

PUTTING STUDIES OF NORTH AMERICAN GOSHAWKS IN CONTEXT

ROBERT E. KENWARD

Writing the foreword for this collection of papers provides an opportunity to take stock of how research on the Northern Goshawk (*Accipiter gentilis*) has developed on both sides of the Atlantic Ocean. The first period of international overview of the Northern Goshawk was in 1980–1981. An early monograph on goshawks (Fischer 1980) was not easily accessible to western biologists, because it came from what was then East Germany. Moreover, the only English language text was in 60 of its 250 references. Most of the early quantitative studies of this species were published in German and Scandinavian languages (Hagen 1942, Holstein 1942, Brüll 1964; Höglund 1964a, b; Sulkava 1964).

However, by the late 1970s quantitative studies also originated from Britain and North America (McGowan 1975), including the first radio tracking of free-living hawks (Bendock 1975, Kenward 1976). These studies, and a need to make European material accessible in English, stimulated the collection of 21 papers for a symposium in Oxford titled *Understanding the Goshawk* (Kenward and Lindsay 1981a). The main topics were population trends (four papers), wild and domestic breeding (six), hunting behavior and predation (seven). Not one paper focused on features of the habitat.

Around 1980, rather little knowledge of Goshawks was crossing the Atlantic in either direction. In 1982, a remarkable raptor enthusiast, the late Richard Olfendorff, provided search findings from a pioneering raptor management information system that he had just established. Among 139 references that mentioned goshawks in the text, including 23 that Olfendorff considered substantially about goshawks, only six were also among the 250 in Fischer (1980).

Since about 1990, great interest in habitat requirements has developed in North America, as a result of attempts to use the Northern Goshawk as a flagship species for preserving old-growth forest. Useful reviews of the politics and resulting work were published by Reynolds et al. (1992), Squires and Reynolds (1997), Bosakowski (1999), Kennedy (2003) and in the proceedings of a goshawk symposium (Block et al. 1994). So is most work on Northern Goshawks now done west of the Atlantic?

This question can be best answered by examining publications in scientific journals, because books,

reports, and conference proceedings tend to be biased towards work in particular geographic areas. I searched the Raptor Information System (RIS) (<<http://ris.wr.usgs.gov/>> [24 February 2005]) for papers in scientific journals with Northern Goshawk in the title or keywords. Results were filtered for work in the wild (either in Europe or North America), to exclude conference proceedings and into two 15-yr periods to seek trends. In the 15 yr of forest interest since 1990, 147 journal papers included 85 (58%) from Europe, compared with 74 publications including 41 (55%) from Europe in the 1975–1989 period (Fig. 1a). Papers on goshawks doubled both in Europe and North America.

A new database of goshawk demography and feeding habits (Rutz et al., *this volume*) that traced citations from recent publications without using the RIS, suggests that the RIS may slightly underestimate European publications. In August 2004, the database included 174 references from 1975 onward with 108 (62%) from Europe. For North American work, 49 of 66 references (74%) were also in the RIS, compared with 36 of 108 (33%) for Europe (Fig. 1b).

So, research on goshawks remains very healthy east of the Atlantic, and it is good for the research in Europe to continue informing researchers in America, as Mike Morrison understood when he sought two review papers from Europe for this volume. It is also worth noting that the 972 citations for Northern Goshawk (title + keyword) in the RIS in July 2004 were not greatly exceeded by the 1,082 for Golden Eagle (*Aquila chrysaetos*), which was beaten only by Bald Eagle (*Haliaeetus leucocephalus*) (2,563) and Peregrine Falcon (*Falco peregrinus*) (1,442). A perfect bibliography might well give a citation bronze medal to studies of the Northern Goshawk.

In the 22 papers of this volume, the focus of research is more holistic than a decade earlier. Among 23 papers in Block et al. (1994), 10 had habitat issues in the title and were extensively concerned with where goshawks nest. Research now tends to emphasize how goshawks are performing in different situations rather than where they nest. In this volume, only four of the 22 papers have habitat in the title, and one of the four actually concentrates on habitats of goshawk prey. Joseph Drennan uses

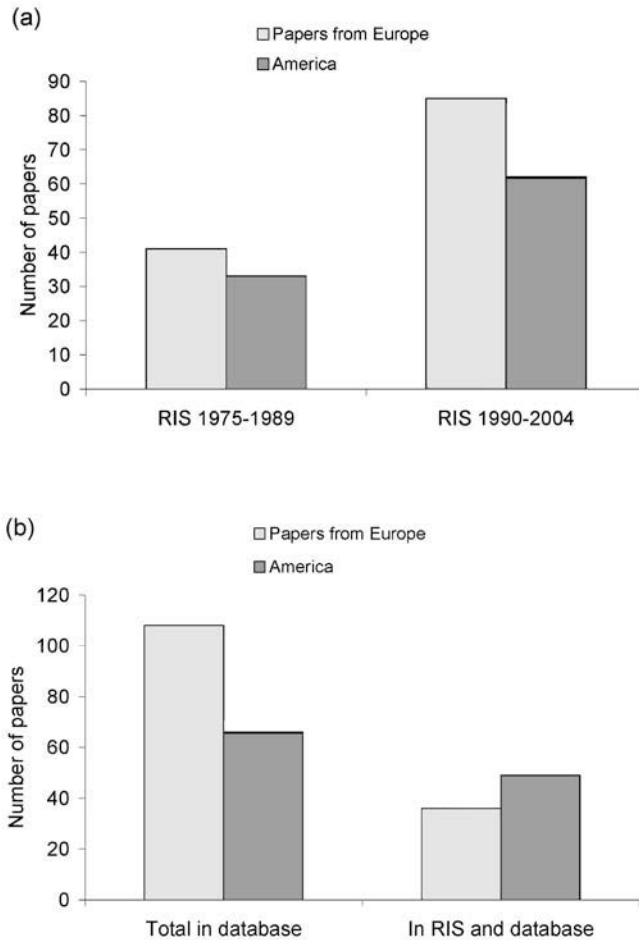


FIGURE 1. The Raptor Information System (RIS) shows a parallel increase in goshawk publications in Europe and America (a) with European papers represented less than in a new database on demography and diet (b).

the diet of goshawks in the southwestern US and elsewhere to illustrate the converging requirements of predator and prey species. His prey-based approach illustrates why habitat use remains an important theme throughout this volume.

Two papers, one by Sarah Sonsthagen and the other by Jared Underwood, in each case with Ronald Rodriguez and Clayton White as co-authors, give data on habitats used by 42 adult female goshawks that were tracked by satellite in Utah between 2000 and 2003. Another paper by Carlos Carroll, Ronald Rodriguez, Clinton McCarthy, and Kathleen Paulin, is linked to these two by location (Utah) and use of remote sensing. These authors model the distribution of goshawk nests from satellite-mapped data on spatial resources, with reasonable out-of-area predictive ability and similarity to resource requirements of bears and wolves. These three papers from Utah,

with a fourth, by Sonsthagen, Rodriguez, and White on annual movements of the same satellite-tracked goshawks, will for many readers be the most remarkable in the volume. Goshawks seem not to have previously been tracked by satellite and certainly not in such numbers. In view of low tracking accuracy from the ARGOS system, differences in habitat use between seasons and between resident and migrant hawks are likely to be even more robust than results suggest, because significance levels are probably reduced by noise. However, the low accuracy will have overestimated home ranges. Moreover, 21 of the adult female hawks produced stationary, cold-transmitter readings before the following April and none among 11 survivors tracked the following summer reproduced successfully, which indicates a high impact of tags; such an impact may have biased movements and survival.

Another North American paper with a focus on habitat is by Stephen DeStefano, Michael McGrath, Steven Desimone, and Sonya Daw, on goshawks in inland Washington and Oregon. There they found weak tendencies for greatest persistence of nesting in areas that retained most forest with mid- and late seral stages, and productivity was lowest in one of three areas with least mammals in the diet. Moving further north, into Canada, Frank Doyle reviews evidence that mainland goshawks coexisting with abundant lagomorph populations may be little impacted by timber harvest, compared with hawks on islands with few lagomorphs. Another theme of this paper is that collection of robust data on nest density and productivity is likely to be more useful for monitoring goshawks than observing hawks in migration or in winter.

Similar comments on the need for robust reproductive data that are comparable across studies, and also on winter diet and foraging, are found in the paper by Clint Boal, David Andersen, Pat Kennedy, and Aimee Roberson. As well as reviewing nesting habitats, diet, and productivity in the Great Lakes region, these authors include data on home range, residency, and mortality for 28 breeding adult goshawks. Further eastward, the theme of describing nest habitat, productivity and diet is continued by Trevor Becker, Dwight Smith, and Thomas Bosakowski for 16 nests in Connecticut. Bosakowski and Smith provide similar data for goshawks in the nearby East Coast states of New York and New Jersey, which have been re-colonized following re-forestation. In addition, the latter paper includes comments on migratory movements of goshawks in the eastern US.

Habitat change is also addressed by one of the two papers from Europe. Risto Tornberg, Erkki Korpimäki, and Patrik Byholm review 12 multi-year studies of breeding and winter ecology in Fennoscandia. From the nationwide counts of prey populations, there are indications that Goshawks may have subtle impacts on populations of their main prey, woodland grouse, especially because extensive radio tagging shows that healthy populations may contain many non-breeders. There is evidence of converse effects too, with variation in goshawk numbers and body-size linked to impacts on prey of recent changes in forest management.

Returning to the southwest of North America, four papers concentrate on seasonal and spatial variation in breeding biology. Andi Rogers, Michael Ingraldi, and Stephen DeStefano use video recording to show that although prey deliveries at 10 nest sites in Arizona declined after a peak at a nestling

age of 15–20 d, an increase in size of prey caused biomass per day to increase throughout the season. Marc Bechard, Graham Fairhurst, and Gregory Kaltenecker analyze 11 yr of data on occupancy and productivity for a study area in Nevada, compared to 10 yr of similar data from Idaho. They also provide records of natal dispersal movements and adult turnover. These are the longest data sets from North America in this volume.

From another multi-year study in the southwest US, Richard Reynolds and the late Suzanne Joy provide data on productivity, turnover, and survival of adult goshawks of both sexes on the Kaibab Plateau. Useful analytic techniques are introduced, including Mayfield estimates to correct late-finding bias, and distance thresholds to increase information from nearest-neighbor-distance analyses of nest spacing. In the fourth site-specific study, John Keane, Michael Morrison, and Michael Fry use 4 yr of data to indicate that large brood size in the California Sierra Nevada correlated with early laying and high pre-laying mean temperature, while abundance and frequency in goshawk diet of Douglas squirrels (*Tamiasciurus douglasii*) correlated with cone crops.

The remaining six papers are essentially reviews. At the end of the *Regional* section of the volume, Christian Rutz, Mick Marquiss, Rob Bijlsma, and I consider factors that may limit goshawk populations across Europe. We discuss why goshawks are more focussed on woodland and eating mammals in North America and note that goshawk colonization of European towns shows how well this species can adapt to habitat change. The creation of a database for the inter-continental comparisons raised issues of data standards. Such meta-analyses would be most robust if biologists always (1) climbed trees to assess productivity, (2) collected individual-unique prey remains in diet studies, (3) adopted in Europe the habitat measures used in North America (e.g. canopy cover in nest stands), (4) recorded nest density and percentage of forest in North American study areas, and (5) estimated mean nearest-neighbor nest distances in case these prove better than density for investigations of population variation in strongly heterogeneous landscapes.

In the last paper in the *Ecology* section of the volume, Richard Reynolds, Susan Salafsky, and David Wiens consider how goshawk populations are affected by predators, competitors, weather, and habitats for nesting, provisioning, and winter foraging. They concur, from the many recent studies of goshawks in North America, with results obtained earlier by studying goshawks in European habitats, namely that goshawks can be quite flexible in breeding habitat but

require habitats good for prey populations and hunting them (Kenward and Widén 1989).

This sets the scene for the point at which work on goshawks in North America has gone beyond the situation in Europe, into monitoring and practical habitat planning for goshawk conservation, as described in the following *Management* section. At the start of this section, Christina Hargis and Brian Woodridge consider how goshawk populations could be monitored at the regional scale across North America. They propose standardized use of a broadcast acoustical survey during incubation and nestling periods, in 688 ha blocks at 5-yr intervals, to indicate change in presence of breeders for analysis in relation to covariates such as changing habitat.

In the final two papers, Richard Reynolds, Douglas Boyce, and Russell Graham, give a preliminary assessment of the ecosystem-based conservation strategy developed for goshawks in the southwestern US. Their principle is to conserve the whole food web as well as breeding and foraging habitats, by summing forest habitat elements required for nesting, foraging and the needs of four main prey species, and then planning to ensure an adequate proportion of each vegetation structure stages in the long term (which must be as much as 200 yr for the oldest trees). This principle is embedded in the management guidelines for the southwestern US that were adopted in 1992. These are considered in the second paper, in which Boyce leads a look at the status of goshawks on land managed by the USDA Forest Service. The management guidelines are now widely praised as a pioneering wildlife management initiative, developed by consensus of many interests for use in the wider countryside beyond reserves and management. Their interest in maintaining prey populations benefits other species than goshawks, including humans in that initiation of low-intensity

ground fires is recommended to clear inflammable debris and hence deter crown fires.

I have left a long introductory paper by John Squires and Pat Kennedy until last, because it includes all the topics of the others and yet goes beyond them. As the authors point out, it does not attempt to consider all the literature (especially from Europe) and passes lightly over issues that the authors have reviewed thoroughly elsewhere. However, it is the most comprehensive yet concise account of goshawk biology and politics in North America that is available in English.

The papers in this volume provide an excellent overview of the extensive recent work on goshawks in Europe and North America. On both continents, studies have evolved from the descriptive to the correlative, to multi-site, multi-year studies and now to compilations of data for meta-analyses. In Europe, population and predation studies have become more sophisticated through radio tagging and by using extensive data on prey demography. In North America, goshawk biologists are applying advanced remote sensing technology and linking goshawk conservation with silviculture. Differences between goshawks in Europe and North America continue to raise challenging questions, and Europeans continue to produce at least as many publications on the Northern Goshawk as their North American colleagues.

Ultimately, conservation of goshawks may benefit from many interests and subtle socio-economic approaches. For instance, might goshawks be as amenable as Peregrine Falcons to introduction by falconers for urban living? It may be hoped that innovations in the coming decade also include greater inter-continental liaison, to transfer data standards and understanding of how the Northern Goshawk and other species respond to changing land use.