethesda, Maryland, USA.

For an extended list of references on the species see Connelly et al. 1998. All publications referred to in the text are listed in the References section.

Table 3.16. Sharp-tailed grouse

Country	Red list[1]	Legal protection[2]				Hunting[3]	Population[4]		Threats[5]							Conservation measures[6]						
		TP	PP	NT	IT		Size	Trend	S	F	H	P	E	D	C	O	S	M	H	C	R	E	O
Canada	-		x			L, S, R	>1 Million	0/-	x	x	x						x	x					
USA	-		x			L, S, R	>100,000	0/-/+	x	x	x						x	x			x		

1 Red list: x listed as threatened species at the national level, - not listed

2 Legal Protection: TP total protection, PP partial protection, NT possession and/or national trade prohibited or regulated, IT international trade prohibited or regulated

3 Hunting: L legal, P poaching (illegal), R regionally restricted, S restricted hunting season, M males only

4 Population size (order of magnitude): estimated number of individuals in spring;

Population trend (during the past 10 years): + increasing, 0 stable, - declining, ? unknown

5 Threats (factors suspected to cause significant, longer-term population declines and extinction): S small population size, F habitat loss/fragmentation, H habitat degradation, P predation, E exploitation, D disturbance by tourism/leisure activities, C climate change, O other threats

6 Conservation measures (ongoing at the time of reporting): S surveys, M monitoring, H habitat management, C captive breeding, R restocking/reintroduction, E education, O other measures

3.17 Greater Prairie-chicken

Scientific name:	*Tympanuchus cupido*	Linnaeus 1758
Common names:	Greater prairie-chicken, pinnated grouse	English
	Poule des prairies	French
	Gallo de las parades grande	Spanish

Photo 3.17. Greater prairie-chicken, male booming *(Photo Robert E. Bennetts).*

3.17.1. Conservation Status

IUCN 2006 (http://www.redlist.org/): Vulnerable
CITES 2005 http://www.cites.org/eng/app/index.shtml): Attwater's prairie-chicken *T. c. attwateri* (Appendix I)
EU (EC 338/97 Protection by Regulating Trade): *T. c. attwateri* (Annex A)
National Red Data books: listed in Canada (extinct): *T. c. attwateri* listed as endangered in the US.

The subspecies Attwater's prairie-chicken *T. c. attwateri* qualifies to be listed as critically endangered according to the IUCN Red List Categories under criteria CR; A1a, D (see Appendix 2). Numbers have declined from 8,700 birds in 1937 (Lehmann 1941) to 1,584 birds in 1980 (Lawrence and Silvy 1980, Morrow et al. 1996, Silvy et al. 1999). The total population remaining in the wild in 1999 was 46 birds in two isolated populations in Texas that were largely supported by releases of captive-reared birds (N. Silvy, pers. comm). A recovery plan specifies priority conservation measures (http://ecos.fws.gov/docs/recovery_plans/1993/930208a.pdf).

3.17.2. Taxonomy

Two geographically isolated subspecies are recognised: Greater prairie-chicken (*T. c. pinnatus*) and Attwater´s prairie-chicken (*T. c. attwateri)*. A third subspecies, the Heath hen (*T. c. cupido)*, has been extinct since the 1930s.

3.17.3. Distribution

Central North America. *T. c. pinnatus* and *T. c. attwateri* were originally found in eastern portions of the Great Plains from Minnesota, Wisconsin and Michigan, south through southern Texas. *T. c. cupido* was found in north-eastern USA including the states of Massachusetts, Connecticut, New York, Pennsylvania, New Jersey and Maryland. *T. c. pinnatus* responded positively to initial increases in agriculture throughout central and western portions of the Great Plains. Areas of expansion included the Canadian provinces of Alberta, Saskatchewan and Manitoba, and the state of Colorado. Currently, *T. c. pinnatus* is restricted to Oklahoma, Kansas, Nebraska, South Dakota, North Dakota and small portions of Colorado, Minnesota, Wisconsin, Illinois, Iowa and Missouri. *T. c. attwateri* is restricted to small isolated areas in south-eastern Texas (see the stars on the distribution map).

3.17.4. Population Size and Trend

T. c. cupido became extinct in the 1930s after many years of dramatic declines; exploitation is thought to have played an important role. *T. c. attwateri* declined from 8,700 birds in 1937 (Lehman 1941) to 1,070 birds in 1967 (Lehmann 1968); by 1999 only 46 birds remained in two isolated populations that were largely supported by releases of captive-reared birds (N. Silvy, pers. comm.). Consequently, there is an immediate risk of extinction for *T. c. attwateri*. The subspecies was included in the Red Data Books in the late 1970s and its decline could not be stopped despite extensive conservation efforts. In contrast, although *T. c. pinnatus* has declined in many regions, current populations appear to be relatively stable throughout much of the range. Total population size is estimated at within an order of magnitude of 600,000 birds (Schroeder and Robb 1993, M. Schroeder pers. comm).

3.17.5. Habitat and Ecology

Originally, greater prairie-chickens were inhabitants of eastern and southern tall grass prairie habitats, interspersed with oak *Quercus* spp. woodland. Birds fed, roosted and nested in grass-dominated habitats during most of the year. During winter, food habitats shifted toward buds or mast (acorns), occasionally necessitating migration between breeding and wintering habitats. Currently, the critical winter food throughout most of the range is grain, frequently corn and soybeans. Consequently, the configuration of cropland with adequate mid and tall grass prairie for nesting and brood-rearing appears to be a significant feature of most occupied habitat. Lack of sufficient quantity and quality of nesting habitat appears to be the limiting factor in most areas where greater prairie-chicken populations are depressed or extinct (see Schroeder and Robb 1993).

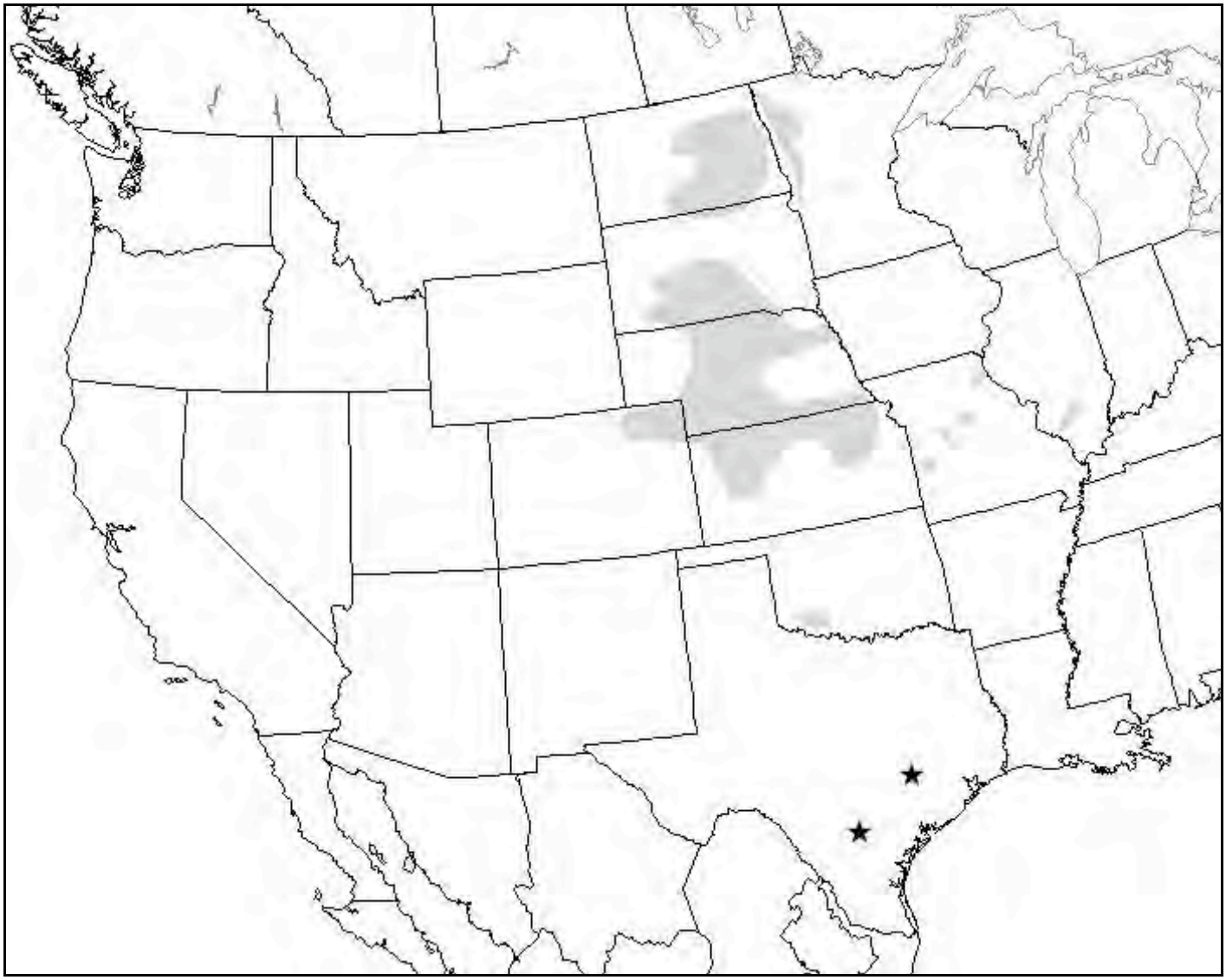
3.17.6. Hunting and Cultural Importance

Greater prairie-chickens were a game species for aboriginal Americans and the Europeans that followed them, but their influence on the population was probably low. Market hunting and poaching may have had dramatic impacts on some populations during the late 1800s and early 1900s. The first legislation to regulate hunting in the north-eastern USA was passed in 1791. Greater prairie-chickens are currently receiving more attention from naturalists and/or bird-watchers as more people appreciate the spectacular breeding display of birds at leks (booming grounds).

3.17.7. Principal Threats

***Habitat loss*.** Although a mixture of small amounts of cropland with native prairie can be optimal, large-scale conversion of prairie to cropland, woodland or development, resulted in the dramatic loss of greater prairie-chickens throughout most of their original range.

Habitat degradation. Degradation may be caused by a variety of factors including overgrazing by livestock, encroachment by noxious weeds, alteration of fire regimes and fragmentation. Reduction in habitat quality may reduce survival and nesting/brood-rearing success. In Kansas, for



Map 3.17. Greater prairie-chicken distribution.

example, nearly 90% of the Flint Hills tallgrass prairie is burned annually in March and April to manage for cattle grazing. This, coupled with early intensive grazing regimes, greatly restricts available nesting and brood rearing cover. In eastern Kansas, much native warm-season grass pasture has been converted to cool-season grasses such as tall fescue, which provides no habitat benefit to prairie-chickens or other grasslands birds. In south-eastern Kansas, total lack of burning has led to extensive encroachment of woody vegetation into grasslands (R. Applegate, pers. comm., 1999).

3.17.7. Principal Threats

***Habitat loss*.** Although a mixture of small amounts of cropland with native prairie can be optimal, large-scale conversion of prairie to cropland, woodland or development, resulted in the dramatic loss of greater prairie-chickens throughout most of their original range.

Habitat degradation. Degradation may be caused by a variety of factors including overgrazing by livestock, encroachment by noxious weeds, alteration of fire regimes and fragmentation. Reduction in habitat quality may reduce survival and nesting/brood-rearing success. In Kansas, for example, nearly 90% of the Flint Hills tallgrass prairie is burned annually in March and April to manage for cattle grazing. This, coupled with early intensive grazing regimes, greatly restricts available nesting and brood rearing cover. In eastern Kansas, much native warm-season grass pasture has been converted to cool-season grasses such as tall fescue, which provides no habitat benefit to prairie-chickens or other grasslands birds. In south-eastern Kansas, total lack of burning has led to extensive encroachment of woody vegetation into grasslands (R. Applegate, pers. comm., 1999).

***Small population size*.** Habitat loss and fragmentation have led to small and isolated populations in some areas. Small isolated populations may be vulnerable to declines in genetic heterogeneity and fertility, and subsequently to extinction (Westemeier et al. 1998a) (see Small Population Size; Chapter 2). Due to the small size of the remnant populations, the extinction of the Attwater's prairie-chicken is probable.

Pesticides and herbicides. Herbicide treatment of rangeland may result in the loss of cover for nesting, brood-rearing and loafing. Pesticides may affect birds directly by poisoning them, or indirectly by reducing the abundance of invertebrates.

3.17.8. Research Needs

Monitoring and assessment. Information on sex ratio, lek detection rates, lek attendance rates by males and females, and lek stability is needed so that lek surveys can be used to adequately monitor populations of greater prairie-chickens throughout their range. Because of the importance of the lek mating system in this species, and the reliance on counts of lekking males for monitoring populations, there is a need to understand the relationship between the number of lekking males to the number of females, and total population size.

Population dynamics. The influence of habitat and predation on adult survival, nest success (e.g. Mckee et al. 1998) and survival of juveniles to the age of recruitment, remains a poorly understood aspect of greater prairie-chicken life history. Additional research needs include the impact of harvesting on population dynamics and viability.

Landscape ecology. There is a crucial need to understand the landscape use of the greater prairie-chicken (e.g. Mckee et al. 1998). These birds do not use or occupy small habitat patches except under intensive management, such as that provided in Illinois, Wisconsin and other edges of the occupied range. The relationship of patch size and other landscape characteristics to population vital rates is not well understood. Few studies of greater prairie-chickens have been conducted in the existing core areas of the range, such as Kansas, where populations utilise a landscape that is comprised of extensive grasslands with small areas of cropland, developments and woody cover (R. Applegate, pers. comm., 1999). Finally, impacts of energy development and supporting infrastructure on habitat use, movements and population vital rates must be documented.

Habitat fragmentation and population viability. Research in Illinois indicated that reduced breeding success due to loss of genetic diversity may affect the viability of isolated, remnant populations of greater prairie-chickens (Westemeier et al. 1998a). There is a need to further investigate the genetic diversity (e.g. Westemeier et al. 1998a, Bouzat et al. 1997, 1998), dynamics (e.g. Peterson and Silvy 1996, Mckee et al. 1998), dispersal behaviour and viability of populations and metapopulations in fragmented habitats.

Habitat management and restoration. Experiments are rarely conducted to evaluate the long-term impacts of management practices (such as grazing, burning, cultivation, fragmentation, restoration and food plots) on populations of greater prairie-chickens. The information necessary to restore degraded habitats adequately is also largely unavailable.

3.17.9. Current Conservation Measures

Legal protection. Greater prairie-chickens are legally protected throughout their range. States permitting a regulated harvest include Kansas, Nebraska, South Dakota, North Dakota, Minnesota and Wisconsin. *T. c. attwateri* is federally listed and protected as an 'endangered' species. It is also included in CITES Appendix I, which almost completely prohibits international trade. There are some trade restrictions for the UK and some Asian countries as well (see table below).

Habitat improvement. Manipulation of grazing by livestock and the controlled use of fire, are the primary tools used to improve the quality of habitat. Because nesting and brood-rearing habitat is usually considered to be a limiting factor, efforts are directed toward increasing the protective cover of grasses in most areas, decreasing the grass cover in portions of Texas and Missouri, and decreasing encroachment by trees in Wisconsin and Minnesota. The CRP, a US federal agricultural conservation programme (see Habitat Management; Chapter 2), has resulted in the conversion of millions of hectares of cropland to potential habitat for greater prairie-chickens. This programme is seen as a major factor in the recent stabilisation of the populations. It is scheduled to continue until at least the year 2008. In the long term, a more permanent substitute in the form of landowner incentives must be developed because of the lack of guarantee that this program will be renewed after its expiration.

Predator control. Predator control may increase the nesting success of greater prairie-chickens, however, the long-term effects of predator control on population viability is unknown. Because the political ramifications of predator control are likely to be negative, it is possible that predator control efforts should be re-directed toward manipulations of habitat.

Competitor control. Ring-necked pheasants *Phasianus colchicus* are removed in portions of Illinois where they parasitise greater prairie-chicken nests (Westemeier et al. 1998b).

Food and water provision. Because greater prairie-chickens clearly use cropland during winter, food plots are often provided. However, specific food plots and water provision have not been shown to influence populations on a large scale.

Reintroduction. Translocations of birds into formerly occupied habitats have mostly been unsuccessful. The reasons are seen as inadequate habitat at the release site, and poor survival and reproductive success of the translocated birds.

Captive breeding. Captive breeding is used as a last resort for *T. c. attwateri* in an effort to prevent extinction. Thus far, little or no recruitment from captive reared birds has been documented (Lockwood et al. 2005). There are no examples so far of captive breeding successfully producing or augmenting a wild population, but the subspecies may be preserved in captivity.

Translocation. Re-introductions have been mostly unsuccessful, usually because of inadequate habitat at the release site. Projects in Colorado, Missouri and Iowa may be regarded as positive exceptions (M. Schroeder, pers. comm.). Translocations are likely to be used more in the future to increase genetic heterogeneity and fertility of small isolated populations; a study in Illinois provides an example (Westemeier et al. 1998a).

3.17.10. Priority Conservation Measures

The conservation of Attwater's prairie-chicken, a subspecies that is globally endangered, has highest priority among actions for the greater prairie-chicken. Recommendations concerning Attwater's prairie-chicken are described in Chapter 4. Below, general conservation needs for the greater prairie-chicken are suggested.

Habitat preservation and restoration. There is a need to manage habitats actively in the core of the range to maintain large and genetically healthy populations. The CRP (see Habitat Manegement; Chapter 2) has the potential to provide millions of hectares of habitat for greater prairie-chickens throughout their range but must be regarded as a temporary solution. The programme is currently designed to produce relatively high quality prairie with a diversity of native grass and forb species. A permanently funded landowner incentive programme will be necessary in order to assure the future of species.

Maintaining and restoring spatial connectivity. Maintaining and restoring spatial connectivity among local populations seems to be vital. The fate of Attwater's prairie-chicken indicates that once populations and habitat have become small and isolated, the chances for population restoration are poor. Preventative measures are needed for the remaining larger populations and metapopulation systems. Restoration of habitats should include the development of corridors between isolated populations.

Design and application of conservation plans. Landscape scale conservation plans for each population of greater prairie-chickens should be designed with the aid of public and private landowners and interested citizens. The conservation plans should include appropriate recommendations for habitat management, restoration, configuration and acquisition in order to maintain long-term population viability. Efforts should be made with reasonable speed to apply management recommendations in conservation plans.

3.17.11 Recent Changes

Habitat loss and fragmentation, degradation of habitat by overgrazing, haying and too frequent burning, and increase in human disturbance on leks continue to negatively affect the species. In 2002, the greater prairie-chicken was uplisted as Vulnerable in the Red List of Threatened Species owing to rapid population decline (http://www.redlist.org/).

3.17.12. Correspondents

1999: Roger Applegate, Rick Baydack, Jack Connelly, Kenneth Giesen, Michael Morrow, Markus Peterson, Michael Schroeder, Nova Silvy

2004: Roger Applegate, Michael Schroeder, Jack Connelly

Table 3.17. Greater prairie-chicken *Tympanuchus cupido* Linnaeus, 1758

Country	Red list[1]	Legal protection[2]				Hunting[3]	Population[4]		Threats[5]							Conservation measures[6]						
		TP	PP	NT	IT		Size	Trend	S	F	H	P	E	D	C	O	S	M	H	C	R	E	O
Canada	x	x	x	x			0	0															
USA			x	x		L P S, R	600,000	0/+/-	x	x	x	x	x	x		x	x	x	x			x	
USA *T. c. attwateri*	x	x	x	x	x		50-60	-	x	x	x	x					x	x	x	x	x	x	x
Non-range countries *(refers to T. c. attwateri)*																							
Japan		x		x	x																		
Malaysia				x	x																		
Singapore				x	x																		
UK				x	x																		

1 Red list: x listed as threatened species at the national level, - not listed

2 Legal Protection: TP total protection, PP partial protection, NT possession and/or national trade prohibited or regulated, IT international trade prohibited or regulated

3 Hunting: L legal, P poaching (illegal), R regionally restricted, S restricted hunting season, M males only

4 Population size (order of magnitude): estimated number of individuals in spring;

Population trend (during the past 10 years): + increasing, 0 stable, - declining, ? unknown

5 Threats (factors suspected to cause significant, longer-term population declines and extinction): S small population size, F habitat loss/fragmentation, H habitat degradation, P predation, E exploitation, D disturbance by tourism/leisure activities, C climate change, O other threats

6 Conservation measures (ongoing at the time of reporting): S surveys, M monitoring, H habitat management, C captive breeding, R restocking/reintroduction, E education, O other measures

3.17.13. Key Publications

Lehmann, V.W. 1941. *Attwater's prairie-chicken: its life history and management*. U.S. Fish and Wildlife Service, North American Fauna 57.

Lockwood, M. A., C. P. Griffon, M. E. Morrow, C. J. Randel, and N. J. Silvy. 2005. Survival, movements and reproduction of released captive-reared Attwater's Prairie-Chicken. Journal of Wildlife Management 69:1251-1258.

Morrow, M. E., T. A. Rossignol, and N. J. Silvy. 2004. Federal listing of prairie grouse: lessons from the Attwater's prairie-chicken. Wildlife Society Bulletin 32:112-118.

Schroeder, M. and Robb, L. 1993. Greater prairie-chicken. *The birds of North America*, No. 36. The birds of North America, Inc., Philadelphia, PA.

Silvy, N.J., C.P. Griffin, M.A. Lockwood, M.E. Morrow, and M.J. Peterson. 1999. Attwater's prairie-chicken: a lesson in conservation biology research. Pages 153-162 *in* W.D. Svedarsky, R.H. Hier, and N.J. Silvy, editors. *The greater prairie-chicken: a national look*. Minnesota Agricultural Experiment Station Miscellaneous Publication 99-1999. University of Minnesota, St. Paul, Minnesota, USA.

Silvy, N. J., M. J. Peterson, and R. R. Lopez. 2004. The cause of the decline of pinnated grouse: the Texas example. Wildlife Society Bulletin 32:16-21.

Westemeier, R.L., Brawn, J.D., Simpson, S.A., Esker, T.L., Jansen, R.W., Walk, J.W., Kershner, E.L., Bouzat, J.L., and Paige, K.N. 1998a. Tracking the long-term decline and recovery of an isolated population. *Science* 282:1695-1698.

For an extended list of references on the species see Schroeder and Robb (1993) and Silvy et al. (1999).

All publications referred to in the text are listed in the References section

3.18 Lesser Prairie-chicken

Scientific name:	*Tympanuchus pallidicinctus*	Linnaeus, 1758
Common names:	Lesser prairie-chicken	English
	Tétras pâle	French
	Gallo de las praderas chico	Spanish

Photo 3.18a. Lesser prairie-chicken, male displaying *(Photo Kansas Dept of Wildlife and Parks, from Roger Applegate).*

3.18.1. Conservation Status

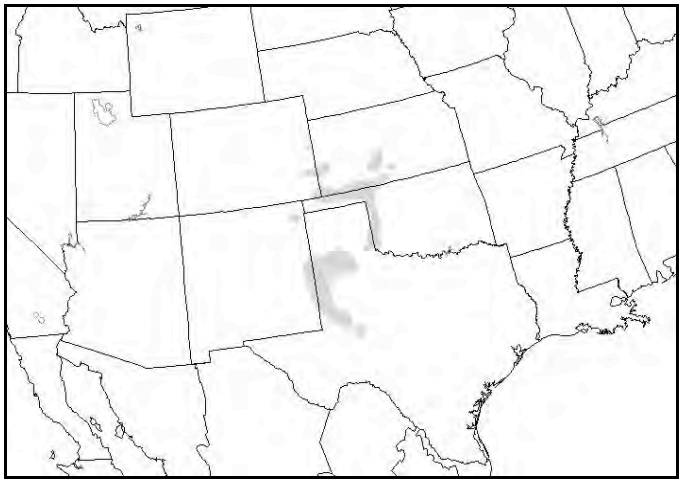
IUCN 2006 (http://www.redlist.org/): Vulnerable
CITES 2005: not listed in Appendices. (http://www.cites.org/eng/app/index.shtml)
National Red Data books: listed in some states of the USA; federal listing as a 'candidate' species under the US Endangered Species Act.

3.18.2. Taxonomy

Monotypic; no subspecies recognised.
Lesser and greater prairie-chicken are easily confused. Greater prairie-chickens are slightly larger and appear uniformly dark on the back whereas lesser prairie-chickens have fine barring on the back. Also, the air sacs of the greater prairie-chicken are golden-yellow whereas those of the lesser prairie-chicken are red-orange. Lesser prairie-chickens have finer barring on the breast.

3.18.3. Distribution

Originally found in south-western portions of the Great Plains in south-eastern Colorado, south-western Kansas, western Oklahoma, northern Texas and eastern New Mexico. The species may have responded positively to initial increases in agriculture by expanding northward to southern Nebraska and perhaps also eastward to western Missouri. Currently, the range is restricted to relatively small and scattered portions totalling about 8% (Hagen 2005) of the original range. In North America, the lesser prairie-chicken is second only to the Gunnison sage-grouse in smallest population size and most restricted distribution of all the grouse species (Hagen 2005).



Map 3.18. Lesser prairie-chicken distribution.

3.18.4. Population Size and Trend

Historically, the lesser prairie-chicken increased temporarily with the advent of agriculture. Since the 1800s, the population size may have declined by about 97%. However, there were no surveys until the mid 20th century and during at least the first half of the 19th century, the lesser and greater prairie-chickens were considered the same species. Therefore, the extent of the early decline is uncertain.

From 1963 to 1980, the species has declined by 78%, and by 92% since the late 1800's. Most evidence indicates that by the mid 1990s, populations were at their lowest levels since lek count survey monitoring began. Spring densities of displaying males vary greatly between years and range from 0.2 to 11.8 males/km^2 in various areas. Total population size has been crudely estimated between 10,000 and 25,000 birds (Johnsgard 2002), but actual numbers remain unknown.

3.18.5. Habitat and Ecology

Lesser prairie-chickens were originally inhabitants of the southern Great Plains which were dominated by mid grass prairie mixed with shinnery oak (*Quercus havardii*) or sand sagebrush (*Artemisia filifolia*). At present, the species is most common in sandy dwarf shrub-mixed grass vegetation, sometimes interspersed with short grass habitats. Densities are believed to be generally higher in shinnery oak than in sand sagebrush habitats. Although lesser prairie-chickens may use scattered areas of cropland, the overall effect of conversion of prairie to cropland is negative. Leks are mostly located in sparse vegetation and in elevated locations, such as knolls or ridges. In winter, the birds make more use of small-scale agricultural fields. Lesser prairie-chickens feed on insects, seeds, leaves, buds and cultivated grains. In winter, acorns are a major food item in shinnery oak region. Some movements of up to approx. 10km may occur between seasonal habitats (Hagen 2005).

3.18.6. Hunting and Cultural Importance

Lesser prairie-chickens were a game species for native Americans and the Europeans that followed them, but their influence on the population was probably low. Market hunting and poaching may have had dramatic impacts on some populations during the 1800s and early 1900s. The first legislation to regulate hunting was passed in 1861 in Kansas. Hunting seasons were closed in Colorado in the early 1900s, and in the other states for various periods in response to population trends. At present, limited hunting is allowed in Kansas and Texas; the total annual hunting bag has been estimated as <1,000 birds. In general, the effects of hunting

on population dynamics are believed to be low. Lesser prairie-chickens are currently receiving more attention from naturalists and bird-watchers as more people appreciate the spectacular breeding display of birds on leks (gobbling grounds).

3.18.7. Principal Threats

Habitat loss and degradation. The lesser prairie-chicken has primarily declined because of loss, fragmentation and degradation of sand sagebrush and shinnery oak rangelands, due to agriculture. Large-scale conversion of prairie to cropland has resulted in the dramatic loss of lesser prairie-chickens throughout most of their original range. Degradation due to overgrazing by livestock has reduced the quality of most remaining prairie habitats; reduction in habitat quality may reduce survival and nesting and brood-rearing success. Also, oil and natural gas development have possible implications (Hagen 2005)

Small population size. Small isolated populations may be vulnerable to declines in genetic heterogeneity and fertility, leading to extinction (Hagen 2005).

Pesticides and herbicides. Pesticides may affect birds directly by poisoning them or indirectly by reducing the abundance of invertebrates. Herbicide treatment of rangeland may result in the loss of cover for nesting, brood-rearing and loafing. This is especially true of sagebrush or shinnery oak control programs.

3.18.8. Research Needs

Monitoring and assessment. Inventory methods rely on counts of males at the lek. Existing lek survey methods measure population trends but do not provide a size or density estimate. For estimating population size and trends, the proportion of males attending leks and the sex ratio in spring need to be better understood. Information on sex ratios, lek attendance by males and females, and lek stability is needed so that lek surveys can be adequately used to monitor populations of lesser prairie-chickens throughout their range.

Population dynamics. The influence of habitat and predation on adult survival, nest success, and survival of juveniles to the age of recruitment, remain a poorly understood aspect of lesser prairie-chicken life history. As populations are becoming increasingly fragmented, information is needed on genetic variability, dispersal, minimum viable population size, minimum habitat patch size and metapopulation dynamics in relation to the spatial distribution of suitable habitats. Additional research should include the impact of harvest on population dynamics and viability. The extent to which parasites and disease affect population dynamics is unknown and additional work is needed.

Habitat management and restoration. Understanding the effects of various land use practices (such as grazing, burning, cultivation, etc.) is vital for habitat preservation and restoration for the lesser prairie-chicken. Applied experiments are rarely conducted to evaluate the long-term impacts of management practices on populations of lesser prairie-chickens. The information necessary to restore degraded habitats is largely unavailable.

Photo 3.18b Habitat of lesser prairie-chicken in North-West Oklahoma *(Sept. 2003, Photo Michèle Loneux*

3.18.9. Current Conservation Measures

Legal protection. Lesser prairie-chickens are legally protected throughout their range. The only states permitting a regulated harvest are Kansas and Texas. The species is currently under consideration for federal (USA) listing as 'threatened' or 'endangered'.

Monitoring. Generally, two indices are used to assess population trends: numbers of lekking males and the number of leks; both show great annual and geographic variation.

Habitat improvement. Manipulation of grazing by livestock is the primary tool used to improve the quality of habitat. Because nesting and brood-rearing habitat are usually considered to be a limiting factor, most efforts are directed toward increasing the protective cover of grasses. The CRP (see Habitat Management; Chapter 2) has resulted in the conversion of thousands of hectares of cropland to potential habitat for lesser prairie-chickens, with mixed success. CRP plantings vary in composition and density of grasses, and thus in habitat suitability for lesser prairie chickens, from one area to another. For example, in Oklahoma, they are predominately bermuda grass whereas in Kansas they are comprised of native short and mixed grasses (Hagen 2005).

Reintroduction. Reintroduction and restocking by transplantations of lesser prairie chickens trapped in the wild have been tried at least 12 times, but all have failed. The lack of adequate habitat at the release site appeared to be the primary explanation (Hagen et al. 2004).

Food and water provision. Provisions of extra food and water have not been shown to influence populations on a large scale.

3.18.10. Priority Conservation Measures

Conservation plans. Each state should develop and implement conservation plans for lesser prairie chickens. These plans should use local groups comprised of representatives from all interested stakeholders to identify and solve regional issues within ecological regions. Conservation plans should include 1) quantity and quality of lesser prairie-chicken habitat remaining in the state, 2) common problems involved in conserving the lesser prairie-chicken, and 3) conditions needed to maintain healthy populations. Regional variations in vegetative communities (e.g. sand sagebrush, shinnery oak, mixed shrub or grass dominated), weather or resource use that affect populations and their management need to be considered in conservation

plans. To date, only New Mexico has developed and is implementing such a plan (Massey 2001).

Habitat preservation and restoration. Nesting habitat should be improved through better management of livestock grazing and restoration of native rangelands. There is a need for both protection and active management of occupied habitats and restoration of habitat corridors between isolated populations. Energy development (i.e. renewable and fossil fuels) is an increasing issue in these habitats and appropriate measures are needed to protect the remaining populations. Because most lesser prairie chickens occur on private lands, there should be an incentive programme for landowners to protect and maintain populations on their lands.

Monitoring. Intensive population monitoring is necessary to identify population sinks and to locate isolated populations facing genetic bottlenecks.

3.18.11 Recent Changes

Hybridization with the greater prairie-chicken has been observed in areas of low population densities, and may further contribute to the species decline (Hagen 2005). Habitat loss and fragmentation, and habitat degradation from overgrazing continue to have major negative effects. In 2001, the lesser prairie-chicken was uplisted as Vulnerable in the Red List of Threatened Species owing to a rapid population decline (http://www.redlist.org/).

3.18.12. Correspondents

2000: Jack Connelly, Christian A. Hagen, Don H. Wolfe

2005: Roger Applegate, Jack Connelly, Christian A. Hagen, Stephanie Manes

3.18.13. Key Publication

Hagen, C. A. 2005. Lesser prairie-chicken (*Tympanuchus pallidicinctus*). *The birds of North America, No. 364.* (A. Poole, Ed.). Ithaca: Cornell Laboratory of Ornithology. Available online *http://bna.birds.cornell.edu/BNA/*

For an extended list of references on the species see Hagen (2005). All publications referred to in the text are listed in the References section.

Table 3.18. Lesser prairie chicken *Tympanuchus pallidicinctus* Linnaeus, 1758

Country	Red list[1]	Legal protection[2]				Hunting[3]	Population[4]		Threats[5]								Conservation measures[6]						
		TP	PP	NT	IT		Size	Trend	S	F	H	P	E	D	C	O	S	M	H	C	R	E	O
USA	x	x	x	x		L, S, R	10-25,000	0/-/+	x	x	x						x	x	x		x	x	

1 Red list: x listed as threatened species at the national level, - not listed

2 Legal Protection: TP total protection, PP partial protection, NT possession and/or national trade prohibited or regulated, IT international trade prohibited or regulated

3 Hunting: L legal, P poaching (illegal), R regionally restricted, S restricted hunting season, M males only

4 Population size (order of magnitude): estimated number of individuals in spring;

Population trend (during the past 10 years): + increasing, 0 stable, - declining, ? unknown

5 Threats (factors suspected to cause significant, longer-term population declines and extinction): S small population size, F habitat loss/fragmentation, H habitat degradation, P predation, E exploitation, D disturbance by tourism/leisure activities, C climate change, O other threats

6 Conservation measures (ongoing at the time of reporting): S surveys, M monitoring, H habitat management, C captive breeding, R restocking/reintroduction, E education, O other measures

4. Recommended Conservation and Research Priorities

4.1 Rationale

The major objective of this Action Plan is to identify conservation and research priorities for the grouse from a global perspective. In this rationale, conservation actions for globally threatened species are rated higher than those for threatened subspecies and for regional and local populations. In the species' accounts in Chapter 3, general research and conservation needs for each individual species are outlined. The conservation status of the grouse has deteriorated since publication of the first Grouse Action Plan (Storch 2000), when none of the species were considered to be globally threatened. Today (IUCN 2006), one species is listed as Endangered (Gunnison sage-grouse), two as Vulnerable (greater prairie-chicken, lesser prairie-chicken), one as Data Deficient (Caucasian black grouse; a candidate for being re-classified as Near Threatened) and three as Near Threatened (Chinese grouse, Siberian grouse, greater sage-grouse). From a global perspective, these species are of the greatest concern. They are the focus of this chapter. In addition, we also point out two subspecies, Attwater's prairie-chicken and Cantabrian capercaillie, that the Grouse Specialist Group (GSG) proposes to be considered as threatened (see Chapter 3 for details) according to the IUCN Red List categories (IUCN 2001).

The overall goal of all conservation recommendations given in this chapter is to strengthen the viability of the threatened and near-threatened species and subspecies of grouse. Conservation priorities are those activities which appear to be urgent (according to IUCN Red list categories; IUCN 2001) and which are believed to have a good chance of implementation within the next five years, i.e. 2006-2010. Some of the suggested measures could be incorporated within larger, multi-species or ecosystem conservation programmes. Also, beyond the recommendations given in this chapter, the Action Plan can be used as a basis for new research. Scientists and students around the world should be encouraged to suggest their own, conservation-oriented research ideas to the GSG. If endorsed by the GSG, project proposals may stand a good chance to find national or international financial support.

For the threatened grouse species, the information in this chapter is based upon BirdLife International (2005) species fact sheets (http://www.birdlife.org). These grouse fact sheets were compiled by the World Pheasant Association and based on information provided by the Grouse Specialist Group.

4.2 Recommended Actions

4.2.1 Gunnison sage-grouse

2006 IUCN Red List Category	**Endangered**
Total population estimate	2,600 in 8 isolated populations
Population trend	declining
Occupied range	<500 km^2; fragmented
Habitat	sagebrush *Artemisia* spp. dominated ecosystems
Country	USA
Threats	Habitat loss, degradation and fragmentation resulting from conversion to roads, reservoirs, livestock-grazing, hay and other crops, real estate developments, powerlines, land treatments, increased deer populations Human disturbance related to recreation, tourism, lek viewing

The Gunnison sage-grouse (*Centrocercus minimus)* in southwestern Colorado and southeastern Utah has been recognized as a separate species from the greater sage-grouse *(C. urophasianus* (Young et al. 2000)). There are currently eight distinct populations ranging from two to 498 males counted during spring lek surveys and only one population is estimated to contain over 500 individuals (Gunnison Sage-grouse Rangewide Steering Committee 2005). The Gunnison sage-grouse is listed as Endangered (IUCN 2001, 2004) because of a low (i.e. <5,000 individuals) population size, very restricted (i.e. <500 km) occupied range that is severely fragmented, ongoing population decline, and habitat degradation, loss and fragmentation related to livestock grazing, agriculture, housing, industry and infrastructure development, and road construction (see Connelly & Braun 1997, Bureau of Land Management 1999, Oyler-McCance 1999). Habitat fragmentation is of particular concern because the species requires a variety of adjacent habitats that differ seasonally and also for age and sex classes. Human disturbance (recreation, tourism, lek viewing) and recent droughts pose additional threats. Overall, populations declined during the 2000-2004 period. Estimated population size in 2004 was 3,200 individuals (Gunnison Sage-grouse Rangewide Steering Committee 2005). 2005 lek counts suggest that only the Gunnison Basin population increased during the past year; at present, population estimates around 2600 appear realistic (C.E. Braun, J. R. Young, pers. comm.). The species is a candidate for U.S. federal listing under the Endangered Species Act (http://ecos.fws.gov/docs/candforms_pdf/_r6/B0B0_V01.pdf).

Conservation measures underway: In 1995, a working group was formed and in 1998, a conservation plan identified over 200 actions (Bureau of Land Management 1999). By 2004, over 95% of the population was covered by local working groups' conservation plans (J. R. Young, pers. comm.). While the success of such local efforts may be controversial, hunting has ceased and significant gains have been made in land protection through conservation easements and land acquisitions (J. R. Young, pers. comm.). Current actions include lek enhancement, riparian area restoration, nest habitat treatments, improved livestock management, nest predator research and education. Education measures include sponsored grouse viewing, information brochures and talks given in local schools and fairs. Radio-telemetry and graduate research is helping to determine winter habitat use and lek sites have been protected. Hunting of the species has been stopped (C.E. Braun, W. Martinson, Y.R. Young, pers. comm.). In 2005 state and federal employees drafted a 'Rangewide Plan' and have begun contact with local landowners to present voluntary conservation agreements (Gunnison Sage-grouse Rangewide Steering Committee 2005).

Conservation measures proposed: To restore and improve habitat, while continuing work to prevent further loss and fragmentation. Support the listing on the Endangered Species Act. Continue population monitoring at key sites. Conduct further ecological research, focusing on survival, dispersal and habitat use at different life stages. Encourage and facilitate the implementation of local and range-wide management plans. Reduce disturbance, especially at active leks. Investigate the possibility of using translocations to augment small populations. Continue work to raise awareness of key issues among stakeholders.

Factors limiting conservation success. Land use interests competing with species habitat needs. Small size and fragmentation of remaining populations.

References

Bureau of Land Management 1999. Gunnison sage-grouse conservation plan. Bureau of Land Management, Colorado Gunnison Field Office, Gunnison, Colorado, USA. Available at www.co.blm.gov/gra/sagegrouse. html

Connelly, J. and Braun, C. E. 1997. Long-term changes in sage-grouse populations in western North America. Wildlife Biology 3:229-234.

Connelly, J. W., M. A. Schroeder, A. R. Sands, and C. E. Braun. 2000. Guidelines to manage sage-grouse populations and their habitats. Wildlife Society Bulletin 28:967-985.

Gunnison Sage-grouse Rangewide Steering Committee. 2005. Gunnison sage-grouse rangewide conservation plan. Division of Wildlife, Denver, Colorado. 359 pp. + appendices.

Oyler-McCance, S.J.; Burnham, K.P.; Braun, C.E. 2001. Influence of changes in sagebrush on Gunnison sage-grouse in southwestern Colorado. Southwestern Naturalist, 46: 323-331.

Oyler-McCance, S.J., J. St. John, S.E. Taylor, A.D. Apa, and T.W. Quinn. 2005. Population genetics of Gunnison sage-grouse: implications for management. Journal of Wildlife Management 69(2): 630-637.

Young, J. R., Braun, C. E., Oyler-McCance, S. J., Hupp, J. W., and T. W. Quinn. 2000. A new species of Sage-grouse from Southwestern Colorado. Wilson Bulletin 112:445-453.

Web sources of information

http://www.birdlife.org/datazone/species/index.html

http://www.western.edu/bio/young/gunnsg/gunnsg.htm

http://wildlife.state.co.us/WildlifeSpecies/Profiles/Birds/GunnisonsageGrouse.htm

http://ecos.fws.gov/docs/candforms_pdf/r6/B0B0_V01.pdf

Correspondents: C. E. Braun, J. R. Young

The status information for this species is partly based upon: BirdLife International (2005) Species factsheet: Centrocercus minimus. http://www.birdlife.org

4.2.2 Lesser prairie-chicken

2006 IUCN Red List Category	**Vulnerable**
Total population estimate	10,000-25,000; most populations <1,000
Population trend	declining
Total range	~100,000 km^2
Occupied range	~25,000 km^2, fragmented
Habitat	mid grass prairie mixed with shinnery oak *Quercus havardii* or sand sagebrush *Artemisia filifolia*
Country	USA
Threats	Habitat loss, degradation and fragmentation resulting from conversion of prairie to cropland, livestock-grazing, pesticide treatment of rangeland, oil and gas development Hunting Droughts

The lesser prairie-chicken of the southwestern portions of the North American Great Plains, is classified as Vulnerable owing to a rapid population decline, equivalent to 30–49% per decade between 1979 and 1995 (IUCN 2004, Hagen 2005). The species still occurs in southwest Kansas, southeast Colorado, the Oklahoma panhandle, west Texas and east New Mexico, USA. There have been substantial decreases (>90%) in occupied range and population size since the 1800s that were related to habitat loss and overharvesting. Ongoing habitat loss, but also severe drought and harvest levels, contribute to continuing declines. The species has lost most of its original range and the remaining population size is estimated at 10,000-25,000 birds. The range is highly fragmented and most populations are less than 1,000 birds in size (Hagen 2005). Major threats are conversion of prairie to cropland, pesticide treatment of rangeland, overgrazing by livestock, oil and gas development, and hunting. Restricted hunting produces an annual bag of fewer than 1,000 birds. The species is a candidate for U.S. federal listing under the Endangered Species Act. (http://ecos.fws.gov/docs/candforms_pdf/r2/B0AZ_V01.pdf).

Conservation measures underway. The species is legally protected in all range states, and is being considered for listing under the Federal Endangered Species Act. Numbers of leks and attending males are monitored. Reintroduction or restocking by transplantations of lesser prairie-chickens trapped in the wild have been tried at least 12 times, but all failed due to the lack of adequate habitat at release sites (Hagen et al. 2004). Manipulation of grazing by livestock to improve the quality of nesting and brood-rearing habitat is the primary approach to LPC conservation; most efforts are directed toward increasing the protective cover of grasses. The Conservation Reserve Program (CRP, http://www.nrcs.usda.gov/programs/crp/) and other private lands management schemes have resulted in the conversion of thousands of hectares of cropland to potential habitat for lesser prairie-chickens, with mixed success. CRP plantings vary in composition and density of grasses, and thus in habitat suitability for lesser prairie-chickens, from one area to another. For example, in Oklahoma, they are predominately bermuda grass whereas in Kansas they are comprised of native short and mixed grasses (Hagen 2005). Large areas of land habitat have been purchased by states and the Nature Conservancy, and policies are now being implemented that will protect additional habitat from wind energy development (R. Applegate pers. comm.). Species recovery plans are under way (see http://wildlife.state.co.us/WildlifeSpecies/ComprehensiveWildlifeConservationStraegy/RecoveryConservationPlans.htm and http://www.westgov.org/wga/initiatives/HighPlains/hppbroch.htm).

Conservation measures proposed. Develop and implement state-wide conservation plans for lesser prairie-chickens. Allow habitat regeneration, reduce grazing stock and construct livestock exclosures. Continue to manage occupied habitats on private lands and hasten progress towards effective management on public lands. Protect occupied habitats. Develop and promote effective incentives for land-owners to maintain populations. Continue monitoring leks.

Factors limiting conservation success. Land use interests competing with species habitat needs. Small size and fragmentation of remaining populations. Continued hunting.

References

Hagen, C. A. 2005. Lesser prairie-chicken (*Tympanuchus pallidicinctus*). *The birds of North America, No. 364,* Available Online *http://bna.birds.cornell.edu/BNA/* (A. Poole, Ed.). Ithaca: Cornell Laboratory of Ornithology.

Web sources of information

http://www.birdlife.org/datazone/species/index.html

http://wildlife.state.co.us/WildlifeSpecies/ComprehensiveWildlifeConservationStrategy/RecoveryConservationPlans.htm

http://www.westgov.org/wga/initiatives/HighPlains/hppbroch.htm).

http://ecos.fws.gov/docs/candforms_pdf/r6/B0B0_V01.pdf

http://ecos.fws.gov/servlet/SpeciesProfile?spcode=B0AZ

Correspondents: Roger Applegate, Christian A. Hagen, Don H. Wolfe, Jack Connelly

The status information for this species is partly based upon: BirdLife International (2005) Species factsheet: Centrocercus minimus. http://www.birdlife.org

4.2.3 Greater prairie-chicken

2006 IUCN Red List Category	**Vulnerable**
Total population estimate	600,000
Population trend	declining
Total range	377,850 km^2; fragmented
Habitat	tall grass prairie habitats interspersed with oak woodland
Country	USA
Threats	Habitat loss, degradation and fragmentation resulting from conversion of prairie to cropland, livestock-grazing, haying, pesticide treatment of rangeland, too frequent burning Human disturbance on leks Hunting

The greater prairie-chicken of central North America has been uplisted to Vulnerable (IUCN 2004) due to rapid declines in both population size and occupied range. It has already disappeared from many U.S. states in which it was formerly common. The subspecies *T. c. pinnatus* and *T. c. attwateri* originally occurred in eastern portions of the Great Plains from Minnesota, Wisconsin and Michigan, south through southern Texas, while *T. c. cupido* occurred in the northeastern USA, including Massachusetts, Connecticut, New York, Pennsylvania, New Jersey and Maryland. *T. c. cupido* became extinct in the 1930s after many years of dramatic declines; exploitation and fire control are thought to have had an important role. *T. c. attwateri* declined from 8,700 birds in 1937 (Lehman 1941) to ~50 individuals and consequently, faces an immediate risk of extinction. Also *T. c. pinnatus* has declined in many regions and is now restricted to Oklahoma, Kansas, Nebraska, South Dakota, North Dakota and small portions of Colorado, Minnesota, Wisconsin, Illinois, Iowa and Missouri. Total population size is estimated at about 600,000 birds. Major threats are habitat loss and degradation due to agriculture (crops, livestock, pesticides). Also legal hunting may negatively affect the species.

Conservation measures underway. The species is legally protected in all range states, but some still allow controlled hunting. Most management effort has been directed toward improvement of habitat. Manipulation of grazing by livestock and the controlled use of fire are the primary tools. The CRP, a US federal agricultural conservation programme (http://www.nrcs. usda.gov/programs/crp/), has resulted in the conversion of millions of hectares of cropland to potential habitat for greater prairie-chickens. Ring-necked pheasants *Phasianus colchicus* are removed in parts of Illinois where they parasitize greater prairie-chicken nests (Westemeier et al. 1998b). Translocations of birds into formerly occupied habitats have mostly been unsuccessful, usually because of inadequate habitat at the release site. Translocations are likely to be used more in the future to increase genetic heterogeneity and fertility of small isolated populations; a study in Illinois provides an example (Westemeier et al. 1998a).

Conservation measures proposed. Continue CRP programme and develop a more permanent substitute in the form of landowner incentives to preserve habitats in the long term. Protect occupied habitats. Develop and promote effective incentives for land-owners to maintain populations. Continue monitoring leks. Maintain and restore spatial connectivity among local populations by developing corridors between isolated populations. Develop and implement landscape scale conservation plans for each population.

Factors limiting conservation success. Land use interests competing with species habitat needs. Continued hunting.

References

Lehmann, V.W. 1941. Attwater's prairie-chicken: its life history and management. U.S. Fish and Wildlife Service, North American Fauna 57.US Department of Interior, Washington DC.

Schroeder, M.A. and Robb, L.A. 1993. Greater Prairie-Chicken (Tympanuchus cupido). In The Birds of North America, No. 36 (A. Poole and F. Gill, eds.). The Academy of Natural Sciences, Philadelphia, PA, and The American Ornithologists' Union, Washington, DC

Silvy, N. J., M. J. Peterson, and R. R. Lopez. 2004. The cause of the decline of pinnated grouse: the Texas example. Wildlife Society Bulletin 32:16-21.

Westemeier, R.L., Brawn, J.D., Simpson, S.A., Esker, T.L., Jansen, R.W., Walk, J.W., Kershner, E.L., Bouzat, J.L., and Paige, K.N. 1998a. Tracking the Long-Term Decline and Recovery of an Isolated Population. Science 282:1695-1698.

Westemeier, R.L., J E. Buhnerkempe, W.R. Edwards, J.D. Brawn, and S.A Simpson. 1998b. Parasitism of greater prairie-chicken nests by ring-necked pheasants. Journal of Wildlife Management 62:854-863.

Web sources of information

BirdLife International (2005) Species factsheet: *Tympanuchus cupido*. http://www.birdlife.org/datazone/species/index.html

http://southwest.fws.gov/refuges/texas/apc.html

http://audubon2.org/webapp/watchlist/viewSpecies.jsp?id=91

Correspondents:

Roger Applegate, Mike Schroeder, Jack Connelly

The status information for this species is partly based upon: BirdLife International (2005) Species factsheet Tympanuchus cupido. http://www.birdlife.org

4.2.4 Caucasian black grouse

2006 IUCN Red List Category	**Data deficient**; reclassification as near Threatened proposed on the basis of suspected declines in the near future.
Total population estimate	80,000-90,000
Population trend	At least locally declining, particularly in the Lesser Caucasus declines may continue to accelerate.
Total range	Lesser and greater Caucasus; north-east Turkey
Occupied range	Unknown; fragmented
Countries	Armenia, Azerbaijan, Georgia, Iran, Turkey, Russia
Threats	Habitat loss, degradation and fragmentation resulting from intensive grazing of subalpine meadows Predation by feral and shepherd-dogs Illegal sport hunting

The Caucasian black grouse has the smallest distribution of all Eurasian grouse and is endemic to the Greater and Lesser Caucasus Mountains. The species has probably been declining since at least the 1980s and has disappeared from some mountains at the limits of the range. The range is highly fragmented. Political unrest and poor economies throughout much of the range have limited studies of the species. Due to its uncertain status the species has been listed as Data Deficient (IUCN 2006). In recent years, surveys and population studies have been initiated in Georgia, Turkey, and Azerbaijan. Current population estimates assume 40,000-50,000 birds in Georgia, 25,000-30,000 in Russia, 7,500 in Turkey, 1,500-3,500 in Azerbaijan, 300 in Armenia and 100 in Iran, resulting in an estimated total population of 80,000-90,000 birds. Habitat loss and deterioration, particularly from intensive grazing of subalpine meadows, are likely to be the major threats. Predation by feral and shepherd-dogs, and illegal sport hunting are believed to pose threats to the species (Klaus et al. 1990, Gokhelashvili et al. 2003, Baskaya 2003; Vasil Ananian, Sagdan Baskaya, Ramaz Gokhelashvili, Sam Khosravifard, Siegfried Klaus, Roald Potapov, Alexander Solokha, Elchin Sultanov, Geoff Welch, pers. comm., 2005). This recent improvements in knowledge of its distribution and the size and trend of the population now allow assessment of the species's status against the IUCN Red List criteria. Declines in the Lesser Caucasus may continue to accelerate, and global declines are therefore projected to approach 30% over 12 years (three generations), and hence the species warrants precautionary reclassification as Near Threatened (BirdLife International, pers. comm. Dec. 2007).

Conservation underway. Large scale conservation projects are underway in Georgia and Turkey to improve our understanding of the species' biology, develop monitoring and management activities and promote public awareness. A project to survey the species in Azerbaijan has begun. Future work to develop a conservation strategy and create a potential distribution map for all range countries is planned.

Conservation measures proposed
Continue fieldwork (including extensive surveys in Russia) to determine population status, availability of habitats and principle threats, leading to a full Red List assessment. Encourage the development and implementation of national species action plans. Develop public awareness campaigns. Identify threats and develop mitigation measures. Review the adequacy of the existing protected area network.

Factors limiting conservation success.
Limited knowledge on species´ distribution, status and habitat needs. Socio-economic situation in range countries. Political unrest in parts of the range. Lack of funding for basic research and conservation measures in parts of the range.

References
Baskaya, S. 2003. Distribution and principal threats to Caucasian black grouse *Tetrao mlokosiewiczi* in the Eastern Karadeniz Mountains in Turkey, Wildlife Biology, 9:4, 377-383.

Gokhelashvili, R., Kerry P. Reese and Lexo Gavashelishvill. 2003. How much do we know about the Caucasian Black Grouse *Tetrao mlokosiewiczi*? Sandgrouse 25:32-40.

Klaus, S., Bergmann, H.-H., Marti, C., Müller, F., Vitovic, O. A., and Wiesner, J. 1990. *Die Birkhühner*. Die Neue Brehm-Bücherei. Westarp Wissenschaften, Magdeburg, Germany.

Web information sources
BirdLife International (2005) Species factsheet: *Tetrao mlokosiewiczi*. http://www.birdlife.org
http://www.gccw.org/index.php?a=activities-cbg.

Correspondents
Vasil Ananian, Sagdan Baskaya, Ramaz Gokhelashvili, Siegfried Klaus, Sam Khosravifard, Mehdi Nabian, Roald Potapov, Elchin Sultanov, Geoff Welch

4.2.5 Chinese grouse

2006 IUCN Red List Category	**Near Threatened**
Total population estimate	10,000
Population trend	declining
Total range extent	12,400 km^2 in Gansu and Quinghai (*B. s. sewerzowi)* 303,000 km^2 in Sichuan, E-Tibet, N-Yunnan *(B. s. secunda)*
Habitat	conifer-rich mixed montane forests from valley bottoms to treeline
Country	China
Threats	Habitat loss, degradation and fragmentation resulting from forest exploitation, deforestation, erosion and conversion of forest into farmland Hunting

The Chinese grouse, a forest-dwelling species endemic to central China, nearly qualifies for listing as threatened because of ongoing significant reductions in population size and area of occupancy (IUCN 2004). Major threats are habitat loss due to clearcutting and illegal hunting for food. The range of the Chinese grouse is restricted, contracting, and highly fragmented. The population is declining and is currently estimated at ~10,000 birds (Sun Yue-Hua, pers. comm.). The first studies of the species´ population biology (Sun et al. 2003), population genetics (Larsson et al. 2003) and landscape ecology (Sun et al. 2003) were presented in 2003. Recently, the Chinese government stopped logging the natural forest within Gansu and Sichuan provinces. This may have helped to at least locally stabilize Chinese grouse population trends. However, studies have been restricted to minor parts of the distribution range, and more surveys are needed to clarify the species´ rangewide status. Most probably, ongoing deforestation, fragmentation and erosion continue to affect the species in large parts of the range. Rates of habitat loss and population decline need to be clarified.

Conservation underway. Chinese grouse are totally protected as a species listed in category I of the China Red Data Book of Endangered Animals. Reserves are considered to be critical for the survival of the species; their present effectiveness is judged to be high. Surveys and field studies of Chinese grouse have been limited to restricted areas in different parts of the range. The studies of Sun and co-workers established a basic understanding of the species´ population biology (Sun et al. 2003), population genetics (Larsson et al. 2003) and landscape ecology (Sun et al. 2003). Logging bans since 1998 in the natural forest of Gansu and Sichuan for flood prevention may help to, at least locally, stabilize population trends.

Conservation measures proposed. Continue research (including extensive surveys) to determine population status throughout the range. Assess availability and quality of habitats. Clarify rates of habitat loss and of population decline. Identify threats and develop mitigation measures. Assess, maintain and restore the connections between local populations. As a first step towards integrating sylvicultural practices and Chinese grouse conservation, the effects of various cutting regimes should be assessed by comparing populations in different types of managed forest, and by monitoring population dynamics before and after cutting. Encourage the development and implementation of a national species action plan, using the Chinese grouse as an umbrella species. Encourage improvement of law enforcement accompanied by public awareness campaigns.

Factors limiting conservation success. Limited knowledge on species´ status for large parts of the range. Forest exploitation interests and land demands for a growing human population competing with species habitat needs.

References

Bergmann, H.-H., Klaus, S., Müller, F., Scherzinger, W., Swenson, J.E., Wiesner, J. 1996. Die Haselhühner, Westarp Wissenschaften. Magdeburg, Germany. Pp 210-276.

Klaus, S. & Y.-H. Sun (2003): Bonasa sewerzowi (Przewalski, 1876) Chinahaselhuhn. Atlas der Verbreitung paläarktischer Vögel. Lieferung 20, edited by J. Martens, S. Eck and Y.-H. Sun. 6 p.

Larsson, J.K., Y.H. Sun, Y. Fang, G. Segelbacher & J. Höglund (2003) Microsatellite variation in a Chinese grouse population: signs of genetic impoverishment? Wildlife Biology 9 (4): 261-266.

Sun, Y.H. (2000) Distribution and status of the Chinese Grouse. Wildl. Biol. 6: 275-279.

Sun Y.-H., J.E. Swenson, Y. Fang, Klaus, S. & W. Scherzinger (2003): Population ecology of the Chinese grouse in a fragmented landscape. Biology of Conservation 110: 177-184.

Correspondents

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4.2.6 Greater sage-grouse

2006 IUCN Red List Category	**Near Threatened**
Total population estimate	250,000
Population trend	Long-term decline; locally short-term increases
Occupied range	668,000 km^2
Habitat	sagebrush *Artemisia* spp. dominated ecosystems
Country	USA, Canada
Threats	Habitat loss, degradation and fragmentation resulting from conversion of prairie to cropland, livestock-grazing, oil and gas development Hunting Human disturbance

The greater sage-grouse originally occurred throughout the sagebrush *Artemisia spp*. range of western North America. The species nearly qualifies for listing as threatened, because of a significant reduction in population size and area of occupancy (IUCN 2004). Related to extensive conversion and degradation of habitat throughout the range, greater sage-grouse numbers have been declining throughout much of the 20th century. The most recent declines have been attributed to habitat loss and degradation by oil and gas development, management for livestock and big game, as well as unusually dry weather conditions. Greater sage-grouse are currently estimated to number from 140,000 to 300,000 individuals (C. E. Braun, pers. comm.). Populations are estimated to have declined an average of 3.5% per year from 1965 to 1985. From 1985 to 2003, the decline continued at a range-wide average of 0.37% annually (http://mountain-prairie.fws.gov/species/birds/ sagegrouse/). Major threats are habitat loss, degradation and fragmentation due to agriculture (crops, livestock and pollution), as well as harvesting and human disturbance. In recent years, industrial oil and gas drilling development has accelerated the loss of useable habitat (M. A. Schroeder, pers. comm.). Recent petitions for federal listing of the species were rejected by the U.S. Fish and Wildlife Service, who concluded that the greater sage-grouse does not warrant protection under the Endangered Species Act at this time (http://mountain-prairie.fws.gov/species/birds/sagegrouse/).

Conservation underway. Greater sage-grouse are legally protected throughout their range, although regulated harvesting is still permitted in 10 US states. Hunting pressure was reduced through more conservative seasons in most western states. Most sage-grouse habitat in the US is federally owned and appropriate management practices are being developed in many areas. The Conservation Reserve Program may also increase greater sage-grouse habitat on private lands in some parts of the species' range. Range-wide monitoring efforts increased since 2000 and a comprehensive range-wide conservation assessment for greater sage-grouse was completed in 2004 (Connelly et al. 2004). In parts of the range, local and state-wide recovery plans are under way (see http://wildlife.state.co.us/WildlifeSpecies/Profiles/Birds/GreaterSagegrouseStatewideConservationPlan.htm).

Conservation measures proposed. Conservation plans for each population of greater sage-grouse should be designed with the aid of public and private landowners and interested citizens. The conservation plans should include appropriate recommendations for habitat management, restoration, configuration and acquisition in order to maintain long-term population viability. Efforts should be made to apply management recommendations in conservation plans with reasonable speed. Critical breeding, brood-rearing and winter habitat should be protected through land exchange programmes, conservation easements and purchase of private lands and management of public lands to promote sage-grouse. Restore habitats in disturbed and especially in burned areas. Continue monitoring programmes. Educate both the public and management agencies about human impacts due to development, grazing, recreation and management land treatments.

Factors limiting conservation success. Land use and development interests competing with species habitat needs.

References

Braun, C. E. 1998. Sage-grouse declines in western North America: what are the problems? Proceedings of the Western Association of State Fish and Wildlife Agencies. 78: 139–156.

Connelly, J. and Braun, C. E. 1997. Long-term changes in sage-grouse populations in western North America. Wildlife Biology 3:229-234.

Connelly, J. W., K. P. Reese, E. O. Garton, and M. L. Commons-Kemner. 2003. Response of greater sage-grouse *Centrocercus urophasianus* populations to different levels of exploitation in Idaho, USA. Wildlife Biology 9:335-340.

Connelly, J. W., M. A. Schroeder, A. R. Sands, and C. E. Braun. 2000. Guidelines to manage sage-grouse populations and their habitats. Wildlife Society Bulletin 28:967-985.

Connelly, J. W., S. T. Knick, M. A. Schroeder, and S. J. Stiver. 2004. Conservation assessment of greater sage-grouse and sagebrush habitats. Western Association of Fish and Wildlife Agencies Cheyenne, Wyoming, USA.

Schroeder, M. A., C. L. Aldridge, A. D. Apa, J. R. Bohne, C. E. Braun, S. D. Bunnell, J, W. Connelly, P. A. Deibert, S. C. Gardner, M. A. Hilliard, G. D. Kobriger, S. M. McAdam, C. W. McCarthy, J. J. McCarthy, D. L. Mitchell, E. V. Rickerson, and S. J. Stiver. 2004. Distribution of sage-grouse in North America. Condor 106:363-376.

Schroeder, M. A., J. R. Young, and C. E. Braun. 1999. Sage-grouse (*Centrocercus urophasianus*). Pages 1-28 in A. Poole and F. Gill, editors. The birds of North America, Philadelphia, Pennsylvania, USA.

Web sources of information

http://wildlife.state.co.us/WildlifeSpecies/ComprehensiveWildlifeConservationStrategy/RecoveryConservationPlans.htm

http://wildlife.state.co.us/WildlifeSpecies/Profiles/Birds/GreaterSagegrouseStatewideConservationPlan.htm

http://mountain-prairie.fws.gov/species/birds/sagegrouse/

http://audubon2.org/webapp/watchlist/viewSpecies.jsp?id=182

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4.2.7 Siberian grouse

2006 IUCN Red List Category	**Near Threatened**
Total population estimate	275,000
Population trend	declining
Total range	1 million km^2 (total extent including non-habitat areas)
Habitat	forests of spruce *Picea jezoensis, P. abies*, fir *Abies nephrolepsis*, larch *Larix dahurica* and pine *Pinus koraiensis* which characterise the Amur taiga
Country	Russia
Threats	Habitat loss, degradation and fragmentation resulting from logging, forest fires, roads construction, industrial development Illegal shooting and trapping

The Siberian grouse occurs in a restricted range in far eastern Russia (Martens et al. 2003). It almost qualifies as being listed as threatened (IUCN 2004) due to 1) ongoing declines in occupied range and population, related to habitat loss and exploitation and 2) the restricted total population size and fragmentation of the occupied range. The species has probably been declining since the 1970s and the Russian Red data Book of 2000 (Nachev 2000) reports ongoing population declines. The rate of decline however is unknown. The population has been estimated at ~275,000 birds (A. V. Andreev, pers. comm. 2005). The major cause of decline is forest exploitation, particularly large-scale clear-cutting for timber, and forest fires. Because the species disappears from areas with clearings and exclusively deciduous second growth (Hafner & Andreev 1998), the rate of habitat loss could be inferred from satellite imagery. Besides the threats to its habitat, illegal hunting for food has become a common practice, and the species may disappear rapidly from colonised areas (A. V. Andreev, pers. comm.).

Conservation underway. The Siberian grouse is Red-Listed and protected by law in Russia. Protected areas, which exclude all human utilisation, may maintain viable populations of Siberian Grouse. A network of protected areas and habitat corridors created for tiger conservation may also secure some habitats of the Siberian grouse. The first systematic studies on the species were published in the late 1990s (see Hafner & Andreev 1998) and have revealed important insights into life-history traits, behaviour, food habits, habitat use and spacing patterns.

Conservation measures proposed. Assess distribution, population sizes and trends of the species throughout the range. Identify the recent rate of habitat loss and fragmentation due to clearcutting based on remote sensing techiques, and re-assess the IUCN Red list status accordingly. To understand the length of time needed for regenerating stands after fire or logging to be recolonised by the grouse; surveys in succession forests of different ages are suggested. Assess persistence and population density of Siberian grouse in different types of managed forests with different cutting regimes, including both newly cut primary habitats as well as second-growth forests. These studies are needed to give advice to the state forestry agencies and logging companies on how to integrate forestry operations and grouse habitat conservation. Encourage improvement of law enforcement accompanied by public awareness campaigns. Re-establish an effective fire-control system.

Factors limiting conservation success. Limited knowledge on species´ status for large parts of the range. Habitat relationships in secondary forests insufficiently understood. Forest exploitation interests competing with species habitat needs. Socio-economic situation in the species´ range. Lack of expertise, basic logistics and funding for research and conservation measures.

References

Andreev A V, F Hafner, S Klaus & H Gossow (2001): Displaying behaviour and mating system in the Siberian spruce grouse *Falcipennis falcipennis*. J. Orn. 142: 404-424

Hafner, F. & Andreev, A. V. 1998. Das Sichelhuhn. Naturwissenschaftlicher Verein für Kärnten, Klagenfurt, Austria. 118 pp. (ISBN 3-85328-014-5) (in German with English summaries).

Klaus, S. & A. V. Andreev (2003): Falcipennis falcipennis (Hartlaub, 1855) Sichelhuhn. Atlas der Verbreitung palaearktischer Vögel 20 (2003), 6 pp.

Nachev, V.A. 2000. Dikusha [Siberian Grouse]. In: Krasnaya kniga Rossijskoi Federatsii (Zhivotnye) [Red Data Book of the Russian federation (Animals)]. Moscow, ACT Press-Astrel Press. Pp.465-467. In Russian.

Correspondents

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4.2.8 Attwater's prairie-chicken

2006 IUCN Red List Category	**Critically Endangered**
Total population estimate	40 birds in the wild (spring 2005)
Population trend	Stabilized by ongoing releases of captive-reared birds
Occupied range	50 km^2, fragmented
Habitat	tall grass prairie habitats interspersed with oak woodland
Country	USA
Threats	Small population size Habitat loss, degradation and fragmentation resulting from conversion of prairie to cropland, livestock-grazing, pesticide treatment of rangeland, oil and gas development Droughts

The Attwater's prairie-chicken, a subspecies of the greater prairie-chicken, qualifies to be listed as critically endangered according to the IUCN Red List Categories (www.redlist.org/info/categories_criteria2001) under criteria D (wild population <50 mature individuals) and E (50% extinction risk within 10 years or three generations). Numbers declined from 8,700 birds in 1937 (Lehmann 1941) to 1,584 birds in 1980 (Lawrence & Silvy 1980, Morrow et al. 1996, Silvy et al. 1999); the total population remaining in the wild is ~50 birds in two isolated populations in Texas that are largely supported by releases of captive-reared birds (N. J. Silvy, pers. comm.). The small population size makes it vulnerable to catastrophic events, demographic chance and inbreeding depression. Attwaters prairie-chicken is protected as endangered under the U.S. Endangered Species Act (http://ecos.fws.gov/servlet/SpeciesProfile?spcode=B00O).

Conservation underway. A recovery plan specifies priority conservation measures (http://ecos.fws.gov/docs/ recovery plans/1993/930208a.pdf). Captive breeding is used as a last resort for *T. c. attwateri* in an effort to prevent extinction. An intensive captive breeding program is currently underway at several locations in Texas. The captive-bred birds are then released into two managed areas - the Texas City Preserve and the Attwater Prairie-chicken National Wildlife Refuge (http://www.tpwd.state.tx.us/apc), the only areas with remnant populations. Thus far, little or no recruitment from captive reared birds has been documented (Lockwood et al. 2005). There are no examples so far of captive breeding successfully producing or augmenting a wild population, but the subspecies may be preserved in captivity.

Conservation measures proposed. Continue implementation of the recovery plan.

Factors limiting conservation success. Small size of remaining populations and habitat.

References

Lockwood, M. A., C. P. Griffon, M. E. Morrow, C. J. Randel, and N. J. Silvy. 2005. Survival, movements and reproduction of released captive-reared Attwater's Prairie-chicken. Journal of Wildlife Management 69:1251-1258.

Morrow, M. E., T. A. Rossignol, and N. J. Silvy. 2004. Federal listing of prairie grouse: lessons from the Attwater's prairie-chicken. Wildlife Society Bulletin 32:112-118.

Silvy, N.J., C.P. Griffin, M.A. Lockwood, M.E. Morrow, and M.J. Peterson. 1999. Attwater's prairie-chicken: a lesson in conservation biology research. Pages 153-162 *in* W.D. Svedarsky, R.H. Hier, and N.J. Silvy, editors. *The greater prairie-chicken: a national look*. Minnesota Agricultural Experiment Station Miscellaneous Publication 99-1999. University of Minnesota, St. Paul, Minnesota, USA.

Silvy, N. J., M. J. Peterson, and R. R. Lopez. 2004. The cause of the decline of pinnated grouse: the Texas example. Wildlife Society Bulletin 32:16-21.

Web sources of information

http://ecos.fws.gov/servlet/SpeciesProfile?spcode=B00O
http://ecos.fws.gov/docs/recovery_plans/1993/930208a.pdf
http://www.tpwd.state.tx.us/apc
http://training.fws.gov/library/Pubs9/apcrecov.pdf

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4.2.9 Cantabrian capercaillie

2006 IUCN Red List Category	**Endangered**
Total population estimate	500-1000, fragmented
Population trend	declining
Total range	3,500 km^2
Occupied range	1,700 km^2, fragmented
Habitat	mature beech *Fagus sylvatica* and mixed beech/oak *Quercus* spp. forests with bilberry *Vaccinium myrtillus*
Country	Spain
Threats	Fragmentation and small size of populations Habitat loss and degradation resulting from forestry, livestock-grazing, road construction, high deer densities Hunting Human disturbance Climate change towards wetter conditions during chick rearing

The **Cantabrian capercaillie** qualifies as Endangered (www.redlist.org/info/categories_criteria2001) under criteria EN C1 (population <2,500 individuals and decline >20% in 2 generations; i.e. eight years using a generation length of four years, following standards of BirdLife International [Stuart Burchart, pers.comm]) and C2a(i) (population <2,500 individuals and continuing decline and highly fragmented range with no subpopulation >250 birds) (Stuart Butchart, BirdLife International, pers. comm., 2005; Storch et al. 2006). The subspecies at present inhabits an area of 1,700 km^2 in the Cantabrian Mountains of northern Spain. Compared to a historic range of 3,500 km^2, the area of occupancy has declined by >50% (Quevedo et al. 2006). The range is severely fragmented and separated from its nearest neighbouring population in the Pyrenees (*T. u. aquitanus*) by a distance of more than 300 km. A 60-70% decline in the number of males at leks since 1981 has been estimated (Pollo et al. 2003), equivalent to an average decline of 3% per year. The current population is probably <1,000 or even <500 birds, although reliable estimates are lacking. The negative trend appears to continue, as indicated by a 30% decline in lek occupancy from 2000 to 2005 (N = 164 leks) (Mario Quevedo, Rolando Rodríguez-Munoz, Maria José Banuelos, pers. comm. 2005).

Conservation underway. A range-wide count was carried out in spring 1998. Surveys and research projects have been conducted in several parts of the range. A captive breeding programme is under consideration. A national conservation strategy has been drafted in 2004 (http://www.urogallocantabrico.org/pdfs/estrategia.pdf).

Conservation measures proposed. Develop and implement a legal, range-wide recovery plan. Clarify reproductive parameters, causes of mortality and demographic causes of decline. Assess nesting and brood rearing habitat requirements. Strictly protect the remaining larger habitat patches. Improve connectivity between patches and populations. Improve conditions for understorey development and prevent overgrazing by ungulates.

Factors limiting conservation success. Land use interests competing with species habitat needs. Small size and fragmentation of remaining populations. Continued hunting. Administrative structures causing a lack of range-wide cooperation across province borders.

References

Moritz C (1994) Defining "Evolutionarily Significant Units" for conservation. Trends in Ecology & Evolution 9: 373-375

Pollo C, Robles L, Seijas J, García-Miranda A, Otero R (2003) Cantabrian capercaillie *Tetrao urogallus cantabricus* population size and range trend. Will the capercaillie survive in the Cantabrian Mountains? Grouse News 26: 3-5

Quevedo M, Banuelos MJ, Obeso JR (2006a) The decline of Cantabrian capercaillie: How much does habitat configuration matter? Biological Conservation 127: 190-200

Quevedo M, Bañuelos MJ, Sáez O, Obeso JR (2006b) Habitat selection by Cantabrian capercaillie at the edge of the species distribution. Wildlife Biology 12: in press

Quevedo M, Rodríguez-Muñoz R., Bañuelos M, Fernández-Gil A (2005) A captive breeding programme for Cantabrian capercaillie: does it make any sense? Grouse News 30: 10-13

Storch, I., Bañuelos, M.J. Fernández-Gil, A., Obeso, J.R.,Quevedo, M. Rodríguez-Muñoz, R. 2006. Subspecies Cantabrian capercaillie *Tetrao urogallus cantabricus* endangered according to IUCN criteria. Journal of Ornithology: 147:653–655

Web sources of information

http://www.urogallocantabrico.org/index_en.htm

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Glossary of Terms

Alpine zone: The area above the altitudinal treeline in mountainous areas.

Biodiversity: Biological diversity. The sum of genes, species, ecosystems and ecosystem processes.

Booming: Typical vocalisations of displaying male prairie chickens.

Booming ground: The display ground of prairie chickens.

Boreal zone: The biogeographical region situated between the temperate and the Arctic zones and which is dominated by coniferous forest.

Canopy cover: The proportion of the forest floor shielded by the leaves and branches of the trees.

Circumpolar distribution: "Surrounding the pole", i.e. occurring around the globe

Climax vegetation: The final stage of vegetational succession

Coniferous forest: Forest dominated by conifer trees, e.g. pine, spruce, fir, etc.

Connectivity: Contact and exchange of birds between neighbouring (sub-) populations.

Conservation Reserve Program: A programme launched in 1985 in the USA to restore prairie vegetation on set-aside farmland.

CRP: Conservation Reserve Program.

Coppice woodland: Thicket of small trees maintained by regular cutting of stems.

Deciduous forest: Forest dominated by broad-leaved trees, e.g. beech, maple, oak, etc.

Demography: The statistical description of the size and composition of populations.

Dispersal: The act of dispersing. Juvenile dispersal means the process during which juveniles leave their native area and settle elsewhere.

Drumming: The display of the male ruffed grouse.

Endemic species: Species that occurs in a particular geographic area only.

Ericaceous shrubs: Shrubs of the heath *Ericaceae* plant family, e.g. heather, bilberry, rhododendron.

Finnish triangle method: A countrywide wildlife monitoring scheme in Finland based on triangle-shaped transect lines.

Flock: A group of birds feeding or moving together.

Galliformes: Birds of the chicken family; e.g. grouse, pheasants, partridges.

Generalist predator: Carnivorous species feeding on a wide range of prey.

Gobbling: Typical vocalisations of displaying male lesser prairie chickens and sharp-tailed grouse.

Gobbling ground: A name for the display ground of the lesser prairie chicken. Also: booming ground.

Habitat degradation: A decline in habitat quality for a species, e.g. related to changes in food availability, cover, or climate.

Habitat fragmentation: The process and result of breaking an area of contiguous habitat into distinct patches. Example: clearcutting fragments the remaining forest.

Habitat loss: An area that has become totally unsuitable for a species.

Habitat specialist: A species that tends to show relatively narrow habitat preferences and therefore is susceptible to habitat change.

Habitat: The environment where a species occurs, survives and reproduces.

Hooting: Typical vocalisations of displaying male blue grouse.

Human disturbance: Presence of humans, e.g. recreationists in wildlife habitats, and the individual responses and population-level effects caused by man-wildlife encounters.

Hybridisation: Cross-breeding between individuals of different species.

Indicator species: Indicates certain environmental conditions or suitable habitats for other species.

Invertebrates: Animals without a backbone, such as insects, snails and worms.

Krummholz: Literally: bended wood. Low-growing trees and bushes in the subalpine zone of mountainous areas with bended shapes e.g. some species of alder and pine.

Lek: Traditional communal display ground where males display and compete for females.

Metapopulation: A system of connected, spatially distinct subpopulations. (In a strict sense, such a system is a metapopulation only if it is regulated by a balance of extinction and re-colonisation of local patches.)

Migration: A directional movement to and from seasonal habitats.

Minimum Viable Population: The estimated minimum number of animals in a population needed for long-term survival (e.g. 100 years) with high probablity (e.g. 95%).

Monitoring: Regular, statistically designed counts of a population in order to watch its numbers, composition and distribution.

Monogamy: Mating system with pair bonds; partners have only one mate.

Montane zone: The montaineous vegetation zone dominated by coniferous forest.

Morphology: The form and structure of animals or plants.

MVP: Minimum Viable Population.

Old growth forest: Forest that resulted from natural succession without human influence.

Poaching: Illegal hunting.

Population dynamics: The development of population size over time.

Prairie: Natural grassland areas (steppe) of North America.

Race: A distinct variety within a species or subspecies.

Rangeland: In North America, a large open area of grassland over which livestock can wander and graze.

Red grouse: The British subspecies *Lagopus lagopus scoticus* of the willow ptarmigan.

Re-enforcement: The release of individuals to supplement a remnant population.

Re-introduction: The release of individuals into a formerly occupied area after the native population have become extinct.

Re-nesting: A second attempt of nesting after a bird´s first clutch was lost.

Secondary habitat: An area that has become suitable as a habitat for a species due to human land use.

Second-growth: Regenerating forest after disturbance, such as fire or clear-cutting.

Sex ratio: The ratio between the number of males and females in a population.

Sexual dimorphism: Differences in size, shape, colour and behaviour etc., between males and females of a species.

Species: Individuals that can generally interbreed only among themselves. Individuals of different species are normally not able to produce fertile young.

Strutting ground: The display ground or lek of sage grouse.

Strutting: The display of the male sage grouse in the mating season.

Subalpine: The vegetation zone below the treeline in high mountain areas. The transition between montane forest and alpine grassland characterized by krummholz and scattered trees.

Subspecies: A morphologically, behaviourally, ecologically and geographically distinct variety within a species. Individuals of different subspecies are able to produce fertile young.

Survey: Examining an area for the occurrence, distribution and population density of a species.

Sylviculture: Practices and methods of cultivating a forest.

Sympatric: Occurring in the same area or habitat.

Taiga: The boreal forest. Dominated by conifers.

Taxon: Any unit within the hierarchical system of biological classification: species, genus, family, order and class.

Taxonomy: The classification of animals and plants into a hierarchical system of related groups or taxa.

Temperate zone: The vegetation zone between the boreal forest and the subtropics. By nature dominated by deciduous forests, most of this zone have been converted into farmland.

Territory: An area defended and/or exclusively used by an individual.

Translocation: Release of birds caught in the wild elsewhere.

Treeline: Altitudinal or latitudinal line or zone beyond which trees are absent.

Tundra: Treeless plains of the Arctic dominated by shrubs, grasses, lichens and mosses. Also: any habitat beyond the latitudinal (Arctic) or altitudinal (alpine) treeline. Limited by cold temperatures.

Viable population: A population large enough for long-term survival.

References

Åberg, J. 1996. Effects of habitat fragmentation on hazel grouse *(Bonasa bonasia)* in boreal landscapes. Swedish University of Agricultural Sciences, Department of Wildlife Ecology, Report 32, 69pp.

Adamian M.S. and Klem D.Jr. 1999. Handbook of the birds of Armenia. American University of Armenia, Oakland, CA,USA.

Aldrich, J.W. 1963. Geographic orientation of North American Tetraonidae. J. Wildl. Manage. 27:529-545.

Almasan, H., Kohlmann, S. 1989. Über die taxonomische Stellung des Karpatischen Haselhuhnes – *Bonasa bonasia* (L.). Travaux du Museum National d'Historie Naturelle „Grigore Antipa", 30: 231 – 246.

American Ornithologists´ Union. 1998. Check-list of North American birds. 7th edition. American Ornithologists´ Union, Washington, DC, USA.

Andreev A.V, F Hafner, S Klaus & H Gossow. 2001. Displaying behaviour and mating system in the Siberian spruce grouse *Falcipennis falcipennis*. J. Orn. 142: 404-424

Andreev A.V. 1990. The winter biology of siberian spruce grouse (*Falcipennis falcipennis*) in the Priamurie. Zoologichesky Zhurnal 69 (3): 69-80

Andreev, A.V. 1991 Winter habitat segregation in the sexually dimorphic Black-billed capercaillie. Ornis Scandinavica 22:287-291.

Andrén, H. 1992. Corvid density and nest predation in relation to forest fragmentation: a landscape perspective. Ecology 73:794-804.

Andrén, H. and Angelstam, P. 1988. Elevated predation rates as an edge effect in habitat islands: Experimental evidence. Ecology 69: 544-547.

Angelstam, P. 1983. Population dynamics of tetraonids, especially the black grouse *Tetrao tetrix* (L.), in boreal forests. PhD thesis, Univ. Uppsala.

AOU. 1998 + supplements. Check-list of North American birds. Seventh edition. Washington, DC: American Ornithologists' Union.

Aschenbrenner, H. 1982. Keeping and rearing of grouse in enclosures, problems and experience. Pp. 212-218 in: Lovel. T.W.I (ed). Proceedings International Symposium on Grouse 2, Edinburgh UK, 1981. World Pheasant Association, Reading, UK.

Aschenbrenner, H. 1985. Rauhfußhühner: Lebensweise, Zucht Krankheit, Ausbürgerung.Verlag M&H Schaper, Hannover, Germany.

Atwater, S. and Schnell, J. (eds.). 1989. Ruffed grouse. Stackpole Books, Harrisburg, PA. 370 pp.

Baba Y, Y Fujimaki, S Klaus, O Butorina, S Drovetskij & H Koike. 2002. Molecular population phylogeny for hazel grouse *Bonasa bonasia* using mitochondrial control-region sequences. – Wildlife Biology 8: 283-291.

Baines, D. 1995. Habitat requirements of back grouse. Pp. 147-150 in: Jenkins, D. (ed.). Proceedings International Symposium on Grouse 6, Udine, Italy, 1993. World Pheasant Association, Reading, UK.

Baines, D. 1996. The implications of grazing and predator management on the habitats and breeding success of black grouse *Tetrao tetrix*. J. Appl. Ecol.; 33(1):45-53.

Baines, D. and Andrew, M. 2003. Marking of deer fences to reduce frequency of collisions by woodland grouse. Biological Conservation 110:169–176

Baines, D. and Lindén, H. 1991. The impact of hunting on grouse population dynamics. Ornis Scandin. 22: 245-246.

Baines, D. and Summers, R.W. 1997. Assessment of bird collisions with deer fences in Scottish forests. J. Applied Ecology 34:941-948.

Baines, D., Sage, R. B. and Baines, M. M. 1994. The implications of red deer grazing to ground vegetation and invertebrate communities of scottish native pinewoods. J. Appl. Ecol. 31(4): 776-783.

Baines, D., Moss, R. & Dugan, D. 2004. Capercaillie breeding success in relation to forest habitat and predator abundance. Journal of Applied Ecology 41 (1), 59-71.

Banks, R. et al. 2006. Forty-seventh supplement to the American Ornithologists' Union check-list of north American birds. The Auk 123(3):926–936

Barrowclough G.F., Groth J.G., Mertz L.A., Gutiérrez R.J. 2004. Phylogeographic structure, gene flow and species status in blue grouse (*Dendragapus obscurus*). Molecular Ecology 13:1911-1922.

Baskaya, S. 1997. Izmir-Turkiye, A. M. (ed.). Dag Horozu (*Tetrao mlokosiewiczi*). Dostlar Rasgele., pp.22–23.

Baskaya, S. 1998. Dag Horozu (*Tetrao mlokosiewiczi*)'nun Dogu Karadeniz Daglarindaki Teritoryal ve Kur Yapma Davranislari, XIV. Ulusal Biyoloji Kongresi, 7–10 Eyul 1998, Samsun-Turkiye, Bildriler Kitabi, pp.369–377.

Baskaya, S. 2003. Distribution and principal threats to Caucasian black grouse *Tetrao mlokosiewiczi* in the Eastern Karadeniz Mountains in Turkey, Wildlife Biology, 9:4, 377-383.

Beck, T. D. I. 1977. Sage grouse flock characteristics and habitat selection in winter. J. Wildl. Manage. 41:18-26.

Beres I., Chereches D. 2000. Galiformele (Galliformes) in Maramures. Naturalia, Studii si Cercetari, Pitesti 4–5:155–162.

Bergmann H.-H. and Klaus, S. 1994a. Distribution, status and limiting factors of hazel grouse in central Europe, particularly in Germany. Gibier Faune Sauvage 11:5-32.

Bergmann H.-H. and Klaus, S. 1994b. Distribution, status and limiting factors of black grouse in central Europe, particularly in Germany, including an evaluation of reintroductions. Gibier Faune Sauvage 11:99-124.

Bergmann, H.-H., Klaus, S., Müller, F., Scherzinger, W., Swenson, J.E., Wiesner, J. 1996. Die Haselhühner. Westarp Wissenschaften, Magdeburg, Germany. 278 pp.

Bevanger, K. and Brøseth, H. 2000. Impact of power lines on bird mortality in a subalpine area. Animal Biodiversity and Conservation 27.2: 67-77.

Bevanger, K. 1995. Estimates and population conesquences of tetraonid mortality caused by collisions with high tension power lines in Norway. J. Applied Ecology 32:745-753.

Boag, D. A. and Schroeder, M. A. 1992. Spruce grouse. The birds of North America, No. 5. The Birds of North America, Inc., Philadelphia, PA.

Borchtchevski 1993. Population biology of the capercaillie. Principles of the structural organisation. Izdatelstvo Tsnil ochotnitshjego chosjaistva i zapovednikov, Moscow, 268 pp. (ISBN 5-87560-011-X)

Bouzat, J. L., Cheng, H. H., Lewin, H. A., Westemeier, R. L., Brawn, J. D., and Paige, K. N. 1997. Genetic evaluation of a demographic bottleneck in greater prairie Chicken. Conservation Biology 12:836-843.

Bouzat, J. L., Lewin, H. A., and Paige, K. N. 1998. The ghost of genetic diversity past: historical DNA analysis of the greater prairie chicken. American Naturalist 152:1-6.

Braun, C.E. 1988 1984. Biological investigations of white-tailed ptarmigan in Colorado, USA – a review. Pp 131-147 in: Lovel. T.W.I (ed). Proceedings International Symposium on Grouse 3, 1984, York, UK. World Pheasant Association, Reading, UK.

Braun, C. E. 1998. Sage Grouse declines in western North America: what are the problems? Proc. West. Assoc. State Fish and Wildl. Agencies 78: 139-156

Braun, C. E., Martin, K. and Robb, L. A. 1993. White-tailed ptarmigan. The birds of North America, No. 68. The birds of North America, Inc., Philadelphia, PA.

Braun, C. E., Martin, K., Remington, T. E. & Young, J. R. 1994. North American grouse: issues and strategies for the 21st century. Pp 428 - 438 in: McCabe R E and Wadsworth K G (eds): Trans. 59th North Am. Wildl. Nat. Resources Conf Anchorage, Alaska, USA, 1994; Wildlife Management Institute, Washington D.C., USA

Braun, C. E. and Young, J. R. 1995. A new species of sage grouse in Colorado. Joint Meeting Wilson Ornithological Society and the Virginia Society of Ornithology, Abstract #23, Williamsburg, Virginia.

Brewer, L.W. 1980. The ruffed grouse in western Washington. Wash. State Dept. of Game, Biol. Bull. No. 16. Washington, USA.

Brooks, D.M. and Strahl, S.D. (Compilers) 2000. Curassows, Guans and Chachalacas: Status Survey and Conservation Action Plan 2000-2004. WPA/BirdLife/SSC Curassows, Guans and Chachalacas Specialist Group. IUCN, Gland, Switzerland and Cambridge, UK and the World Pheasant Association, Reading, UK.

Bureau of Land Management 1999. Gunnison sage grouse conservation plan. Bureau of Land Management, Colorado Gunnison Field Office, Gunnison, Colorado, USA. (also available at www.co.blm.gov/gra/sagegrouse.html)

Cade, BS; Hoffman, RW 1990. Winter use of douglas-fir forests by blue grouse in Colorado. Journal Wildlife Management, 54 (3): 471-479 Jul 1990

Cade, BS; Hoffman, RW 1993. Differential migration of blue grouse in Colorado. Auk, 110 (1): 70-77 Jan 1993

Caizergues, A. and Ellison, L.N. 2002. Blackwell Science Ltd. Natal dispersal and its consequences in Black Grouse *Tetrao tetrix*. Ibis 144: 478–487.

Calladine J.; Baines D.; Warren P. 2002. Effects of reduced grazing on population density and breeding success of black grouse in northern England. Journal of Applied Ecology 39: 772-780.

Castroviejo J., Delibes M., Garcia, M.A., Garzon J., and Junco, E. 1974. Census of the Cantabrian capercaillie (*Tetrao urogallus cantabricus*) Transactions Int. Congr. Game Biol., Stockholm (1973) 11: 203-223.

Castroviejo, J. 1967. Eine neue Auerhuhnrasse von der Iberischen Halbinsel. Journal für Ornithologie 108:220-221.

Castroviejo, J. 1975. El Urogallo en Espana. Publicaciones del C.S.I.C. Monografias de la Estacion Biologica de Doñana 3. 547 pp.

Cogar, V. F., Horkel J. D., and Silvy, N. J. 1977. Cover requirements of Attwater's prairie chicken in native gulf coastal prairie. Proc.Ann. Conf. Southeastern Assoc. Fish Wildl. Agencies. 31: 41-50.

Connelly, J. 1997. Prairie grouse translocations in North America. Grouse News 14:7-11.

Connelly, J. and Braun, C. E. 1997. Long-term changes in sage grouse populations in western North America. Wildlife Biology 3:229-234.

Connelly, J. W., Browers, H. W. and Gates, R. J. 1988. Seasonal movements of sage grouse in southeastern Idaho. J. of Wildl. Manage. 52: 116-122.

Connelly, J. W., Gratson, M. W., and Reese, K. P. 1998. Sharp-tailed grouse. The birds of North America, No. 354. The birds of North America, Inc., Philadelphia, PA.

Connelly, J. W., J. H. Gammonley, and J. M. Peek. 2005. Harvest management. Pages 658-690 in C. E. Braun, editor, Techniques for Wildlife Investigations and management. Sixth edition. The Wildlife Society, Bethesda, Maryland, USA.

Cooper, C. and Bendell, J.F. 1982. The rearing and survival of blue grouse in captivity. Pp. 233-246 in: Lovel. T.W.I (ed). Proceedings International Symposium on Grouse 2, Edinburgh 1981. World Pheasant Association, Reading, UK.

Council of Europe. 1997. Red data book of European Vertebrates. Final draft for review. Convention on the conservation of European wildlife and natural habitats Standing Committee. Strasbourg, France.

Cramp, S., and K. E. L. Simmons, Eds. 1977-1994. The Birds of the Western Palearctic, Oxford University Press, Oxford.

Debrunner, R. 2004. Das Auerhuhn als Schirmart für ausgewählte Käferarten: Eine Untersuchung zur Beziehung zwischen Auerhuhnvorkommen und Biodiversität. Thesis, ETH Zurich, Switzerland.

Dekker R.W.R.J., Fuller R.A., and Baker G.C. (Compilers) 2000. Megapodes: Status Survey and Conservation Action Plan 2000-2004. WPA/BirdLife/SSC Megapode Specialist Group. IUCN, Gland, Switzerland and Cambridge, UK and the World Pheasant Association, Reading, UK.

Dekker, R.W.R.J. and McGowan, P.J.K. (Compilers). 1995. Megapodes: an action plan for their conservation 1995-1999. IUCN,Gland, Switzerland.

del Hoyo, J., Elliott, A. and Sargatal, J. (eds.). 1994. Handbook of the birds of the world. Vol. 2. Lynx Ediciones, Barcelona, Spain.

Dickerman, R. W. and Gustafson, J. 1996. The Prince of Wales spruce grouse: a new subspecies from southeastern Alaska. Western Birds 27: 41-47.

Dimcheff D.E., Drovetski S.V., Mindell D.P. 2002. Phylogeny of Tetraoninae and other galliform birds using mitochondrial 12S and ND2 genes. Molecular Phylogenetics and Evolution 24: 203-215.

Drew M. L., Wigle W. L., Graham D. L., Griffin C. P., Silvy N. J., Fadly, A. M., and Witter, R. L. 1998. Reticuloendotheliosis in captive greater and Attwater's prairie chickens. J. Wildl. Diseases. 34: 783-791.

Drovetski S.V. 2002. Molecular Phylogeny of grouse: individual and combined performance of w-linked, autosomal, and mitochondrial Loci. Systematic Biology 51: 930-945.

Dunn C.P., Stearns F. Guntenspergen G.N. and Sharpe D.M. 1993. Ecological benefits of the conservation reserve program. Conserv. Biol. 7: 132-139.

Dunn P.O. and C.E. Braun 1986a. Late summer-spring movements of juvenile sage grouse. Wilson Bull. 98: 83-92.

Dunn P.O. and C.E. Braun 1986b. Summer habitat use by adult female and juvenile sage grouse. J. Wildl. Manage. 50: 228-235.

Ellison L.N. 1991. Shooting and compensatory mortality in tetraonids. Ornis Scand. 22: 229-240.

Ellsworth D. L. 1991. Mitochondrial DNA and nuclear gene diversity among white-tailed deer (*Odocoileus virginianus*) and within the North American prairie grouse (*Tympanuchus*) complex. Ph.D. Dissertation, Texas A&M University, College Station. 113 pp.

Ellsworth D. L., Honeycutt R. L., and Silvy N. J. 1996. Systematics of grouse and ptarmigan determined by nucleotide sequences of the mitochondrial cytochrome-B gene. Auk 113: 811-822.

Ellsworth D. L., Honeycutt R. L., and Silvy N. J.1995. Phylogenetic relationships among North American grouse inferred from restriction endonuclease analysis of mitochondrial DNA. Condor 97: 492-502.

Ellsworth D. L., Honeycutt R. L., Silvy N. J., Rittenhouse K. D., and Smith M. H. 1994. Mitochondrial-DNA and nuclear-gene differentiation in North American prairie grouse (Genus *Tympanuchus*). Auk 111: 661-671.

Eng R. L. and Schladweiler P. 1972. Sage grouse winter movements and habitat use in Central Montana. J. Wildl. Manage. 36: 141-146.

Flint V.E. 1995. Numbers of grouse and their conservation in Russia. Pp. 173 in: Jenkins D. (ed.). Proceedings International Symposium on Grouse 6, Udine, Italy, 1993. World Pheasant Association, Reading, UK.

Forman T.T. and Alexander L.E. 1998. Roads and their major ecological effects. Annu. Rev. Ecol. Syst. 29: 207-231.

Fujimaki Y. 1995. Status of the hazel grouse in Hokkaido, Japan in 1923-93. Pp. 168-169 in: Jenkins, D. (ed.). Proceedings International Symposium on Grouse 6, Udine, Italy, 1993. World Pheasant Association, Reading, UK.

Fuller R.A., and Garson P.J. (Compilers) 2000. Pheasants: Status Survey and Conservation Action Plan 2000-2004. WPA/BirdLife/SSC Pheasant Specialist Group. IUCN, Gland, Switzerland and Cambridge, UK and the World Pheasant Association, Reading, UK.

Fuller R.A., Carroll J.P., and McGowan P.J. (Compilers) 2000. Partridges, Quails, Francolins, Snowcocks, Guineafowl, and Turkeys: Status Survey and Conservation Action Plan 2000-2004. WPA/BirdLife/SSC Partridge, Quail, and Francolin Specialist Group. IUCN, Gland, Switzerland & Cambridge, UK and the World Pheasant Association, Reading, UK.

Fuller R.A., McGowan P.J., Carroll J.P., Dekker R.W, Garson P.J. 2003. What does IUCN species action planning contribute to the conservation process? Biological Conservation 112: 343-349

Gabuzov O.S. 1995. Grouse hunting statistics in Russia. Pp. 173 in: Jenkins D. (ed.). Proceedings 6th International Grouse Symposium, Udine, Italy 1993. World Pheasant Association, Reading, UK.

Giesen, K. M. 1998. Lesser prairie-chicken. The birds of North America, No. 364. The birds of North America, Inc., Philadelphia, PA.

Giminez-Dixon, M. and Stuart, S. 1993. Action Plans for species conservation, and evaluation of their effectiveness. Species 20: 6-10.

Gjerde, I. 1991. Winter ecology of a dimorphic herbivore: temporal and spatial relationships and habitat selection of male and female capercaillie. Ph.D. thesis, University of Bergen, Norway.

Glänzer, U. 1985. Effects of land use changes on bird life, example: *Tetrao tetrix* and *Lagopus lagopus*. Trans. Congress Internat. Union Game Biologists. 17: 501-507 (in German).

Gokhelashvili, R., Kerry P. Reese and Lexo Gavashelishvili 2003. How much do we know about the Caucasian Black Grouse *Tetrao mlokosiewiczi*? Sandgrouse 25: 32-40.

Graf, K. & Klaus S. 2001. A translocation experiment using capercaillie *Tetrao urogallus* from central Russia. Vogelkdl. Ber. Niedersachs. 33: 181-186.

Grimm, V. & Storch, I. 2000. Minimum viable population size of capercaillie *Tetrao urogallus*: results from a stochastic model. Wildlife Biology 6: 259-265.

Gunnison Sage Grouse Task Force. 1997. Gunnison Sage Grouse Conservation Plan. Gunnison, Colorado. 108 pp. Bureau of Land Management, Gunnison, Colorado, USA

Gunnison Sage-grouse Rangewide Steering Committee. 2005. Gunnison sage-grouse rangewide conservation plan. Colorado Division of Wildlife, Denver, Colorado. 359 pp. + appendices.

Gustafson, J. 1994. The Frankin´s grouse of southern southeast Alaska. Report, Alaska Department of Fish and Game, Ketchikan, Alaska.

Gutiérrez RJ, Barrowclough GF, Groth JF. 2000. A classification of the grouse (Aves: *Tetraoninae*) based on mitochondrial DNA sequences. Wildlife Biology 6:205-211.

Gyllesten, U., Ryman, N., and Saether, T. 1985. Genetic divergence between willow grouse (*Lagopus lagopus*) and rock ptarmigan (*Lagopus mutus*) and the genetic structure of Scandinavian grouse populations. Hereditas 102: 47-55.

Hafner, F. and Andreev, A.V. 1998. Das Sichelhuhn. Naturwissenschaftlicher Verein für Kärnten, Klagenfurt, Austria. 118 pp. (ISBN 3-85328-014-5) (in German with English summaries).

Hagen, C. A. 2005. Lesser prairie-chicken (*Tympanuchus pallidicinctus*). *The birds of North America, No. 364,* Available Online *http://bna.birds.cornell.edu/BNA/* (A. Poole, Ed.). Ithaca: Cornell Laboratory of Ornithology.

Hannon, S. J., Martin, K. and Eason, P. K. 1998. Willow ptarmigan. The birds of North America, No. 369. The birds of North America, Inc., Philadelphia, PA.

Hanowski, J. M., D. P. Christian, and G. J. Niemi. 2000. Landscape requirements of prairie sharp-tailed grouse *Tympanuchus phasianellus campestris* in Minnesota, USA. Wildlife Biology 6: 257-263.

Harrison, S. 2001. Effects of forest connectivity on ecological processes: using spruce grouse as a model system. Ph.D. thesis. University of British Columbia, Vancouver, Canada.

Harrison, S., Chatterson, B. and Paul, D. 1997: Landscape connectivity and its effect on the ecological processes of spruce grouse *Dendragapus canadensis* populations. Wildl. Biol. 3: 287.

Hilton-Taylor, C. 2000. 2000 IUCN Red List Of Threatened Species. IUCN, Gland, Switzerland and Cambridge, UK.

Höglund J, Baines D, Larsson JK, Segelbacher G. 2004. Population fragmentation and genetic variability in European Black Grouse: a progress report. Sylvia (suppl.) 39: 17-23.

Höglund, J. and Alatalo, R.V. 1995. Leks. Princeton University Press, Princeton, New Jersey, 248 pp.

Holder, K. and Montgomerie, R. 1993. Rock ptarmigan. The birds of North America, No. 51. The birds of North America, Inc., Philadelphia, PA.

Holst-Jorgensen B., 2001: The Black Grouse in Denmark 1978-2000. Actes du Colloque Tétras Lyre, Liège 26-29 Septembre 2000. Cahiers d'Ethologie 20 (2-3-4): 505-508.

Holst-Jörgensen, B. 1995. The black grouse in Denmark, 1978-1993. Pp. 163-164 in: Jenkins, D. (ed.). Proceedings International Symposium on Grouse 6, Udine, Italy, 1993. World Pheasant Association, Reading, UK.

Horkel, J. D., and Silvy, N. J. 1980. Possible evolutionary consideration of creating artificial leks for Attwater's prairie chicken. North Am. Prairie Grouse Conf. 1: 49-47.

Huboux, R., Léonard, P. & Ellison, L. 1994. Valeur de la méthode du rappel sur itinéraire pour le suivi des populations de mâles de gélinotte des bois (*Bonasa bonasia).* Gibier Faune Sauvage, Game & Wildlife 11: 1-19.

Hudson, P. J. 1992. Grouse in space and time. The Game Conservancy, Fordingbridge, UK.

Hudson, P.J. and Rands, M.R.W. 1988. Ecology and management of gamebirds. BSP Professional Books, Oxford, UK.

Hupp, J. W., and Braun, C. E. 1989. Topographic distribution of sage grouse foraging in winter. J. Wildl. Manage. 53: 823-829.

Hupp, J. W. and Braun, C. E. 1991. Geographical variation among sage grouse populations in Colorado. Wilson Bulletin 103: 255-261.

Hutchinson, C.L. 1979. Capercaillie. Pp. 166-175 in: Lovel, T.W.I. (ed.) Woodland Grouse 1978. World Pheasant Association, Reading, UK.

Ihli, M., P. Sherbenou, and C. W. Welch. 1973. Wintering sage grouse in the Upper Big Lost River. J. Idaho Academy of Science 1973: 73-80.

IUCN 1994. IUCN Red List Categories. Prepared by the IUCN Species Survival Commission. IUCN, Gland, Switzerland.

IUCN 2001. IUCN Red List Categories and Criteria : Version 3.1. IUCN Species Survival Commission. IUCN, Gland, Switzerland and Cambridge, UK.

IUCN 2003. Guidelines for Application of IUCN Red List Criteria at Regional Levels: Version 3.0. IUCN Species Survival Commission. IUCN, Gland, Switzerland and Cambridge, UK.

IUCN 2004. 2004 IUCN Red List Of Threatened Species. (http://www.redlist.org/)

IUCN. 1987. IUCN Policy Statement on Captive Breeding. IUCN, Gland, Switzerland.

IUCN. 1987. IUCN Position Statement On Translocation Of Living Organisms: Introductions, Reintroductions And Re-Stocking. IUCN, Gland, Switzerland.

IUCN. 1996. 1996 Red list of threatened animals. IUCN, Gland, Switzerland.

IUCN. 1998. Guidelines for re-introductions. Prepared by the IUCN/SSC Re-introduction Specialist Group. IUCN, Gland, Switzerland and Cambridge, UK. 10 pp.

IUCN. 2002. Technical Guidelines on the Management of *Ex Situ* Populations for Conservation. IUCN, Gland, Switzerland (http://www.iucn.org/themes/ssc/pubs/policy/exsituen.htm)

Jacob, L. 1987. Le régime alimentaire du grand tétras: synthèse bibliographique. Gibier Faune Sauvage 4:429-448

Jenkins, D. (ed.) 1991. Proceedings International Symposium on Grouse 5, Ornis Scandinavica 22: 176-302.

Jenkins, D. (ed.) 1995. Proceedings International Symposium on Grouse 6: 1-175.Udine, Italy, 1993. World Pheasant Association, Reading, UK.

Johnsgard P.A. 1983. The grouse of the world. Univ. Nebraska Press, Lincoln, USA, 203 pp.

Johnson D.H. and Schwartz M.D. 1993. The conservation reserve program and grassland birds. Conservation Biology 7: 934-937.

Joyce L.A., Mitchell J.E. and Skold M.D. (eds.) 1991. The conservation reserve: yesterday, today and tomorrow. Symposium Proceedings, January 14, 1991, Washington, D.C., U.S. Forest Service, General Technical Report, RM; No. 203. 65pp.

Kahn N.W., Braun C., Young J., Wood S., Mata D. and Quinn T.W. 1999. Rapid morphological evolution in a new species of sage grouse in Colorado inferred from phylogeographic analysis of mitochondrial control region sequences. The Auk 116: 819-824

Kamieniarz R. 2001: Bewertung der Verbreitung und Bestandgröße der Birkhuhnpopulation (*Tetrao tetrix*) in Polen in den 90er Jahren und Voraussetzungen für das aktive Schutzprogramm. Actes du Colloque Tétras Lyre, Liège 26-29 Septembre 2000. Cahiers d'Ethologie 20 (2-3-4): 253-276.

Kamieniarz R. 2003: Black Grouse habitats in Poland. Sylvia, Journal of Ornithology 39 (suppl.): 25-29.

Kangas A. and Kurki S. 2000: Predicting the future of capercaillie (*Tetrao urogallus*) in Finland. Ecological Modelling 134: 73-87.

Kaphegyi T.A.M. 1998. Fuchsreduktion zum Schutz gZefährdeter Waldhühnerpopulationen im Schwarzwald: Eine sinnvolle Managementmassnahme? In: Auerhuhn und Haselhuhn in einer mitteleuropäischen Kulturlandschaft, Internationale Fachtagung Oberprechtal, Baden-Württemberg, Oktober 1997. Berichte Freiburger Forstliche Forschung 2: 102-109.

Kauhala K., Helle P. and Helle E. 2000. Predator control and the density and reproductive success of grouse populations in Finland. ECOGRAPHY 23: 161-168.

Keppie D.M. 1992. An audio-index for male spruce grouse. Can. J. Zool. 70:307-313.

Klaus S. and Sewitz A. 2000. Ecology and conservation of hazel grouse *Bonasa bonasia* in the Bohemian Forest (Sumava, Czech Republik). - Proceedings of the Intern. Conf. Tetraonids - Tetraonids at the break of the millenium. Ceske Budejovice, Czech Republic, 24-26 March, 2000. pp. 138-146

Klaus S. 1995. Hazel Grouse in the Bohemian Forest- results of a twenty year study. Proceedings 6th International Grouse Symposium, Udine, Italy 6: 27-33.

Klaus S. 1994. To Survive or to Become Extinct: Small Populations of Tetraonids in Central Europe. in: Minimum Animal Populations, Ecological Studies 106: 137-152. Remmert H. (Ed) Springer Verlag.

Klaus S. 1994. To survive or to become extinct: small populations of Tetraonids in central Europe. Pp. 137-152 in Remmert, H. (ed.) Minimum animal populations. Ecological Studies 106, Springer-Verlag, Berlin.

Klaus S. 1997. Breeding and releasing projects for capercaillie in Germany. Grouse News 14:4-7.

Klaus S. and Andreev A.V. 2003. *Falcipennis falcipennis* (Hartlaub, 1855) Sichelhuhn. Atlas der Verbreitung palaearktischer Vögel 20 (2003), 6 pp.

Klaus S. and Graf K. 2000. Russian capercaillie *Tetrao urogallus* from the wild released into Thuringian forests. Grouse News 19: 4-7.

Klaus S. and Sun Y.-H. 2003. *Bonasa sewerzowi* (Przewalski, 1876) Chinahaselhuhn. Atlas der Verbreitung paläarktischer Vögel. Lieferung 20, edited by J. Martens, S. Eck and Y.-H. Sun. 6 p.

Klaus S. 1991. Effects of forestry on grouse populations: case studies from the Thuringian and Bohemian forests, central Europe. Ornis Scand. 22:218-223.

Klaus S. 1998. Breeding and releasing projects for capercaillie in Germany. - Reintroduction-News/IUCN No. 16: 7-9

Klaus S. and Bergmann H.-H. 1994. Distribution, status and limiting factors of capercaillie in central Europe, particularly in Germany, including an evaluation of reintroductions. Gibier Faune Sauvage 11:57-80.

Klaus S., Lieser M., Suchant R., Andreev A.V. 1995. Die Wälder in der fernöstlichen Amurtaiga Russlands. Allgemeine Forst Zeitung 14:744-748.

Klaus S., Andreev A.V., Bergmann H.-H., Müller F., Porkert J. and Wiesner J. 1989. Die Auerhühner. Die Neue Brehm-Bücherei. Band 86. Westarp Wissenschaften, Magdeburg, Germany.

Klaus S., Bergmann H.-H., Marti C., Müller F., Vitovic O. A., and Wiesner, J. 1990. Die Birkhühner. Die Neue Brehm-Bücherei. Westarp Wissenschaften, Magdeburg, Germany.

Klaus, S., J. Martens, Andreev A. V. & Sun Y.-H. 2003. *Bonasa bonasia* (Linnaeus, 1758) Haselhuhn. Atlas der Verbreitung paläarktischer Vögel. Lieferung 20, edited by J. Martens, S. Eck and Y.-H. Sun. 15 pp. (German with extended English summary).

Klaus S., P. Selsam, Y.-H. Sun and Y. Fang (2001) Habitat mapping from SPOT images as tool for the conservation of Endangered Species – Chinese Grouse (*Bonasa sewerzowi*) as an example. Naturschutz und Landschaftsplanung 33 (9): 281-285.

Klaus S., Scherzinger W., Sun Y.-H. 1996. Ecology and behaviour of the Chinese grouse *Bonasa sewerzowi*. [Oekologie und Verhalten des Chinahaselhuhns Bonasa sewerzowi.] Ornithol. Beob. 93:343-365.

Klaus S., Wiesner J., and Vitovic O.A., 1990. Territorial and courtship behaviour of the Caucasian black grouse. Chapter 36 in: Lovel. T. and Hudson, P. (eds.) Proceedings International Symposium on Grouse 4, Lam, Germany, September 1987. World Pheasant Association, Reading, UK.

Kortland K. 2003. Multi-scale Forest Habitat Management for Capercaillie. Scottish Forestry, 2003, vol. 57, no. 2, pp. 91-96

Kurki S. and Lindén H. 1995. Forest fragmentation due to agriculture affects the reproductive success of the ground-nesting black grouse. Ecography 18:109-113.

Kurki S., A. Nikula, P. Helle, and H. Lindén. 2000. Landscape fragmentation and forest composition effects on grouse breeding success in boreal forests. Ecology 81:1985-1997.

Kutubidze M. 1961. Ecology and distribution of Caucasian black grouse within Georgia. Proceedings Institute of Zoology, Academy of Sciences of Georgia, Vol. XVIII. pp. 4-40. (in Georgian). Tbilisi, Georgia

Landres P. B., Verner J. and Thomas J. W. 1988. Ecological Uses of Vertebrate Indicator Species: A Critique. Conservation Biology 2: 316-328.

Larsson, J. K., Y.H. Sun, Y. Fang, G. Segelbacher & J. Höglund J. 2003 Microsatellite variation in a Chinese grouse population: signs of genetic impoverishment? Wildlife Biology 9 (4): 261-266.

Lawrence, J. S., and Silvy, N. J. 1980. Status of the Attwater's prairie chicken-an update. Pp 29-33 in: Vohs, Jr. P. A. and Knopf F. L. (eds). Proceedings of the Prairie Grouse Symposium. Stillwater, Oklahoma, 1980. Oklahoma State University Publishing and Printing, Stillwater, Oklahoma, USA

Lawrence, J. S., and Silvy, N. J. 1987. Movement and mortality of transplanted Attwater's prairie chickens. J. World Pheasant Assoc. 12: 57-65.

Lawrence, J. S., and Silvy, N. J. 1995. Effect of predator reduction on nest success of Attwater's prairie chicken. Proc. Annual Conference Southeastern Fish Wildl. Agencies. 49:276-283.

Ledant J.P. & Devillers P., 1991: La gélinotte des Bois en Ardenne et dans les régions voisines. Habitats, distribution et perspectives de conservation. Documents de travail de l'I.R.S.N.B. No. 65, 93 pp. (ISSN 0777-0111) (in French).

Lehmann, V.W. 1941. Attwater's prairie chicken: its life history and management. U.S. Fish and Wildlife Service, North American Fauna 57.US Department of Interior, Washington DC.

Lehmann, V.W. 1968. The Attwater prairie chicken, current status and restoration opportunities. Trans. North Am. Wildl. Nat. Res. Conf. 33:398-407.

Lewis, RA 1988. Effect of previous occupancy on recruitment to territorial sites of male blue grouse. Wilson Bulletin, 100 (2): 310-312 Jun 1988

Li, X.-T. 1996. The gamebirds of China: their distribution and status. International Academic Publishers, Beijing, China.

Lindén H. & Helle P. 2003. The rise and fall of Black Grouse populations in Finland since 1860s. Sylvia, Journal of Ornithology 39 Supplement Praha 2003: 113-114.

Lindén, H., Danilov, P.I., Gromtsev, A.N., Helle, P., Ivanter, E.V. & Kurhinen, J. 2000. Large-scale forest corridors to connect the taiga fauna to Fennoscandia. — Wildlife Biology 6: 179-188.

Lindén, H., Helle, E., Helle, P., Wikman, M. 1996. Wildlife triangle scheme in Finland: methods and aims for monitoring wildlife populations. Finnish Game Research 49: 4-11.

Lindström, J., Rintamäki, P. T. & Storch, I. 1998. Black grouse. - BWP Update. The journal of birds of the Western Palearctic (Oxford University Press, Oxford, UK) 2: 173-191.

Loneux M. & Vandiepenbeeck M. 2003. Incidence de la météorologie locale sur les fluctuations de population du tétras-lyre (*Tetrao tetrix*). Publications de l'Association Internationale de Climatologie Vol 15: 95-103.

Loneux M. 2001. Modélisation de l'influence du climat sur les fluctuations de population du tétras lyre *Tetrao tetrix* en Europe. Actes de la Conférence internationale Tétras Lyre, Liège 26-29 Septembre 2000. Cahiers d'Ethologie, 20 (2-3-4): 191-216.

Loneux M., Lindsey J.K., Vandiepenbeeck M., Charlet O., Keulen C., Poncin P. & Ruwet J.C. 2004. Climatic influence on Black grouse population dynamic in Belgian Hautes-Fagnes nature reserve: an update. Sylvia, Journal of Ornithology 39 Supplement Praha 2003: 53-57.

Loneux, M. and Ruwet, J.C. 1997. Evolution des population du Tétras lyre en Europe. Cahiers d´Ethologie 17: 287-343.

Lovel T. and Hudson P. 1990. Proceedings International Symposium on Grouse 4, Lam, Germany, September 1987. World Pheasant Association, Reading, UK.

Lu Xin. 1997. A new distribution area of the Chinese grouse in Tibet. Grouse News 14: 18-20.

Lucchini V, Höglund J, Klaus S, Swenson J, Randi E. 2001. Historical Biogeography and a mitochondrial DNA phylogeny of grouse and ptarmigan. Molecular Phylogenetics and Evolution 20: 149-162.

Ludwig, G.X, Alatalo, R.V., Helle, P., Lindén, H., Lindström, J. & Siitari, H. (2006, submitted): Short- and long term population dynamical consequences of asymmetric climate change in black grouse.

Lutz, R. S., and Silvy, N. J. 1980. Predator response to artificial nests in Attwater's prairie chicken habitat. North Am. Prairie Grouse Conf. 1: 47-49.

Lutz, R. S., Lawrence, J. S., and Silvy, N. J. 1994. Nesting ecology of Attwater's prairie-chicken. Journal of Wildlife Management 58: 230-233.

Mäkinen, T., Pyörnilä, A., Putaala, A., and Hissa, R. 1997. Effects of captive rearing on capercaillie *Tetrao urogallus* physiology and anatomy. Wildlife Biology 3: 294.

Magnani, Y. 1988. Sélection de l'habitat de reproduction et influence de l'évolution des pratiques sylvo-pastorales sur la population de tétras lyre (*Tetrao tetrix* L.) de la réserve des Frêtes (Haute-Savoie). Gibier Faune Sauvage 5: 289-307.

Marcström, V., Kenward, R. E., and Engren, E. 1988. The impact of predation on boreal tetraonids during vole cycles: an experimental study. J. Anim. Ecology 57: 859-872.

Marjakangas, A. 1986. On the winter ecology of the black grouse, *Tetrao tetrix*, in central Finland. Acta Universitatis Ouluensis, Series A 183. Biol. 29. 87 pp.

Martin, K. 1998. The role of animal behavior studies in wildlife science and management. Wildlife Society Bulletin 26: 911-920.

Martin, K., Stacey, P.B. and Braun, C.E. 1997. Demographic rescue and maintenance of population stability in grouse – beyond metapopulations. Wildlife Biology 3: 295-296.

McGowan, P., Dekker, R.W.R., Dowell S., and Garson, P. 1998. The making of conservation Action Plans for the Galliformes. Bird Conservation Intern. 8: 173-184.

McGowan, P., Dowell S., Carroll, J.P., and Aebischer, N.J. 1995. Status Survey and Conservation Action Plan 1995-1999 Partridges, quails, francolins, snowcocks and guineafowl. Gland, Switzerland: IUCN.

McGowan, P.J.K. and Garson, P.J. (Comps) 1995. Status Survey and Conservation Action Plan 1995-1999 Pheasants. IUCN, Gland, Switzerland.

Mckee G., Ryan M.R. and Mechlin L.M. 1998. Predicting greater Prairie-chicken nest success from vegetation and landscape characteristics. Journal of Wildlife Management 62: 314-321.

Meile, P. 1982. Skiing facilities in alpine habitat of black grouse and capercaillie. Proc. Int. Grouse Symp. 2: 87-92.

Ménoni, E. 1991. Écologie et dynamique des population du Grand Tétras dans les Pyrénées, avec des références spéciales à la biologie de la reproduction chez les poules - quelques application a sa conservation. Ph.D. thesis, Univ. Toulouse, France.

Ménoni, E. and Magnani, Y. 1998. Human disturbance of grouse in France. Grouse News 15: 4-8.

Ménoni, E., Landry, P. and Berducou, C. 1997. Habitat fragmentation and viability of capercaillie Tetrao urogallus populations in the French Pyrenees. Wildlife Biology 3: 277 (Abstract).

Merker, C.R. 1997. Captive rearing and release of Columbian sharp tailed grouse, (*Tympanuchus phasianellus columbianus*). Wildlife Biology 3: 285.

Messmer TA, Brunson MW, Reiter D, Hewitt DG. 1999. United States public attitudes regarding predators and their management to enhance avian recruitment. Wildlife Society Bulletin 27: 75-85.

Miltschew, B. and Georgiewa, U. 1998. Erstbeobachtung des Alpenschneehuhns in Bulgarien. Ornithologische Mitteilungen 50: 43-44.

Miquet, A. 1986. Tétras-Lyre et stations du ski IV. Premiers résultats d'une enquête sur la mortalité du Tétras-lyre par percussion dans les câbles. Office National de la Chasse - Bulletin Mensuel 99: 33-36.

Monroe, B. L. and Sibley, C. G. 1993. A world checklist of birds. Yale University Press, New Haven & London.

Montadert, M. & Léonard, P. 2003. Survival in an expanding hazel grouse *Bonasa bonasia* population in the southeastern French Alps. - Wildlife Biology 9: 357-364.

Montadert, M. & Léonard, P. 2006. Post-juvenile dispersal of Hazel grouse *Bonasa bonasia* in an expanding population of the southeasten French Alps. Ibis 148: 1–13.

Montadert, M., Desbrosses, R., Huboux, R. & Léonard, P. 1994. Plan de restauration pour la gelinotte des bois (*Bonasa bonasia*) en France. Gibier Faune Sauvage, Game and Wildlife 11 (Hors série Tome 1): 41-62.

Morrow, M. E., Adamcik, R. S., Friday, J. D. and McKinney, L. B. 1996. Factors affecting Attwaters prairie-chicken decline on the Attwater Prairie Chicken National Wildlife Refuge. Wildl. Soc. Bull. 24(4): 593-601

Moss, R. 1985. Rain, breeding success and distribution of capercaillie and black grouse in Scotland. Ibis 128: 65-72.

Moss, R., Oswald, J. And Baines, D. 2001. Climate change and breeding success: decline of the capercaillie in Scotland. Journal of Animal Ecology 70: 47-61

Müller, F. 1978. Rauhfußhühner als Biotopindikatoren. Pp 57-68 in: Hofmann, R. (ed.) Wildbiologische Informationen für den Jäger. Jagd + Hege Ausbildungsbuch II. Ferdinand Enke Verlag, Stuttgart, Germany.

Munteanu D., Papadopol A., Weber P., 2002 - Atlasul pasarilor clocitoare din Romania. Ed. II, Cluj-Napoca: 1 – 152 [The Atlas of Romanian nesting birds].

Nachev, V.A. 2000. Dikusha [Siberian Grouse]. In: Krasnaya kniga Rossijskoi Federatsii (Zhivotnye) [Red Data Book of the Russian federation (Animals)]. Moscow, ACT Press-Astrel Press. Pp.465-467. In Russian.

Nappée, C. 1999. The reintroduction of capercaillie in Parc National des Cévennes. Grouse News 17: 16-17.

Niewold F.J.J., ten Den P.G. & Jansman H.A.H., 2005: Het korhoen blijft in de gevarenzone. Ecologische en genetische monitoring van de populatie van de Sallandse Heuvelrug in 2003-2004. Alterra-rapport 1177, ISSN 1566-7197. 58 pp.

Niewold, F.J.J. 1990. The decline of black grouse in the Netherlands. Pp 71-81 in: Lumeij J.T. and Hoogeveen Y.R. (eds). The Future of Wild Galliformes in the Netherlands. Organisatie commissie Nederlandse Wilde Hoenders, Amersfoort, Netherlands.

Norman, G. W., et al. 2004. Ruffed grouse ecology and management in the Appalachian region. Report, Virginia Department of Game and Inland Fisheries, Richmond, VA.

Ormerod S.J. 2002. Applied issues with predators and predation: editor's introduction. Journal of Applied Ecology, Volume 39, Number 2, April 2002, pp. 181-188.

Office National de la Chasse 1994. Plan de restauration pour quelques galliformes européens: gélinotte, grand tétras, tétras-lyre et perdix bartavelle – tome 1. Gibier Faune Sauvage 11(1), 348 p.

Office National de la Chasse 1994. Restoration plans for some European galliformes: hazel grouse, capercaillie and black grouse; part 2. Gibier Faune Sauvage 11(2), 222 p.

Oyler-McCance, S. J. 1999. Genetic and habitat factors underlying conservation strategies for Gunnison Sage Grouse. Ph.D. dissertation. Colorado State University, Colorado, USA

Oyler-McCance, S.J., J. St. John, S.E. Taylor, A.D. Apa, and T.W. Quinn. 2005. Population genetics of Gunnison sage-grouse: implications for management. Journal of Wildlife Management 69(2): 630-637.

Oyler-McCance, S.J., Kahn, N.W., Burnham, K.P., Braun, C.E. and Quinn, T.W. 1999. A population genetic comparison of large and small bodied sage grouse in Colorado using microsatellite and mitochondrial DNA markers. Molecular Ecology 8: 1457-1466.

Oyler-McCance Sara J., Burnham Kenneth P., Braun Clait E. 2001. Influence of changes in sagebrush on Gunnison sage grouse in southwestern Colorado. Southwestern Naturalist, 46(3): 323-331

Pakkala T., Pellikka J. & Lindén H. 2003. Capercaillie Tetrao urogallus - a good candidate for an umbrella species in taiga forests. - Wildlife Biology 9: 309-316.

Parker H. 1984. Effect of corvid removal on reproduction of willow ptarmigan and black grouse. J. Wildl. Manage. 48: 1197-1205.

Pekins P.J. Gessaman J.A., Lindzey F.G. 1992. Winter energy-requirements of blue grouse. Canadian Journal Zoology, 70 (1): 22-24 Jan 1992

Peterson J. J., Purvis J. R., Lichtenfels J. R., Craig T. M., Dronen N. O. Jr., and Silvy N. J. 1998. Serologic and parasitologic survey of the endangered Attwater's prairie chicken. J. Wildl. Dis. 34: 137-144.

Peterson M. J., Grant W. E. and Silvy N. J. 1998. Simulation of reproductive stages limiting productivity of the endangered Attwater's prairie chicken. Ecol. Model. 111: 283-0295.

Peterson, M. J. 1996. The endangered Attwater's prairie chicken and an analysis of prairie grouse helminthic endoparasitism. Ecography 19: 424-431.

Peterson, M. J., and Silvy, N. J. 1996. Reproductive stages limiting productivity of the endangered Attwater´s prairie chicken. Conservation Biology 10: 1264-1276.

Peterson, M. J., and Silvy, N. J. 1994. Spring precipitation and fluctuations in Attwater's prairie-chicken numbers: Hypotheses revisited. J. Wildl. Manage. 58: 222-229.

Peterson, M. J., J. R. Purvis, J. R. Lichtenfels, T. M. Craig, N. O. Dronen, Jr., and N. J. Silvy. 1998. Serologic and parasitologic survey of the endangered Attwater's prairie chicken. J. Wildl. Dis. 34: 137-144.

Pfeffer J.-J. 1997. Découverte du lagopède alpin *Lagopus mutus* et observations ornithologiques au Tadjikistan. Alauda; 65: 379-380.

Picozzi, N., Catt, D.C. and Moss, R. 1992. Evaluation of capercaillie habitat. J. Appl. Ecol. 29:751-762.

Picozzi N., Moss R. and Kortland K. 1999. Diet and survival of capercaillie *Tetrao urogallus*. chicks in Scotland. Wildlife Biology 5: 11–23

Pollo C, Robles L, Seijas J, García-Miranda A, Otero R 2003. Cantabrian capercaillie *Tetrao urogallus cantabricus* population size and range trend. Will the capercaillie survive in the Cantabrian Mountains? Grouse News 26: 3-5

Potapov, R. L. and Flint, V. E. 1989. Handbuch der Vögel der Sowjetunion. Band 4 Galliformes, Gruiformes.. Ziemsen Verlag Wittenberg Lutherstadt, Germany. 427 pp (ISBN 3-7403-0027-2).

Prüter J. & Wübbenhorst J., 2004: Zur Situation des Birkhuhns (*Tetrao tetrix*) im Naturschutzgebiet Lüneburger Heide. Jahrbuch des Naturwissenschaftlichen Vereins für das Fürstentum Lüneburg 43: 9-34.

Purvis, J. R.,. Peterson, M. J., Dronen, N. O., Lichtenfels, J. R. and Silvy, N. J. 1998. Northern bobwhites as disease indicators for the endangered Attwater's prairie chicken. J. Wildl. Dis. 34: 348-354.

Pynnönen, A. 1954. Beiträge zur Kenntnis der Lebensweise des Haselhuhns, *Tetrastes bonasia* (L.). Papers on Game Research 12: 1–90.

Quevedo, M., Banuelos, M.J., & Obeso, J.R. 2006. The decline of Cantabrian capercaillie: How much does habitat configuration matter? Biol. Conservation, 127: 190-200.

Randi, E., Fusco, G., Lorenzini, R., and Crowe, T.M. 1991. Phylogenetic relationships and rates of allozyme evolution within the Phasianidae. Biochem. Syst. Ecol. 19: 213-221.

Ranta, E., Lindström, J. & Lindén, H. 1995: Synchrony in tetraonid population dynamics. – Journal of Animal Ecology 64: 767-776.

Remington, T. E., and C. E. Braun. 1985. Sage grouse food selection in winter, North Park, Colorado. J. Wildl. Manage. 49: 1055-1061.

Remington, TE; Hoffman, RW 1996. Food habits and preferences of blue grouse during winter. Journal of Wildlife Management, 60 (4): 808-817

Reynolds J.C. 1990. The impact of generalist predators on game bird populations. Pp 172-184 in: Lumeij J.T. and Hoogeveen Y.R. (eds). The Future of Wild Galliformes in the Netherlands. Organisatiecommissie Nederlandse Wilde Hoenders, Amersfoort, Netherlands.

Rhim, S.J., W.-H. Hur, and W.-S. Lee 2003. The first record of black grouse *Tetrao tetrix* in South Korea. The Korean Journal of Ornithology, 9: 69-70.

Rodríguez, A.E. & Obeso, J.R. 2000. Diet of the Cantabrian capercaillie: geographic variation and energetic content. Ardeola, 47, 77-83.

Rolstad, J. 1989. Habitat and range use of capercaillie in southcentral Scandinavian boreal forests. Ph.D. thesis, Agric. Univ., As, Norway.

Rolstad, J. 1991. Consequences of forest fragmentation for the dynamics of bird populations: conceptual issues and the evidence. Biol. Journal of the Linnean Society 42:149-163.

Rolstad, J. and Wegge, P. 1987. Distribution and size of capercaillie leks in relation to old forest fragmentation. Oecologia 72: 389-394.

Rolstad, J. and Wegge, P. 1989. Capercaillie populations and modern forestry - a case for landscape ecological studies. Finn. Game Res. 46: 43-52.

Rusch D., DeStefano S., Reynolds M.C. & Lauten D. 2000. Ruffed grouse. The birds of North America No. 515. The birds of North America, Inc., Philadelphia, Pennsylvania, USA.

Sablevicius, B. 1997. The willow grouse still living in Lithuania. Acta Zoologica Lituanica; Ornithologia 6: 133-134.

Salo, L.J. 1971: Autumn and winter diet of the hazel grouse (*Tetrastes bonasia* L.) in northeastern Finnish Lapland. – Annales Zoologici Fennici 8: 543–546.

Sandercock, B.K., K. Martin, and S.J. Hannon. 2005. Demographic consequences of age-structure in extreme environments: population models for arctic and alpine ptarmigan. OECOLOGIA 146 (1): 13-24.

Scherzinger, W. 1989. Biotopansprüche bedrohter Waldvogelarten und ihre Eingliederung in die Waldsukzession. Stapfia 20: 81-100.

Schroeder , M.A. and Boag, D.A. 1989. Evaluation of a density index for territorial male spruce grouse. J. Wildl. Management. 53: 475-478.

Schroeder, M. A., and R. K. Baydack. 2001. Predation and the management of prairie grouse. Wildlife Society Bulletin 29: 24-32.

Schroeder, M. and Robb, L. 1993. Greater prairie chicken. The birds of North America, No. 36. The birds of North America, Inc., Philadelphia, PA.

Segelbacher, G. & Storch, I. 2002. Capercaillie in the Alps: genetic evidence of metapopulation structure and population decline. - Molecular Ecology 11: 1669-1677.

Segelbacher, G., Höglund, J. & Storch, I. 2003a. From connectivity to isolation: genetic consequences of population fragmentation in capercaillie across Europe. - Molecular Ecology 12: 1773-1780.

Segelbacher, G., Storch, I. & Tomiuk, J. 2003b. Genetic evidence of capercaillie dispersal sources and sinks in the Alps. - Wildlife Biology 9:267-274.

Segelbacher, G. & Storch, I. 2002. Capercaillie in the Alps: genetic evidence of metapopulation structure and population decline. - Molecular Ecology 11: 1669-1677.

Seiler Ch., Angelstam P. & Bergmann H.-H. 2001. Conservation Releases of captive-reared Grouse in Europe: What do we know and what do we need ? Actes du Colloque Tétras Lyre, Liège 26-29 Septembre 2000. Cahiers d'Ethologie 20 (2-3-4): 235-252.

Shaffer, M. 1987. Minimum viable populations: coping with uncertainty. Pp. 69-86 in: Soulé M. E. (ed).. Viable populations for conservation. Cambridge Univ. Press, Cambridge; New York.

Short, L.L. 1967. A review of the genera of grouse. American Museum Nivitates 2289: 1-39.

Sibley, C. G. and Monroe, B. L. 1991. Distribution and taxonomy of the birds of the world. Yale University Press, New Haven & London.

Silvy, N.J., Brown, D.L., Labuda, S.E., Teer, J.G., Williams, D. 1993. Attwater's Prairie Chicken (*Tympanuchus cupido attawteri*) Revised Recovery Plan. U.S. Fish and Wildlife Service; 58 pp.

Silvy, N.J., Griffin C.P., Lockwood M.A., Morrow M.E., and Peterson M.J. 1999. Attwater's prairie chicken: a lesson in conservation biology research. Pp 153-162 in: Svedarsky W.D., Hier R.H., and Silvy N.J, (eds). The greater prairie chicken: a national look. Minnesota Agricultural Experiment Station Miscellaneous Publication 99-1999. University of Minnesota, St. Paul, Minnesota, USA.

Starling, A.E. 1991. Workshop summary: Captive breeding and release. Ornis Scandinavica 22: 255-257.

Storch, I. 1995. Habitat requirements of capercaillie. Pp. 151-154 in: Jenkins, D. (ed.). Proceedings 6th International Symposium on Grouse, Udine, Italy, 1993. World Pheasant Association, Reading, UK.

Storch, I. 1997. The importance of scale in habitat conservation for an endangered species: the capercaillie in central Europe. Pp 310-330 in: J. A. Bissonette, (ed). Wildlife and Landscape Ecology: effects of pattern and scale. Springer Verlag, New York.

Storch I. 1998. A disturbing topic. Grouse News 15: 3-4.

Storch, I. (Compiler) 2000. Grouse: Status Survey and Conservation Action Plan 2000-2004. WPA/BirdLife/SSC Grouse Specialist Group. IUCN, Gland, Switzerland and Cambridge, UK and the World Pheasant Association, Reading, UK.

Storch, I. 2002a. Linking a multi-scale habitat concept to species conservation. In: Bissonette, J. & Storch, I. (eds.): Landscape ecology and resource management: linking theory with practice. Island Press, Washington D.C. and Covelo, CA., USA; Pp. 303-320.

Storch I. 2002b. On spatial resolution in habitat models: Can small-scale forest structure explain Capercaillie numbers? Conservation Ecology 6(1): 6. [online] URL: http://www.consecol.org/vol6/iss1/art6

Storch I. and Leidenberger C. 2003. Tourism, mountain huts and the distribution of corvids in the Alps. Wildlife Biology 9: 301-308.

Storch I. 2005. Population status and conservation of Black Grouse worldwide: an update. In Plummer R. (Ed), Proceedings of the 3rd International Black grouse Conference, Ruthin, Wales UK 20-25 March 2005. 131pp. Pp 79-85.

Storch I., Bañuelos M.J., Fernández-Gil A., Obeso J.R., Quevedo M. and Rodríguez-Muñoz, R. 2006. Subspecies Cantabrian capercaillie *Tetrao urogallus cantabricus* endangered according to IUCN criteria. Journal of Ornithology: 147:653–655.

Suchant R., Schäfer A. 2002. Integrating tourism and grouse habitat protection in the Black Forest. In: Arnberger, A., Brandenburg, C., Muhar, A. (Eds.): Monitoring and Management of Visitor Flows in Recreational and Protected Areas. Conference Proceedings, Vienna: 95-101.

Suchant, R. and Braunisch, V. 2005. Grouse and tourism in Natura 2000 areas – guidelines for an integration of nature conservation and nature use. FVA / EU-LIFE-Nature Fonds, 32 p.

Summers, R.W.; Green R.E.; Proctor R.; Dugan D.; Lambie D.; Moncrieff R.; Moss R.; Baines D. 2004. An experimental study of the effects of predation on the breeding productivity of capercaillie and black grouse. Journal of Applied Ecology 41: 513-525

Summers, R. Dugan, D, Kortland, K. 2004. Measuring avoidance of tracks by capercaillie in Scots pine woodland. Report to SNH, FCS and RSPB.

Sun Y.-H., Swenson, J.E., Fang Y. et al. 2003. Population ecology of Chinese grouse, *Bonasa sewerzowi*, in a fragmented landscape. Biology of Conservation 110: 177-184.

Sun, Y.-H. 1995. Studies of grouse in China. Pp. 34-35 in: Jenkins, D. (ed.). Proceedings International Symposium on Grouse 6, Udine, Italy, 1993. World Pheasant Association, Reading, UK.

Sun, Y.-H. 1996. Winter ecological studies of Chinese Grouse. Acta Zoologica Sinica 42: 96-100.

Sun, Y.-H. 2000. Distribution and status of the Chinese Grouse. Wildlife Biology 6: 275-279.

Sun, Y.-H., J. E. Swenson, and Y. Fang 2000. Home range and social behaviour of hazel grouse during the spring in the Changbai Mountains, northeastern China. Game and Wildlife Science 17: 189-198.

Sun, Y.-H., Y. Fang, J. E. Swenson, S. Klaus & G.-M. Zheng 2004. Morphometries of the Chinese grouse *Bonasa sewerzowi*. J. Ornith. 146: 24-26.

Sun, Y.-H., S. Klaus, Y. Fang, P. Selsam & Jia C. 2006. Effects of habitat fragmentation and status of the Chinese grouse *Bonasa sewerzowi* in Lianhuashan Mountains, Gansu, China. IOC Congress Beijing 2002. S11-3. Acta Zoologica Sinica, 202-204.

Sun, Y.-H., Zh.J. Piao & J. E. Swenson 2003. Occurrence of hazel grouse *Bonasa bonasia* in a heavily human-impacted landscape near Changbai Mountains, northeastern China. Wildlife Biology 9: 371-375.

Suter, W., Graf, R.F. & Hess, R. 2002. Capercaillie (*Tetrao urogallus*) and avian biodiversity: testing the umbrella-species concept. – Conservation Biology 16: 778-788.

Svensson, S., Svensson, M. & Tjernberg, M. 1999. Svensk Fågelatlas. Vår Fågelvärld Suppl. 31, Stockholm.

Swenson, J. E. 1991. Social organization of hazel grouse and ecological factors influencing it. PhD Thesis, Univ. of Alberta, Canada.

Swenson, J. E. 1995. Habitat requirements of hazel grouse. Pp. 155-162 in: Jenkins, D. (ed.). Proceedings International Symposium on Grouse 6, Udine, Italy, 1993. World Pheasant Association, Reading, UK.

Swenson, J.E. and Angelstam, P. 1993. Habitat separation by sympatric forest grouse in Fennoscandia in relation to boreal forest succession. Canadian Journal of Zoology 71: 1003-1310.

Ten Den P. & Niewold F. 2001. The Black Grouse in the Netherlands: Monitoring the last (?) surviving Population. Actes du Colloque Tétras Lyre, Liège 26-29 Septembre 2000. Cahiers d'Ethologie 20 (2-3-4): 299-310.

Vitovich, O.A. 1986. Ecology of the Caucasian black grouse. Trudy Teberd. Gos. Zapov. 10: 165-309 (in Russian).

Vos, A. 1995. Population dynamics of the red fox (*Vulpes vulpes*) after the disappearance of rabies in county Garmisch-Partenkirchen, Germany, 1987-1992. In: Helle E, Henttonen J, (eds). II. North Europ. Symp. on the Ecology of Small and Medium-sized Carnivores, Lammi, Finland, April 1994; Ann. Zool. Fenn. 32(1): 93-97.

Wang, S., 1997. China red data book of endangered animals. National Environmental Protection Agency. Science Press, Beijing, Hong Kong, New York.

Wegge, P., Gjerde, I., Kastdalen, L., Rolstad, J., and Storaas, T. 1990. Does forest fragmentation increase the mortality rate of capercaillie? Trans. XIX. IUGB Congr., Trondheim, Norway: 448-453.

Wegge, P., Rolstad, J. and Gjerde I. 1992. Effects of boreal forest fragmentation on capercaillie grouse: empirical evidence and management implications. Pp. 738-749 in: McCullough, D.R. and Barrett, R.H. (eds). Wildlife 2001: Populations. Elsevier Appl. Sci.; Elsevier Sci. Publ., Ltd., Barking, Essex, UK.

Weiss, H. 1998. Waldhühner und Prädatoren. In: Auerhuhn und Haselhuhn in einer mitteleuropaeischen Kulturlandschaft, Internationale Fachtagung Oberprechtal, Baden-Wuerttemberg, Oktober 1997. Berichte Freiburger Forstliche Forschung 2: 124-125.

Westemeier, R.L., Brawn, J.D., Simpson, S.A., Esker, T.L., Jansen, R.W., Walk, J.W., Kershner, E.L., Bouzat, J.L., and Paige, K.N. 1998a. Tracking the Long-Term Decline and Recovery of an Isolated Population. Science 282:1695-1698.

Westemeier, R.L., J E. Buhnerkempe, W.R. Edwards, J.D. Brawn, and S.A Simpson. 1998b. Parasitism of greater prairie-chicken nests by ring-necked pheasants. Journal of Wildlife Management 62:854-863.

World Conservation Monitoring Centre (comp.) 1998. Checklist of CITES Species: A reference to the Appendices to the Convention on International Trade in Endangered Species of Wild Fauna and Flora. World Conservation Monitoring Centre, Cambridge, UK.

UNEP-World Conservation Monitoring Centre. 2003. Checklist of birds listed in the Convention on International Trade in Endangered Species (CITES) appendices and in EC regulation N°338/97. 7th Edition. JNCC Report N° 343. 410pp. Can be downloaded from http://www.ukcites.gov.uk.

Yahner, R.H. 1997. Long-term dynamics of bird communities in a managed forested landscape. Wilson Bulletin 109: 595-613.

Young, J. R., C. E. Braun, S. J. Oyler-McCance, J. W. Hupp, and T. W. Quinn. 2000. A new species of sage-grouse (Phasianidae: *Centrocercus*) from southwestern Colorado. Wilson Bull. 112: 445-453.

Young, J. R., Hupp, J. W., Bradbury, J. W., and Braun, C. E. 1994. Pheontypic divergence of secondary sexual traits among sage grouse populations. Animal behaviour 47: 1353-1362.

Young, J.R. 1994. The influence of sexual selection on phenotypic and genetic divergence of sage grouse. Ph.D. dissertation. Purdue University, IN, USA.

Zeitler A. 2003. Maintaining Black Grouse wintering habitats by alpine pasture management plans. Sylvia 39: 97-102.

Zeitler, A. 2001. Human disturbance, behaviour and spatial distribution of Black Grousein skiing areas in the Bavarian Alps. Cahiers d'Ethologie 20: 1-22.

Zeitler, A. and Glänzer, U. 1998. Skiing and grouse in the Bavarian Alps. Grouse News 15: 8-12.

Zwickel, F. C. 1992. Blue grouse. The birds of North America, No. 15. The birds of North America, Inc., Philadelphia, PA.

Zwickel, F. C., and J. F. Bendell. 2004. Blue grouse: their biology and natural history. NRC Research Press, Ottawa, Ontario, Canada. 284pp.

Zwickel, FC; Lewis, RA; Mckinnon, DT 1988. Nesting parameters in a high-density, declining population of blue grouse. Canadian Journal Zoology. 66 (8): 1736-1741 Aug 1988.

Appendix 1
2007 List of the Grouse Specialist Group members

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Appendix 2
IUCN/SSC Action Plans for the Conservation of Biological Diversity

Action Plan for African Primate Conservation: 1986-1990. Compiled by J.F. Oates. IUCN/SSC Primate Specialist Group, 1986, 41 pp. (out of print)

Action Plan for Asian Primate Conservation: 1987-1991. Compiled by A.A. Eudey. IUCN/SSC Primate SpecialistGroup, 1987, 65 pp. (out of print)

Antelopes. Global Survey and Regional Action Plans. Part1. East and Northeast Africa. Compiled by R. East. IUCN/SSC Antelope Specialist Group, 1988, 96 pp. (out of print)

Dolphins, Porpoises and Whales. An Action Plan for the Conservation of Biological Diversity: 1988-1992. Second Edition. Compiled by W.F. Perrin. IUCN/SSC Cetacean Specialist Group, 1989, 27 pp. (out of print)

The Kouprey. An Action Plan for its Conservation. Edited by J.R. MacKinnon and S.N. Stuart. IUCN/SSC Asian Wild Cattle Specialist Group, 1988, 19 pp. (out of print)

Weasels, Civets, Mongooses and their Relatives. An Action Plan for the Conservation of Mustelids and Viverrids. Compiled by A. Schreiber, R. Wirth, M. Riffel and H. van Rompaey. IUCN/SSC Mustelid and Viverrid Specialist Group, 1989, 99 pp. (out of print.)

Antelopes. Global Survey and Regional Action Plans. Part 2. Southern and South-central Africa. Compiled by R. East. IUCN/SSC Antelope Specialist Group, 1989, 96 pp. (out of print)

Asian Rhinos. An Action Plan for their Conservation. Compiled by Mohd Khan bin Momin Khan. IUCN/SSC Asian Rhino Specialist Group, 1989, 23 pp. (out of print)

Tortoises and Freshwater Turtles. An Action Plan for their Conservation. Compiled by the IUCN/SSC Tortoise and Freshwater Turtle Specialist Group, 1989, 47 pp.

African Elephants and Rhinos. Status Survey and Conservation Action Plan. Compiled by D.H.M. Cumming, R.F. du Toit and S.N. Stuart. IUCN/SSC African Elephant and Rhino Specialist Group, 1990, 73 pp. (out of print)

Foxes, Wolves, Jackals, and Dogs. An Action Plan for the Conservation of Canids. Compiled by J.R. Ginsberg and D.W. Macdonald. IUCN/SSC Canid and Wolf Specialist Groups, 1990, 116 pp. (out of print)

The Asian Elephant. An Action Plan for its Conservation. Compiled by C. Santiapillai and P. Jackson. IUCN/SSC Asian Elephant Specialist Group, 1990, 79 pp.

Antelopes. Global Survey and Regional Action Plans. Part 3. West and Central Africa. Compiled by R. East. IUCN/ SSC Antelope Specialist Group, 1990, 171 pp.

Otters. An Action Plan for their Conservation. Edited P. Foster-Turley, S.Macdonald and C. Maso. IUCN/SSC Otter Specialist Group, 1990, 126 pp. (out of print)

Rabbits, Hares and Pikas. Status Survey and Conservation Action Plan. Compiled and edited by J.A. Chapman, J.E.C. Flux. IUCN/SSC Lagomorph Specialist Group, 1990, 168 pp.

African Insectivora and Elephant-Shrews. An Action Plan for their Conservation. Compiled by M.E. Nicoll and G.B. Rathbun. IUCN/SSC Insectivore, Tree-Shrew and Elephant-Shrew Specialist Group, 1990, 53 pp.

Swallowtail Butterflies. An Action Plan for their Conservation. Compiled by T.R. New and N.M. Collins. IUCN/SSC Lepidoptera Specialist Group, 1991, 36 pp.

Crocodiles. An Action Plan for their Conservation. Compiled by J. Thorbjarnarson and edited by H. Messel, F.W. King and J.P. Ross. IUCN/SSC Crocodile Specialist Group, 1992, 136 pp.

South American Camelids. An Action Plan for their Conservation. Compiled and edited by H. Torres. IUCN/ SSC South American Camelid Specialist Group, 1992, 58 pp.

Australasian Marsupials and Monotremes. An Action Plan for their Conservation. Compiled by M. Kennedy. IUCN/ SSC Australasian Marsupial and Monotreme Specialist Group, 1992, 103 pp.

Lemurs of Madagascar. An Action Plan for their Conservation: 1993-1999. Compiled by R.A. Mittermeier, W.R. Konstant, M.E. Nicoll, O. Langrand. IUCN/SSC Primate Specialist Group, 1992, 58 pp. (out of print)

Zebras, Asses and Horses. An Action Plan for the Conservation of Wild Equids. Edited by P. Duncan. IUCN/ SSC Equid Specialist Group, 1992, 36 pp.

Old World Fruit Bats. An Action Plan for their Conservation. Compiled by S. Mickleburgh, A.M. Hutson and P.A. Racey. IUCN/SSC Chiroptera Specialist Group, 1992, 252 pp. (out of print)

Seals, Fur Seals, Sea Lions, and Walrus. Status Survey and Conservation Action Plan. Peter Reijnders, Sophie Brasseur, Jaap van der Toorn, Peter van der Wolf, Ian Boyd, John Harwood, David Lavigne and Lloyd Lowry. IUCN/SSC Seal Specialist Group, 1993, 88 pp.

Pigs, Peccaries, and Hippos. Status Survey and Conservation Action Plan. Edited by William L.R. Oliver. IUCN/SSC Pigs and Peccaries Specialist Group. IUCN/SSC Hippo Specialist Group, 1993, 202 pp.

Pecaries. Extraido de *Pigs, Peccaries, and Hippos: Status Survey and Conservation Action Plan (1993)* . Editado por William L.R. Oliver. IUCN/CSE Groupo de Especialistas en Puercos y Pecaries, 1996, 58pp.

The Red Panda, Olingos, Coatis, Raccoons, and their Relatives. Status Survey and Conservation Action Plan for Procyonids and Ailurids. (In English and Spanish) Compiled by Angela R. Glatston. IUCN/SSC Mustelid, Viverrid, and Procyonid Specialist Group, 1994, 103 pp.

Dolphins, Porpoises, and Whales. 1994-1998 Action Plan for the Conservation of Cetaceans. Compiled by Randall R. Reeves and Stephen Leatherwood. IUCN/SSC Cetacean Specialist Group, 1994, 91 pp.

Megapodes. An Action Plan for their Conservation 1995- 1999. Compiled by René W.R.J.Dekker, Philip J.K.McGowan and the WPA/Birdlife/SSC Megapode Specialist Group, 1995, 41 pp.

Partridges, Quails, Francolins, Snowcocks and Guineafowl. Status survey and Conservation Action Plan 1995-1999. Compiled by Philip J.K. McGowan, Simon D. Dowell, John P. Carroll and Nicholas J.A.Aebischer and the WPA/BirdLife/SSC Partridge, Quail and Francoliln Specialist Group. 1995, 102 pp.

Pheasants: Status Survey and Conservation Action Plan 1995-1999. Compiled by Philip J.K. McGowan and Peter J. Garson on behalf of the WPA/BirdLife/SSC Pheasant Specialist Group, 1995, 116 pp.

Wild Cats: Status Survey and Conservation Action Plan. Compiled and edited by Kristin Nowell and Peter Jackson. IUCN/SSC Cat Specialist Group, 1996, 406 pp.

Eurasian Insectivores and Tree Shrews: Status Survey and Conservation Action Plan. Compiled by David Stone. IUCN/SSC Insectivore, Tree Shrew and Elephant Shrew Specialist Group. 1996, 108 pp.

African Primates: Status Survey and Conservation Action Plan (Revised edition). Compiled by John F. Oates. IUCN/ SSC Primate Specialist Group. 1996, 80 pp.

The Cranes: Status Survey and Conservation Action Plan. Compiled by Curt D. Meine and George W. Archibald. IUCN/SSC Crane Specialist Group, 1996, 401 pp.

Orchids: Status Survey and Conservation Action Plan. Edited by Eric Hágsater and Vinciane Dumont, compiled by Alec Pridgeon. IUCN/SSC Orchid Specialist Group, 1996, 153 pp.

Palms: Their Conservation and Sustained Utilization. Status Survey and Conservation Action Plan. Edited by Dennis Johnson. IUCN/SSC Palm Specialist Group, 1996, 116 pp.

Conservation of Mediterranean Island Plants. 1. Strategy for Action. Compiled by O. Delanoë, B. de Montmollin and L. Olivier. IUCN/SSC Mediterranean Islands Plant Specialist Group, 1996, 106 pp.

Wild Sheep and Goats and their Relatives. Status Survey and Conservation Action Plan for Caprinae. Edited and compiled by David M. Shackleton. IUCN/SSC Caprinae Specialist Group, 1997, vii + 390 pp.

Asian Rhinos. Status Survey and Conservation Action Plan (2nd Edition) . Edited by Thomas J. Foose and Nico van Strien. IUCN/SSC Asian Rhino Specialist Group, 1997, v + 112 pp. (out of print)

The Ethiopian Wolf. Status Survey and Conservation Action Plan. Compiled and edited by Claudio Sillero-Zubiri and David Macdonald. IUCN/SSC Canid Specialist Group, 1997, 123pp. (out of print)

Cactus and Succulent Plants. *Status Survey and Conservation Action Plan.* Compiled by Sara Oldfield. IUCN/SSC Cactus and Succulent Specialist Group, 1997, x + 212 pp.

Dragonflies. Status Survey and Conservation Action Plan. Compiled by Norman W. Moore. IUCN/SSC Odonata Specialist Group, 1997, v + 28 pp.

Tapirs. Status Survey and Conservation Action Plan. Edited by Daniel M. Brooks, Richard E. Bodmer and Sharon Matola. IUCN/SSC Tapir Specialist Group, 1997, viii + 164 pp.

The African Wild Dog. Status Survey and Conservation Action Plan. Compiled and edited by Rosie Woodroffe, Joshua Ginsberg and David Macdonald. IUCN/SSC Canid Specialist Group, 1997, 166pp.

Grebes. Status Survey and Conservation Action Plan. Compiled by Colin O'Donnel and Jon Fjeldså. IUCN/ SSC Grebe Specialist Group, 1997, vii + 59pp.

Crocodiles: Status Survey and Conservation Action Plan, 2nd Edition. Edited by James Perran Ross. IUCN/SSC Crocodile Specialist Group, 1998, viii + 96pp. (out of print)

Hyaenas: Status Survey and Conservation Action Plan. Compiled by Gus Mills and Heribert Hofer. IUCN/SSC Hyaena Specialist Group, 1998, vi + 154 pp.

North American Rodents: Status Survey and Conservation Action Plan. Compiled and edited by David J. Hafner, Eric Yensen, Gordon L. Kirkland Jr. IUCN/SSC Rodent Specialist Group, 1998, x + 171pp.

Deer: Status Survey and Conservation Action Plan. Edited by C. Wemmer. Compiled by Andrew McCarthy, Raleigh Blouch and Donald Moore. IUCN/SSC Deer Specialist Group, 1998, vi + 106pp.

Bears: Status Survey and Conservation Action Plan. Compiled by C. Servheen, S. Herrero and B. Peyton. IUCN/SSC Bear and Polar Bear Specialist groups, 1998, x + 306pp. (out of print)

Conifers: Status Survey and Conservation Action Plan. Compiled by A. Farjon and C.N. Page. IUCN/SSC Conifer Specialist Group, 1999, ix + 121pp.

African Rhino: Status Survey and Conservation Action Plan. Compiled by R. Emslie and M. Brooks. IUCN/SSC African Rhino Specialist Group, 1999, ix + 92pp. (out of print)

Curassows, Guans and Chachalacas: Status Survey and Conservation Action Plan for Cracids 2000–2004. Compiled by Daniel M. Brooks and Stuart D. Strahl (with Spanish and Portuguese translations). IUCN/SSC Cracid Specialist Group, 2000, viii + 182pp.

Parrots: Status Survey and Conservation Action Plan 2000–2004. Edited by Noel Snyder, Philip McGowan, James Gilardi and Alejandro Grajal, 2000, x + 180pp.

West Indian Iguanas: Status Survey and Conservation Action Plan. Compiled by Allison Alberts. IUCN/SSC West Indian Iguana Specialist Group, 2000, vi + 111pp.

Grouse: Status Survey and Conservation Action Plan 2000–2004. Compiled by Ilse Storch. WPA/BirdLife/SSC Grouse Specialist group, 2000, x + 112pp.

Mosses, Liverworts, and Hornworts: Status Survey and Conservation Action Plan for Bryophytes. Compiled by T. Hallingbäck and N. Hodgetts. IUCN/SSC Bryophyte Specialist Group, 2000, x + 106pp.

Pheasants: Status Survey and Conservation Action Plan 2000–2004. Edited by Richard A. Fuller and Peter J. Garson. WPA/BirdLife/SSC Pheasant Specialist group, 2000, vii + 76pp.

Megapodes. Status Survey and Conservation Action Plan 2000–2004. Edited by René W.R.J. Dekker, Richard A. Fuller and Gillian C. Baker on behalf of the WPA/BirdLife/ SSC Megapode Specialist Group, 2000, vii + 39pp.

Partridges, Quails, Francolins, Snowcocks, Guineafowl and Turkeys. Status Survey and Conservation Action Plan 2000–2004. Edited by Richard A. Fuller, John P. Carroll and Philip J.K. McGowan on behalf of the WPA/BirdLife/ SSC Partridge, Quail and Francolin Specialist Group, 2000, vii + 63pp.

Microchiropteran Bats. Status Survey and Conservation Action Plan. Compiled by Anthony M. Hutson, Simon P. Mickleburgh and Paul A. Racey. IUCN/SSC Chiroptera Specialist Group, 2001, x + 258pp.

Antelopes. Part 4: North Africa, the Middle East and Asia. Global Survey and Regional Action Plans. Compiled by D.P. Mallon and S.C. Kingswood. IUCN/SSC Antelope Specialist Group, 2001, viii + 260pp.

Equids. Zebras, Assess and Horses. Status Survey and Conservation Action Plan. Edited by Patricia D. Moelman. IUCN/SSC Equid Specialist Group, 2002, ix + 190pp.

Dolphins, Whales and Porpoises. 2002–2010 Conservation Action Plan for the World's Cetaceans. Compiled by Randall R. Reeves, Brian D. Smith, Enrique A. Crespo and Giuseppe Notarbartolo di Sciara. IUCN/SSC Cetacean Specialist Group, 2003, ix + 139pp.

Cycads. Status Survey and Conservation Action Plan. Edited by John Donaldson. IUCN/SSC Cycad Specialist Group 2003, ix + 86pp

West African Chimpanzees. Status Survey and Conservation Action Plan. Edited by Rebecca Kormos, Christophe Boesch, Mohamed I. Bakarr and Thomas Butynski. IUCN/ SSC Primate Specialist Group, 2003, ix + 219pp.

Canids: Foxes, Wolves, Jackals and Dogs. Status Survey and Conservation Action Plan. Edited by Claudio Sillero- Zubiri, Michael Hoffman and David W. Macdonald. IUCN/SSC Canid Specialist Group, 2004. vi + 430 pp.

European Bison. Status Survey and Conservation Action Plan. Edited by Zdzis_aw Pucek. Compiled by Zdzis_aw Pucek, Irina P. Belousova, Ma_gorzata Krasi_ska, Zbigniew A. Krasi_ski and Wanda Olech. IUCN/SSC Bison Specialist Group, 2004, ix + 54 pp.

Sharks, Rays and Chimaeras: The Status of the Chondrichthyan Fishes. Status Survey. Compiled and edited by Fowler, S.L., Cavanagh, R.D., Camhi, M., Burgess, G.H., Cailliet, G.M., Fordham, S.V., Simpfendorfer, C.A. and Musick, J.A. IUCN/SSC Shark Specialist Group, 2005. x + 461 pp.

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