Review of Information on the Status of the Northern Goshawk (*Accipiter gentilis atricapillus*) in the Western Great Lakes Region and Ontario

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ACRONYMS USED IN THIS REPORT

American Ornithologists' Union	AOU
Breeding Bird Atlas	BBA
Breeding Bird Survey	BBS
Category 2	C2
Christmas Bird Count	CBC
Department of Natural Resources	DNR
Geographic Information Systems	GIS
Minnesota Cooperative Fisheries and Wildlife Research Unit	MCFWRU
Minnesota Department of Natural Resources	MNDNR
Minnesota Falconers' Association	MFA
Minnesota Ornithologists' Union	MOU
National Council for Air and Stream Improvement	NCASI
National Forest	NF
National Forest Foundation	NFF
National Wildlife Refuge	NWR
United States Fish and Wildlife Service	USFWS
United States Forest Service	USFS

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SUMMARY

This document was written under agreement with the U. S. Fish and Wildlife Service (USFWS) for the purpose of reviewing information pertinent to the status of the northern goshawk (*Accipiter gentilis atricapillus*) in USFWS Region 3 (Illinois, Indiana, Iowa, Michigan, Minnesota, Missouri, Ohio, and Wisconsin) and Ontario. Land managers have expressed concern over the shortage of available goshawk data and the lack of communication across political boundaries regarding the status of the goshawk in the Region. This report summarizes existing information, identifies gaps in our understanding of this species, and makes reference to the state of goshawk management and research in other parts of the species' North American range.

The northern goshawk is the largest of the three species of North American accipiters. In North America, two or three subspecies are recognized depending on the authority cited. The subspecies *A. g. atricapillus* (Wilson) has the largest distribution, and includes the Great Lakes Region. The goshawk is a secretive woodland raptor. They are considered prey generalists.

With the exception of one record from Illinois from the nineteenth century (see Illinois Historical Range), we found no records of goshawk nesting outside of Michigan, Minnesota, Wisconsin, and Ontario in the Region. Although little published information exists, several researchers have been gathering goshawk data in the Region for years. The available portion of this information is summarized in this paper along with information from several regional symposia. A summary of known life history information is included along with a discussion of ongoing research. A history of the legal status of the goshawk in North America and in the Region is included, as is a contact list of interested land managers, researchers and individuals who have contributed information on the goshawk in the Midwest.

No evidence exists to support claims that goshawk populations are declining on a regional basis, or that they are not declining. Much research remains to be done and no valid status determination may be made given the current body of knowledge.

INTRODUCTION

This document was written under agreement with the USFWS for the purpose of reviewing information pertinent to the status of the northern goshawk (*Accipiter gentilis*, hereafter referred to as goshawk) in USFWS Region 3. The Region consists of the states of Minnesota, Wisconsin, Michigan, Iowa, Illinois, Indiana, Ohio, and Missouri (hereafter, these states and the province of Ontario will be referred to as the Western Great Lakes Region or Region). Land managers have expressed concern over both the shortage of available goshawk data and the lack of communication across political boundaries regarding the status of the goshawk in the Region.

One of the problems in developing a reliable goshawk population model is that the densities of populations vary spatially and temporally (Kennedy 1997). The amount of available goshawk information for different regions of North America varies likewise. Squires and Reynolds (1997) cited few references from the Western Great Lakes Region in their species account of goshawks. Most of the references from the Region cover migration or historical range. This is not an oversight by the authors, but merely a reflection of the state of goshawk research in mid-continental North America.

This dearth of information has not gone unnoticed. The number of symposia and meetings devoted to goshawk research and management has increased over the past five years. Regional discussions were held as part of the annual Midwest Peregrine/Raptor Symposia in Madison, Wisconsin in 1993 and in Milwaukee, Wisconsin in 1997. A 1998 meeting held by the MCFWRU brought together agency, industry, and stakeholder officials to discuss goshawk management and research issues at the Raptor Center at the University of Minnesota in January. While little published research exists, some Midwestern researchers have been investigating goshawk biology for decades. Erdman *et al*. have been studying the goshawk in northeastern Wisconsin for more than 25 years and recently published a comprehensive report (Erdman *et al*. 1998). Evans and colleagues have collected and published data on annual migrations and band recoveries dating back to the early seventies.

This report is based primarily on published literature, symposia proceedings, and unpublished management reports. Much of this information resulted from the tireless work of independent researchers and volunteers. However, many of the goshawk studies conducted in the Region should have a caveat attached to the data: **All data should be interpreted cautiously.** Since many of the cited studies are unpublished, written descriptions of study designs, methods, and analytical techniques are not always available for critical analysis through peer review. No studies have been conducted on a regional scale. Most were conducted in limited portions of one state and, except for Rosenfield *et al*. (1996), the study locations were not randomly selected which limits the inference value of the data for determining Region-wide trends. There are also problems with small sample sizes, short study duration, and potential bias in nest detection methods. Some of these items have been included rather than excluded with the hope that by sharing as much information as possible, a better understanding of

goshawk biology will emerge. **It is important to note that no regional inferences should be drawn from these data.** A potential outcome of this effort may be an increased awareness of the lack of available information and the need for additional research.

This document includes information from outside the Region to provide a broader context for discussion of goshawk ecology, despite differences in primary habitats or ecological pressures. Most research in North America has addressed habitat-use patterns, home range characteristics, food habits, productivity, and demography (Squires and Reynolds 1997). The design and results of studies from other parts of the goshawk's range should be considered for their relevance in helping to identify limiting factors and management strategies for Western Great Lakes populations. In writing this report, we frequently cited Braun *et al*. (1996), Kennedy (1997), and Squires and Reynolds (1997), because of their recent publication and comprehensive scope. Nowhere in North America are there long term indices of trends or estimates of goshawk breeding population size derived from standardized, widespread surveys (Braun *et al*. 1996). Insufficient information is available to make a status determination for the entire breeding range contained in the Region or for any state within the regional breeding range.

TAXONOMY

Common Name: Northern Goshawk
Scientific Name in Federal Register: *Accipiter gentilis* (Linnaeus 1758)
Taxonomy

Order: Falconiformes
Suborder: Accipitres
Superfamily: Accipitroidea
Family: Accipitrididae
Subfamily: Accipitrinae (American Ornithologists' Union 1998)

Unresolved Taxonomic Issues

Old and New World goshawks differ in appearance, and may represent different species, rather than subspecies (Brown and Amadon 1968). Approximately 12 subspecies exist worldwide with seven to nine of those in Asia and northern Europe (Gladkov 1941). Alternatively, *A. gentilis* may represent a superspecies with *A. henstii* (Schlegl) of Madagascar, *A. melanoleucus* (Smith) of Africa, and *A. meyerianus* (Sharpe) of Papua (American Ornithologists' Union 1998). Two or three subspecies of *A. gentilis* exist in North America depending on the authority cited: *A. g. laingi*, *A. g. atricapillus* and *A. g. apache* (see Figure 1). The *Apache* subspecies is not recognized by the AOU and is based on few specimens (Kennedy, pers. comm.). The USFWS considered the issue of recognition of *Apache* as a legitimate subspecies to be unresolved (USFWS 1998).

PHYSICAL DESCRIPTION

The northern goshawk is the largest of the North American accipiters. Females are larger than males, but goshawks are less dimorphic than smaller North American accipiters (Storer 1966). The goshawk has short, rounded wings, a long tail, and stout legs and feet (Palmer 1988). The five outer primaries are emarginated on the inner webs, and the seventh is typically longest (Palmer 1988). Relative to body size, the goshawk has a smaller eye and shorter third toe than other North American accipiters. Squires and Reynolds (1997) provided wing-chord, tail and mass measurements for four studies: three conducted in the western United States and one in Wisconsin.

When perched, wingtips do not extend to the tail's midpoint (Johnsgard 1990). The goshawk in immature plumage can be difficult to distinguish from other accipiters. Female Cooper's hawks (*A. cooperii*) approach the size of male goshawks. In the hand, the goshawk is seldom smaller than 50 cm (19.6 in) in length (Palmer 1988), the tarsus of the goshawk is more stout and feathered to two thirds its length, not one half, as with the Cooper's hawk (Brown and Amadon 1968). The tail is less rounded than that of the Cooper's hawk (Palmer 1988).

Weight and length measurements illustrate sexual dimorphism in the goshawk. Johnsgard (1990) reported average weights collected from other sources for 77 males and 103 females. The mean weights were 912g (range 735-1099g) for males and 1137g (range 845-1364g) for females (Johnsgard 1990). Johnsgard (1990) reported tail length measurements of 27 males and 22 females of the *atricapillus* subspecies as 245.7mm (range 226.5-280) and 278mm (range 250-301) respectively.

In adult plumage, dorsal markings tend to be slate gray, although often bluish, and become black on the top of the head. A white superciliary stripe separates the cap from the mottled, whitish sides of the crown. Remiges are fuscous. The rump, upper tail coverts, and tail are similar to the back. The tail has four broad, indistinct fuscous bands which are narrower than the intervening gray. The distal dark bar has a whitish terminal band. Ventral markings are uniformly whitish to pale gray with variable dark gray barring that is usually most noticeable on the lower breast, abdomen, and tibiae. In adult females, the plumage may appear more brownish above, with stronger gray barring ventrally. The bill is bluish gray to black, the cere, tarsi, and toes yellow, and the claws bluish black. The iris is reddish; the male's is more orange-red, becoming darker brown-red with age. The female's iris tends to orange-yellow (Palmer 1988, Johnsgard 1990).

SUMMARY OF BIOLOGICAL INFORMATION ON THE GOSHAWK IN THE WESTERN GREAT LAKES REGION AND ONTARIO

Several published and unpublished studies have reported various aspects of goshawk life history in the Region. Some of these data are potentially biased due to nonrandom or incomplete nest detection methods (for a discussion of bias as it applies to some of these data, see Rosenfield *et al*. 1998 and Siders and Kennedy 1996). All data should be interpreted cautiously. No studies with regional coverage concerning any aspect of goshawk habitat requirements, prey use, or demographics have been conducted.

A problem with inconsistent terminology needs to be addressed before the discussion of habitat. The term *territory* has often been used in the Western Great Lakes Region to describe various portions of goshawk activity areas. Because this term may imply an area defended by the pair, this report will use the term *breeding area*. *Home ranges* and *foraging areas* are used by goshawks but it is not known what portions of these areas are defended against intrusion by conspecifics or heterospecifics. *Breeding season home range* would encompass the areas used by individuals for foraging and resting as well as caring for young (Hargis *et al*. 1994). This report uses the terms *nest site*, *breeding area*, *foraging area*, and *home range*. The area immediately surrounding the nest tree has been referred to by some researchers as the *nest site* or nest area (Steenhof 1987). The nest site may contain more then one nest tree, as in the case of an alternative nest being located in close proximity to an active nest. The forest stand containing the nest tree(s) is considered part of the site although definitions beyond the stand tend to vary by location and study. Forest stand types have often been used to

describe the species cover type(s) containing the site. The *breeding area* may contain more than one *nest site* and the *breeding season home range* contains all *nest sites, breeding areas, foraging areas* and *resting areas* for one breeding pair.

Most of the available habitat data from the Region is limited to breeding season measurements of the features at nest trees or within the immediate vicinity of nests. Lack of standardization of measurement techniques may hinder comparisons in some cases.

Habitat

Breeding Season Habitat

Squires and Reynolds (1997) reported that goshawks nest in a variety of habitat types, and they seem to prefer mature forests with large trees on moderate slopes with open understories. But any preference for mature forests has been demonstrated in only a few studies due to biased nest detection methods (Kennedy pers. comm.). Goshawks nest in either coniferous, deciduous, or mixed-pine forests, depending on availability (Squires and Reynolds 1997).

Historically, many goshawk nesting attempts have been documented in the Region. Nest tree species and diameter breast height (dbh), nest height, and the number of nestlings present have been the most frequently recorded data. Most of the nest site and breeding season home range habitat data for the Western Great Lakes Region presented here were compiled from journal notes, personal communications, agency databases, short-term study records, or records from studies covering limited portions of the Region.

Nest Tree

Nest trees may be deciduous or coniferous, and nests are usually constructed in a crotch close to the main trunk (Palmer 1988). Throughout North America, nest trees are often located near standing water and on slopes (Palmer 1988). Use of the largest trees in the stand has been noted (Squires and Reynolds 1997).

In the Western Great Lakes Region, as in other regions of North America, goshawk nests are found in a variety of tree species. Nest tree data are the easiest habitat data to obtain. A wide variety of tree species and stand types have been recorded for the Region. Table 1 contains a nonquantitative list of goshawk nest tree types compiled from a variety of sources during completion of this report. Trembling aspen (*Populus tremuloides*) was the most frequently recorded species for the Region, but the number of tree species records available to this study was skewed toward records from Minnesota. These records came from the MOU Archives, the MNDNR Nongame Program Database, and Martell and Dick (1996). Most of the nests described in Martell and Dick (1996) were located incidentally by agency field personnel and only two were discovered using call playback surveys.

In Wisconsin, Rosenfield *et al*. (1998) measured nest site habitat at 37 geographically separate nest sites; 23 were measured in the same year as nesting occurred and four and seven were measured one and two years following nesting, respectively (Rosenfield *et al*. 1998). The remaining three nests were sampled five (N=1) and seven (N=2) years following discovery. Of the 37 goshawk nests found during or prior to 1997, 78% were in deciduous trees, principally aspen (Table 1). Nesting goshawks also successfully used other deciduous tree species and conifers (including conifer plantations) in Wisconsin. The mean height and dbh of nest trees (N=37) were 25 m (82 ft). and 41 cm (16.1 in) respectively (Rosenfield *et al*. 1998).

In Minnesota, Martell and Dick (1996) reported on nest attempts at 14 sites for the years 1994-96. Some nests were used more than one year. Trembling aspen, (N=10) was the most common species used followed by white pine (*Pinus strobus*) (N=2), basswood (*Tilia americana*) (N=1) and burr oak (*Quercus macrocarpa*) (N=1) (Table 1). It should be noted that these nest trees were not independent because some were likely to have been repeat uses of the same breeding area in consecutive years (Dick pers. obs.). Trembling aspen dbh (N=7) was 35.7 cm (14.1 in.) (Martell and Dick 1996). Historical records from the MOU and the MNDNR Nongame Database include nests in aspen, birch (*Betula spp.)*, red pine (*Pinus resinosa*), and jack pine (*Pinus banksiana*).

Table 1. List of tree species used for nesting by goshawks in the Western Great Lakes Region and Ontario

State/Province	Common name	Scientific name
Illinois		
	White Oak	*Quercus alba*
	one record for state-1892	
Michigan		
	Beech	*Fagus spp.*
	Eastern Hemlock	*Tsuga canadensis*
	Jack Pine	*Pinus banksiana*
	Oak	*Quercus spp.*
	Paper Birch	*Betula papyrifera*
	Red Pine	*Pinus resinosa*
	Sugar Maple	*Acer saccharum*
	Trembling Aspen	*Populus tremuloides*
	White Pine	*Pinus strobus*
	Yellow Birch	*Betula alleghaniensis*
Minnesota		
	Basswood	*Tilia americana*
	Birch	
	Burr Oak	*Q. macrocarpa*
	Jack Pine	
	Red Pine	
	Trembling Aspen	
	White Pine	
Wisconsin		
	Basswood	
	Black Ash	*Fraxinus nigra*
	Eastern Hemlock	
	Northern Red Oak	*Q. rubra*
	Paper Birch	
	Red Maple	*A. rubrum*
	Sugar Maple	
	Trembling Aspen	
	White Pine	
	Yellow Birch	
Ontario		
	Aspen	
	Beech	
	Birch	
	Maple	
	Pine	

Sources: Illinois-Lux (1892); Michigan-Bowerman *et al*. (1997), Postupalsky (1993), Ennis *et al*. (1993); Minnesota-Martell and Dick (1996), MOU Database, MNDNR Nongame Database; Wisconsin-Rosenfield *et al*. (1998); Ontario-Peck and James (1983).

In Michigan, Postupalsky (1993) listed the records of goshawk breeding in Upper and Lower Michigan as occurring in aspen, paper birch (*Betula papyrifera*), yellow birch (*Betula alleghaniensis*), sugar maple (*Acer saccharum*), white pine, and eastern hemlock (*Tsuga canadensis*) although numbers were unspecified (Table 1). Postupalsky (1993) reported more goshawk nests in mature trees but many nests were in pole-sized timber. Total numbers of nests and the percentages in each size/age class were not specified. Detection technique also may have been biased toward older trees (Postupalsky 1991). Many of the Michigan nests were reported by timber cruisers who spend a disproportionate amount of time in mature timber (Postupalsky 1991).

Bowerman *et al*. (1997) examined 43 nest sites in 41 breeding areas: 23 on the Manistee NF, eight on the Huron NF, five on the Hiawatha NF, and five on the Ottawa NF. Years since nest use were not reported. Nest tree species records (including some alternative nests) were: 12 jack pine, 12 aspen, 12 red pine, five oak, five maple, and four birch, and one beech (*Fagus spp*.). Bowerman (1998a) reported mean nest tree dbh for deciduous and coniferous trees from 45 breeding areas as 39 cm (15.6 in) and 25 cm (9.0 in) respectively.

Of 37 nest tree records listed for Huron-Manistee NF, aspen made up 38% (N=14), oak 19% (N=7), maple 16% (N=6), pine 13% (N=5), and other hardwoods 14% (N=5) (Ennis *et al*. 1993). However, many of these may also have been recorded by Bowerman *et al*. (1997) as reported above. Baumgartner (1938) reported a nest 7.6 m (25 ft) above the ground in a birch in a dense stand of birch and aspen in Michigan.

For Ontario, a review of nest records indicated nests were situated more commonly in deciduous trees (7 species, 24 nests) than in coniferous trees (4 species, 10 nests) (Peck and James 1983). Nest tree genera included birch (N=10), pine (N=10), aspen (N=7), beech (N=3) and maple (N=3). Nests were positioned in forks of branches at the trunk or in main crotches. Heights of 29 nests ranged from 7.5 to 23 m (24.6 to 75.5 ft) with most (N=15) between 9 and 12 m (29.5 to 39.4 ft) (Peck and James 1983).

Nest Site

As mentioned previously, the area immediately surrounding the nest tree and possibly containing alternative nests has been referred to by some researchers as the nest site or nest area (Steenhof 1987). The forest stand containing the nest tree(s) is considered part of the site although definitions beyond the stand tend to vary by location and study. Reynolds *et al*. (1992) defined a nest area as an area approximately 12 ha (30 ac) in size that is the center of movements and behaviors associated with breeding from courtship through fledging. Nest sites may be reused in consecutive years (Palmer 1988).

The goshawk is considered a habitat generalist at large spatial scales but tends to nest in a relatively narrow range of structural conditions (Squires and Reynolds 1997). Siders and Kennedy (1996) however, reported, considerable overlap of structural conditions with Cooper's hawks which are not considered habitat specialists. Some

researchers have reported that nests are typically on sites with high (60-90%) canopy closure levels (Squires and Reynolds 1997) while others have reported lower canopy closure levels (30-40%) (Hargis *et al*. 1994).

Nest site, or nest area, size definitions for the Region are variable and are sometimes ambiguous. Care should be taken when comparing size and composition of nest sites from different regions of the continent. The most frequent measurements reported were mean stem densities, mean dbh, canopy closure, basal area, slope, aspect and distance to geographic features (such as roads and water). Some studies reported the vegetative characteristics of sample plots or circular plots centered on the nest tree.

In Wisconsin, the mean dbh of stems on 0.04 ha (0.1 ac) plots surrounding nests (N=37) was 29 cm (11.4 in) (Rosenfield *et al*. 1998). In Minnesota, Martell and Dick (1996) reported a mean dbh of 16.8 cm (6.6 in) at eight sites on 0.08 ha (0.2 ac) plots surrounding the nest tree. Sample size was small and not all nests were located by unbiased means. The mean tree density for Rosenfield *et al*. (1998) (N=37) was 423 stems per ha (st/ha) (171 st/ac) and a basal area of 30 m^2/ha (132 ft^2/ac). In Minnesota, Martell and Dick (1996) reported a mean stem density on 0.08 ha (0.2 ac) plots of 1153 st/ha (466 st/ac). Basal areas for nest sites in Michigan (Bowerman 1998a) were 30 m^2/ha (136 ft^2/ac) in deciduous stands and 41 m^2/ha (187 ft^2/ac) in coniferous stands. For other regions of North America, mean stem densities from six studies reported by Squires (1996) ranged from 99 st/ha to 1007 st/ha (40 to 407 st/ac). Siders and Kennedy (1994) reported mean stem densities of 427-1135 st/ha (173-460 st/ac). Again, it should be noted that care should be taken to closely examine methodologies before undertaking comparisons of these data.

Closed stands may reduce predation and, along with north facing slopes, provide relatively cool environments (Squires and Reynolds 1997). While canopy closure surrounding the nest is often cited as an important habitat feature (Squires and Reynolds 1997), the nest tree itself may be dead, offering little canopy closure. Nests have been recorded in dead white pines, including repeat, successful nesting in consecutive years in Minnesota (Martell and Dick 1996), and also in Wisconsin (Doolittle pers. comm.). Porter and Wilcox (1941) reported a successful nest in a dead aspen tree in Michigan.

Canopy closure has been measured at a limited number of sites in the Western Great Lakes Region. In Wisconsin, Rosenfield *et al*. (1998) reported on canopy closure and the relative percentages of deciduous and coniferous canopy. The authors measured the percent over the plot occluded by overstory foliage viewed through an ocular tube at 40 points per 0.04 ha (0.1 ac) plot. The mean total percentage closure was 78.7$\pm$4.4% (N=37). Deciduous canopy was 61.5$\pm$7.5% and coniferous canopy was 17.2$\pm$6.5%.

In Minnesota, Martell and Dick (1996) sampled eight nest sites in 1994 and 1995 by ocular estimation at 16 points on 0.08 ha (0.2 ac) plots surrounding nests. The mean canopy closure was 72.5% with a range of 60-91% closure, but severe storms in 1995

may have lowered the percent of closure (Martell and Dick 1996).

Alternative Nests/Alternative Nest Sites

Goshawks may use the same nest for consecutive years, or they may use different structures (Reynolds and Wight 1978). Some pairs may also use alternative sites, usually within 0.4 km (0.25 mi) (Reynolds and Wight 1978). Fidelity to breeding areas and other productivity parameters are difficult to estimate due to difficulties in locating all alternative nests and nest sites. Woodbridge and Detrich (1994) presented a method for looking at clusters of alternative nests and nest sites as a means of analyzing breeding area occupancy.

In Arizona, Reynolds and Joy (1998) reported that of 104 territories in which eggs were laid, 59 contained alternative nests used during the study: 43 (41%) contained two alternative nests, 12 (12%) contained three alternative nests, and four (4%) contained four alternative nests. The proportion of pairs that moved annually to alternative nests ranged between 52-73% (mean=60.4%) (Reynolds and Joy 1998).

Differences in nest search protocol may confound comparisons of occupancy and productivity data. In Minnesota, checks of goshawk nest areas monitored from 1994 to 1996 indicated nests in two breeding areas were reused in consecutive years (Hines 1997). On two other breeding areas, three different trees were used, in three successive years (Hines 1997). One Minnesota site had four nest structures within 200 m (656 ft) of the active nest, although previous occupancy of these structures was uncertain (Martell and Dick 1996). Gullion (1981a) reported on the reuse of sites at the Cloquet Forestry Research Center from 1956-1975. Erdman reported alternative nests on his study sites were within 1 km (0.62 mi) of the formerly active nest (pers. comm.).

Ennis *et al*. (1993) reported one or two alternative nest sites found in 13 of 20 breeding areas searched. The distances to these alternative nests were divided into four categories with the following occurrences: alternative within 40.2 m (132 ft) (N=1), alternative from 40.2 m (132 ft) to 100.5 m (330 ft) (N=6), alternative from 100.5 m (330 ft) to 303.2 m (995 ft) (N=1) and alternative beyond 303.2 m (995 ft) (N=11). Baumgartner (1938) reported three nests in the vicinity of an active goshawk nest in Michigan.

Nest Structure

Peck and James (1983) reported information for Ontario nests including that they were bulky structures of twigs and branches; some up to 90 cm (35.4 in) in length. Nests examined had shallow cups and were variously lined with fresh sprigs of hemlock, pine, cedar, dried and fresh leaves, grasses, mosses, feathers, clay, and bark chips (Peck and James 1983). Outside diameters of six nests ranged from 43 to 106.5 cm (16.9 to 41.9 in). Inside diameters of two nests were 23 and 53.5 cm (9.0 to 21.0 in).

Stand Type

Stand type is often used as a descriptive term by foresters, biologists, and land managers when categorizing groups of forest plants. Although goshawk nest sites may include one or more forest stands, nest sites have often been classified by the predominant stand type found to contain the nest tree(s). Ambiguity in defining nest sites has contributed to difficulties in comparing forest composition around nest trees. Squires and Reynolds (1997) described stands containing goshawk nest sites in the West as being approximately 10-100 ha (24-250 ac) (citing Reynolds *et al*. 1982, Woodbridge and Detrich 1994). Boyce (1997) listed 135 historical nest sites in USFS Region 9 (Northeast) with 96 of those occurring in "northern hardwood" cover types, 16 in red pine cover types, 10 in oak/pine cover types and 13 in aspen cover types. Apfelbaum and Seelbach (1983) reported on 64 nests from various regions of North America using data collected from Cornell University nest record information cards. Of these, 44% were in mixed woodlands, 34% in deciduous forests, and 22% in coniferous forests (Apfelbaum and Seelbach 1983).

In Minnesota, Eng and Gullion (1962) described a breeding area near Cloquet as heavily stocked, pole-stage jack pine with a few trembling aspen and paper birch scattered among the pines. They noted this site generally resembled a site described by Schnell (1958) in the Sierra Mountains of California. They also noted small openings in the forest within 30.5-61.0 m (100 to 200 ft) from the nest and several feeding perches in the vicinity. Gullion (1981a) reported three nests in the late seventies were in hardwoods in stands dominated by jack, red and Scots pine (*Pinus sylvestris*) while all earlier nests at Cloquet (see Eng and Gullion 1962) had been in jack pine. He also noted that the earlier nests were in a larger stand (311 ha [769 ac]) of conifers; the newer nests were in smaller stands of conifers surrounded by mixed conifer hardwood and young aspen stands. Apfelbaum and Haney (1984) characterized a nest stand at Itasca State Park as being in jack pine/aspen forest. Nests reported in Martell and Dick (1996) were found in aspen/balsam fir (*Abies balsamea*), red pine/aspen, mixed hardwood, and jack pine/aspen stands (Dick pers. obs.).

Rosenfield *et al*. (1996) suggested that goshawks in Wisconsin seem to show considerable latitude in nest site habitat use, both in terms of tree species composition and woodland age. Rosenfield *et al*. (1998) also reported four nests in pine plantations. The proximity of some nests to pine plantations has been noted by researchers in Wisconsin (Rosenfield *et al*. 1996, 1998), Michigan (Bowerman 1998a), Minnesota (Dick pers. obs.) and also in Ontario (Peck and James 1983). This phenomenon should

be investigated further.

Postupalsky (1993) reported that the most frequently used nest stand types he has observed in Michigan were northern hardwood forest, aspen, or white pine stands although numbers were unspecified. Ennis *et al*. (1993) listed nests on the Huron/Manistee National Forests as occurring in the following forest types: red pine 35% (N=14), aspen 28% (N=11), oak 12% (N=5), northern/mixed hardwoods 10% (N=4) and other 15% (N=6).

Ennis *et al*. (1993) looked at goshawk nest distributions in relation to Land Type Associations (LTAs) used on those forests and found a preliminary association with two of the eight types but suggested that the survey location techniques may have been biased. More sites, located through more surveys on other land types, may be needed (Ennis *et al*. 1993). Ennis *et al*. (1993) also classified historical sites as to the diversity of vegetation types occurring on the 16.2 ha (40 ac) areas surrounding each of 39 nest sites.

Bowerman reported 30% of nests (N=43) in even aged forests, and 30% of the nest trees were codominant in the stand (pers. comm.). Bowerman's (1998a) examination of 45 nests revealed most nests (62%) were located in early to mid-successional stage deciduous or mixed stands, with the remainder in red pine plantations (38%). He concluded that old growth forests may not be a requirement for nest selection in the Upper Great Lakes (Bowerman 1998a).

Peck and James (1983) described nest stands in Ontario as deciduous, mixed and coniferous woods of various sizes. Peck and James (1983) also stated that large, dense stands were favored by goshawks for nesting, and older coniferous reforestation plots were occasionally used. Sample sizes, nest location methods, and measurement techniques used are uncertain.

Landscape Features

The goshawk in North America has often been described as a species that prefers nesting in large unfragmented forests and away from disturbances such as human traffic or timber harvest activities. However, the degree to which this species is associated with mature forests is unclear (Kennedy pers. comm.). Younk and Bechard (1994) have observed nesting in aspen stands less than three ha (7.5 ac) in size at high elevations in Nevada. In order to better understand nest sites in the Western Great Lakes Region, researchers have measured a number of features of the areas surrounding known nests. Siders and Kennedy (1996) reported that several forest stand variables for goshawk sites and Cooper's hawk sites could not be differentiated in the West.

Kimmel (1993) reported on a four year study in Pennsylvania that showed goshawks exhibited a preference for nest sites on more gentle slopes and further from non-forested edges and medium to heavy duty roads. Bosakowski and Speiser (1994)

suggested that the goshawk in the New York-New Jersey area may be an area-sensitive species: nesting more often in larger forest tracts than what would be expected in a random distribution. They evaluated macrohabitat variables using discriminant variable analysis and found elevation and distance from paved roads to be the two most important discriminant variables. Proximity to water also has been listed as a component of goshawk nest areas (Johnsgard 1990).

In the Western Great Lakes Region, there is little descriptive information on landscape features of nest sites. Ennis *et al*. (1993) measured the distance from historical nests to different types of roads. Martell and Dick (1996) measured distances to maintained roads at nine active nests in 1994-95 in Minnesota. One nest was directly over the right of way, one nest was 62 m (203 ft) away and one was 280 m (918 ft) from a maintained road. The other six were at least one km (0.62 mi) from a road (range=1000-4000 m approx.) (3280-13123 ft).

Foraging Area/Home Range Size

Habitat use and preference of foraging goshawks is poorly understood for North American populations (Squires and Reynolds 1997). Most knowledge of forest-dwelling raptors is restricted to nest sites since activities away from the nest site are difficult to observe (Kennedy *et al*. 1994). Many of the activities most important to survival and recruitment may occur away from the nest site (Kennedy *et al*. 1994). Reynolds *et al*. (1992) described the difficulty in identifying goshawk foraging habitat because of the size of the home range and the dearth of information on preferred habitats. It is also important to consider the prey abundance and availability factors that influence range size and habitat use. To identify the *cause* of foraging-area size variation is preferable to simply describing the pattern of the behavior (Keane and Morrison 1994).

No published telemetry data on goshawk home range during the breeding season is available for the Region. Erdman (1993) reported males ranging over 1000 ha (2470 ac) and females over 650 ha (1606 ac) in Wisconsin but sample size and method were not reported. The distances traveled while foraging and the type of hunting habitats preferred during the breeding, dispersal, and winter seasons are critical components in the development of an effective goshawk management plan. No known home range data had been collected in Michigan prior to 1998. Bowerman *et al*. (1998b) reported placing transmitters on seven females and one male. Nine goshawks were being monitored with telemetry equipment in March 1999 (Bowerman pers. comm.).

Eng and Gullion (1962) reported limited data on foraging area in Minnesota. This information was some of the first foraging area data collected for goshawks in North America. By examining the remains of marked grouse found at goshawk nest sites, they determined that nine banded male grouse were brought to the nest from approximately 1097 to 2514 m (3600 to 8250 ft) (mean=1664 m, 5460 ft) from their drumming sites (Eng and Gullion 1962). They also discuss a “circle of suppression” of lower grouse densities within an approximate 0.8 km (0.48 mi) radius of the feeding

area and a subsequent increase in grouse densities when a female goshawk was removed from the nest site (Gullion 1981a). Davis (1979) followed a radio tagged female and one offspring from the early to late fledgling periods and reported the female's use of the habitat increased from 550 ha (1360 ac) surrounding the nest to 4200 ha (10374 ac).

Breeding Area Occupancy

Erdman *et al*. (1998) reported breeding area use of over 20 years and evaluated mean area occupancy longevities for more than 60 nest areas. They reported mean breeding area longevity of 3.9 years, with a range from one to 28 years (Erdman *et al*. 1998). In their study, one breeding area located in the Nicolet NF in 1968 was still active in 1993. Searches of these areas were not systematic and the entire study area was not covered in the search (Erdman *et al*, 1998). Fidelity to breeding areas is hard to determine due to difficulties in locating all alternative nest sites. Nonrandom, nonsystematic or incomplete searches may bias results when determining breeding area occupancy.

Winter Habitat

The goshawk is considered a winter resident throughout its breeding range but with a portion of the population regularly wintering outside this area (Squires and Reynolds 1997). Little is known about the habitat use and distances associated with the dispersal of young from the natal site or the movement of goshawks away from their breeding season habitat.

Very little is known about the movements or habitat requirements of Western Great Lakes Region goshawks in winter. The degree to which goshawks in the Region remain resident on their breeding areas is unknown. Gathering information on goshawks away from the nest is difficult because more time must be spent to locate the birds. Doolittle (1997) followed three goshawks using 18 gram radio transmitters on back-pack harnesses during winter. Migration distances, winter home range size and winter habitat use need additional investigation in the Region.

Life History

Breeding Biology

Many studies have investigated various aspects of goshawk demography across North America but few have been conducted in the Region. Little is known about annual and lifetime reproductive success (Squires and Reynolds 1997). Reynolds and Joy (1998) provided information from a study with a large sample size and commented on the difficulties of accurately estimating goshawk demographics. They studied dispersal, breeding area occupancy, and demography on 107 breeding areas on the Kaibab Plateau, Arizona from 1991-1996. In their study, they found that the "minimum number of nesting pairs needed in a goshawk monitoring program to accurately estimate means and standard errors of annual number of fledglings produced per nest and proportion of active nests that were successful was 35-40 pairs. However, minimum number of territories needed to estimate the annual proportion of pairs laying eggs, a critical variable in estimating fecundity, was 80-90."

It is difficult to compare reproductive success across studies because of different methods and terminology. It would be useful to determine if specific localities, habitat types, or breeding areas serve as sources of recruitment or as population sinks. Ideally, a validated model based on adequate estimates of parameters of goshawk population dynamics would be the ultimate goal of demographic research in the Western Great Lakes Region. Erdman *et al*. (1998) have been working with a population model for a number of years. Others may be developed in the future, but a reliable regional model will require data from regional, systematic studies conducted over the long term. No estimates exist for survival or mortality, dispersal movements are unknown, populations have not been adequately defined, and problems exist with current productivity estimates. Much work remains to be done to develop a working model in the Region. Braun *et al*. (1996) warned that goshawk population models that attempt to predict increases or declines based on reproductive activity or survivorship alone have little validity. This is because population trends are based on the cumulative effects of survival, reproduction, and dispersal (Kennedy pers. comm.).

Definitions

An effort to standardize terminology and methodology for evaluation of breeding activity and productivity in the Western Great Lakes Region would facilitate compilation of data. Definitions and terminology for breeding season activity and productivity should follow Steenhof (1987).

Mating/Courtship

Mating behavior probably varies little across regions, and timing is probably similar to areas with similar climates. Squires and Reynolds (1997), Johnsgard (1990) or Palmer (1988) discuss courtship rituals and mating. No work has been done investigating mating or courtship in the Region, but detailed information is available in publications on this topic concerning the goshawk's congener, the Cooper’s hawk (see Rosenfield and Bielefeldt 1993).

Age of Reproduction

Goshawks typically do not breed until they are in adult plumage (≥2 yrs). Female goshawks, however, will occasionally breed in juvenile plumage. Such situations may be related to high prey availability. For example, Younk and Bechard (1994) reported five of 14 breeding females observed in 1991 in Nevada were in first year plumage. They hypothesized that an increase of preferred prey populations may have accounted for reproduction by one year old females (Younk and Bechard 1994). McGowan (1975) reported five of 13 breeding female goshawks were yearlings in a year of good food supply, while none of 34 breeding females were yearlings during three years with poor food supply. Observations of nesting females in juvenile plumage have been reported from the Region (Gullion 1981b, Boal pers. comm., Erdman pers. comm. Dick pers. obs.). The female observed by Gullion successfully fledged three young in 1978 (Gullion 1981b).

Reynolds and Joy (1998) reported that high breeding-area occupancy rates and relatively short nearest-neighbor distances signaled that the population in their study was saturated. Since territories were already occupied, young hawks had to wait for years before a territory became available (Reynolds and Joy 1998). Males were on average one year older than females when first found breeding (Reynolds and Joy 1998).

Reproductive Measures/Productivity

Johnsgard (1990) summarized that little regional variation in clutch size exists in North America (although clutch size may increase slightly with latitude), but that there are greater annual differences in nesting and fledging success. Average productivity in North America ranges from 1.4 to 3.9 young per successful nest according to Leslie (1996) and few long term datasets are available to assess annual variation.

The most commonly used statistic quantifying raptor reproduction is the number of young fledged per active nest (Newton 1979). Steenhof (1987) suggested using the term *breeding* instead of *active* if eggs were laid. A pair is considered *successful* if at least one young reaches fledging age (Steenhof 1987). It has become acceptable to consider young observed at 80% of fledging age as surviving to fledge (Steenhof 1987). Fledging age for goshawks is 39 days (McGowan 1975), so acceptable age for nest success determination would be 31 days (Steenhof 1987). Kennedy (1997) defined productivity as the mean number of bandable young produced per occupied breeding area.

Standard terminology and techniques and reliable estimates of variability are important for comparisons among datasets collected by different investigators (Steenhof 1987). Thus, comparisons of productivity estimates from different studies should be tempered by an awareness of the different methods used (Boal pers. comm.).

In Wisconsin, Rosenfield *et al*. (1996) reported that 11 of 13 (85%) goshawk nests fledged at least one young statewide in 1996. The mean number fledged was 1.7

young per successful nest and the median number was 2.0 (Rosenfield *et al*. 1996). Of the two failed nests, both failed during incubation for unknown reasons. They also noted that, from 1977-1982, 21 successful nests in 10 Wisconsin counties contained a mean of 2.1 and median of 2.0 young of bandable age per successful nest. They surmised these figures were also comparable to figures reported for goshawks by Braun *et al*. (1996) (Rosenfield *et al*. 1996).

Rosenfield *et al*. (1996) reported that their nest success data may be skewed by the high proportion of nests found in the later stages of breeding, and may require a correction according to Mayfield (1961). The Mayfield model corrects productivity estimates that may have been skewed by the discovery of conspicuous successful nests found late in the nesting season (Steenhof 1987). Of the five nests they found during the incubation stage, 60% successfully fledged young (Rosenfield *et al*. 1996). However, since statewide mortality estimates for goshawks were unavailable in Wisconsin, the significance of the productivity measures remain uncertain (Rosenfield *et al*. 1996).

In a summary of known Wisconsin nests for 1996, Matteson (1996) summarized some of the findings of Erdman and reported results of searches of historical sites on the Nicolet NF and other sites in northeastern Wisconsin. Of these, 16 nests were active (eggs laid), eight were successful (young fledged) and the mean number of young produced per successful nest was 2.25 (Erdman 1997). The mean number of young (N=18) per known active nest (N=15) was 1.13 (Matteson 1996, Erdman 1997).

Postupalsky recorded nest observations in Michigan at 10-20 nests per year since the early seventies (pers. comm.). Christiansen *et al*. (1998) reported one of seven active nests produced a fledgling in 1996, and all of six territories were successful in 1997 in Upper Michigan. Bowerman reported three year reproduction was 0.72 fledged young per occupied nest from 1996-98 (pers. comm.). Peck and James (1983) reported on 26 Ontario nests that had a mean clutch size of 2.7 eggs.

In Minnesota, Martell and Dick (1996) reported mean of 2.4 young per successful nest (N=5) in 1995, and Hines (1997) reported 2.2 young per successful nest (N=5) in 1997. The small sample sizes and possible bias due to nest detection methods limit the usefulness of the data for comparison.

Survival

Little data exists for goshawk mortality on a national scale (Kennedy 1997). Temporal trends in adult survival have not adequately been evaluated (Kennedy 1997). Further, no estimates of annual juvenile mortality or long-term nestling mortality are available for North America and temporal trends in these parameters are unknown (Kennedy 1997). Braun *et al*. (1996) reported a large portion of the annual mortality occurs during non-breeding seasons and is not easily detected. Due to the lack of sufficient survival information, rates of population change (λ) are not available for any North American

goshawk population (Kennedy 1997). Reynolds and Joy (1998) reported annual survival rates of males (0.688, SE=0.062) and females (0.866, SE=0.051), but found λ could not be estimated in their study because they were unable to determine the survival rates of the juvenile age class.

Mortality information is nonexistent for any Western Great Lakes state or for the Region as a whole. Erdman *et al*. (1998), reported a 40% annual adult nesting female turnover since 1987 which they attribute to mortality, due in large part to fisher predation. The methods used in this determination were uncertain.

One source of information on causes of goshawk injury, disease, and mortality in the Region is the admissions database of the Raptor Center at the University of Minnesota. These data may be biased toward birds in situations where they are more likely to be discovered; particularly collisions with windows, vehicles and structures. For the years 1974-1996, a total of 115 goshawks were admitted (an unknown number of these may have been falconry birds). The leading causes of injury or death were collisions (31%), miscellaneous trauma (18%), and injury by projectile (15%). Collisions included those with windows (N=28), powerlines (N=5) and vehicles (N=3). Of the 95 cases where age was listed, 55 (58%) were listed as immature or hatch-year birds. Of birds from known locations, 84 were found in Minnesota. October (N=39) and November (N=24) were the months of the year with the most admissions. The Raptor Center may publish further analysis concerning this information (Martell pers. comm.). However, owing to bias in detection frequency of certain types of injury and disease, that such descriptions can not be taken as true representations of injury and mortality sources.

Breeding Area Fidelity/Pair Fidelity

Goshawks may mate for life (Palmer 1988), but this has never been demonstrated. Reynolds and Joy (1998) reported territory fidelity of males (91.7%) exceeded that of females (78.6%). They also reported two males and five females changed territories during the study and none of the seven retained their mates in these moves (Reynolds and Joy 1998). Reynolds and Joy (1998) verified one case of divorce during their six year study in Arizona (both the male and female were confirmed alive in subsequent years). Annual turnover rates of breeding goshawks in this Arizona study were 42% for males and 25% for females with an overall rate of 32% (Reynolds and Joy 1998).

While individual goshawk breeding areas have been observed as active over a period of up to 28 years in the Midwest (Erdman *et al*. 1998), fidelity information is limited. Divorce was observed in Wisconsin when a radioed female moved to another territory while the male raised a brood with a new mate (Doolittle pers. comm.). While some nests have been shown to be active from year to year in Minnesota, no banding has been used to measure pair or site fidelity. No information on this topic was available from Ontario or Michigan.

Density

Estimating nest density "require(s) intensive, systematic searches of large areas for nests of goshawks and searches should be repeated over years to detect pairs that do not breed every year" (Reynolds and Joy 1998). Density estimates from North American populations range from less than one to 11 pairs per 100 km^2 (39 mi^2) (Leslie 1996). Kennedy (1997), in a review of density estimates reported by other researchers, reported densities range from 2.6 to 11 occupied nests per 100 km^2 (39 mi^2). Densities were reported for three study areas in Arizona, California, and the Yukon as being in the range of 10-11 occupied nests per 100 km^2 (39 mi^2) (Kennedy 1997).

Mean nearest-neighbor distances between occupied nests range from 3.0-5.6 km (1.83-3.42 mi) for some western studies (Kennedy 1997). Reynolds and Joy (1998) recently reported regularly spaced territories. Mean nearest-neighbor distances between occupied nests were 3.88 km (2.33 mi N=100) in this Arizona study. Using these data, they estimated the breeding population of the study area at 146 territories with about 73% of the breeding population being located during the study (Reynolds and Joy 1998). Kennedy (1997) reported two limitations in working with this type of estimate. The estimate is based on the unlikely assumption that all nests in the area have been located and comparison between studies is complicated by the use of different survey techniques among studies.

Information on the historical abundance of the goshawk in the Western Great Lakes Region is nonexistent (Rosenfield *et al*. 1991). An estimate by Erdman of approximately 300 nests in Wisconsin (one pair/9216 ha [22772 ac]) was reported in Rosenfield *et al*. (1991), but the reasoning behind this approximation was not explained.

In Wisconsin, Rosenfield *et al*. (1996) searched three randomly selected sites in 1996. Composite goshawk nesting density was one pair per 3807 ha (9407 ac). They found one active nest on each of three sites (range = one pair per 3110-4430 ha [7685-10947 ac]) (Rosenfield *et al*. 1996). Due to the limited number of quadrats, these data should be cited cautiously.

Doolittle (1997) reported on a preliminary study on nearest-neighbor distances in northern Wisconsin although the sample size is small and the specific methods of this study are unknown. Erdman *et al*. (1998) reported the mean distance between nest clusters defining the centers of adjacent active territories as 8.8 km (5.4 mi) with a minimum of 1.6 km (1 mi). The methods of this determination were uncertain.

In Minnesota, MNDNR conducted a limited nest search to estimate breeding densities, but found no nests (Hines 1997). The size of areas searched was unspecified. No density estimates were available for Michigan or Ontario.

Distinct Populations/Metapopulations

The degree of isolation between goshawk populations in the Region is unknown, and questions of population viability of the species at a forest, state or regional level are affected by this uncertainty. Rosenfield *et al*. (1996) suggested that Wisconsin goshawk populations are not closed. Nesting records exist for counties along borders shared by Michigan and Wisconsin and also Wisconsin and Minnesota. Nesting records exist for all counties on the Minnesota-Canadian border with the exception of Kittson County, Minnesota (see Minnesota current range). Given current available information, there is no reason to assume the populations in Michigan, Wisconsin, Minnesota and Ontario are closed. A more complete analysis of band return information from Hawk Ridge and other stations in the Region may be useful in determining the degree of isolation between local populations.

Dispersal

Information on dispersal is important for investigating issues of population isolation and demography. Reproduction is less important than other factors governing population dynamics (Newton pers. comm. in Braun *et al*. 1996) and the far more important aspects of mortality and dispersal occur mainly outside the nesting period (Braun *et al*. 1996). More dispersal information is needed for North American populations.

Natal dispersal was defined in Ward and Kennedy (1994) as the first time a juvenile spent more than a week at least 2 km (1.25 mi) away from the nest. Breeding dispersal was defined as subsequent movements of adults between breeding territories or groups (Greenwood and Harvey 1982). Reynolds and Joy (1998) reported both breeding dispersal and natal dispersal distances. During breeding dispersal "both sexes moved to territories either adjacent to their original territory or two territories distant" (Reynolds and Joy 1998). Mean distance for females was 5.2 km (3.12 mi, SD=2.66) and mean distance for males was 2.8 km (1.68 mi, SD=1.06) (Reynolds and Joy 1998). Natal dispersal distances in this study were greater for females (mean=21.5 km, 12.9 mi, SD=9.18) than males (mean=15.9 km, 9.54 mi, SD=6.48) (Reynolds and Joy 1998). This study reported one goshawk banded as a fledgling was recovered 306 km (184 mi) from the natal site.

In a European study, Kenward *et al*. (1993) concluded that natal dispersal in the European subspecies was enabled by completion of feather growth and was accelerated by food shortage, but probably resulted from behavior modification if food was abundant. Perhaps it was maturation of hunting behavior that ultimately drew all hawks from the nest area (Kenward *et al*. 1993). Ward and Kennedy (1996) reported that food supplementation affected young goshawk survival not by limiting starvation, but by causing a behavior modification of increasing the time spent in the nest stand by the adult female, allowing more constant protection from predators.

Davis (1979) radio tracked a female and one offspring from late June through September, 1975 near Cloquet, Minnesota. The fledgling and adult met only for food exchanges, and the fledgling was not observed more than ½ mile from the nest until

dispersing on 26 August (Davis 1979). No other information on dispersal is known for the Region. A telemetry study of juvenile dispersal in the Region would be useful for collecting information on this topic.

Migration/Irruptions

The degree to which goshawks are migratory is largely unknown for both the continent and the Region. Squires and Reynolds (1997) reported that migration and irruptions are poorly understood for North America, and the degree to which populations are migratory may relate to food availability on breeding areas during winter. Johnsgard (1990) described a goshawk irruption as a periodic southward movement out of the breeding range in response to a prey population crash-usually in winter. In contrast, a migration may be a more consistent cyclic movement with less dependance on prey population levels. Data from migration stations, observations of year-round occupancy, and radio telemetry all indicate that the goshawk is a partial migrant (see Squires and Reynolds [1997] for references on these topics). Migration usually commences after young disperse from natal areas (Palmer 1988). Young typically migrate first, though young and adults overlap temporally in migration (Palmer 1988). Johnsgard (1990) cited dependance on cyclic prey populations as a cause for irruptive southward movements of goshawk populations found in the boreal forests east of the Rocky Mountains.

The usefulness of migration data to estimate goshawk population trends has been discussed by Titus and Fuller (1990), Kennedy (1997) and others. Titus and Fuller (1990) found no consistent trend in counts of migrating goshawks at six eastern North American hawk lookouts from 1972 to 1987. They caution that migration data for an irruptive species such as the goshawk may require alternative analytical techniques than those used for non-irruptive species (Titus and Fuller 1990).

Much of the information on migration is derived from band returns. At Hawk Ridge in Duluth, Minnesota, more goshawks are banded than anywhere else in North America (Palmer 1988). Station data from Hawk Ridge indicated that 1972 and 1982 were years of heavy migration through Duluth (Evans 1983). Annual totals for the peak migration in the early 1990's (>2200) were not as great as those of 1982 (5819) or 1972 (>5100) (yearly totals are available on the MOU web page-http://biosci.cbs.umn.edu/~mou).

More than 1400 goshawks were banded at Hawk Ridge during 1972-1975 (Evans 1981). During irruption years, goshawks have been recovered in Missouri, Texas, Arkansas and Louisiana (Evans 1981, Evans and Sindelar 1974). Goshawks banded at Hawk Ridge also have been recovered in northeastern British Columbia, Alberta, Saskatchewan and Ontario (Evans 1981). An adult female banded at Hawk Ridge in 1972 was recaptured in 1982 at Cedar Grove, Wisconsin, north of Milwaukee (Evans 1983). Evans reported that it died one month later near Waukegan, Illinois at an age of at least 12 years, 6 months.

Irruptions probably represent the result of a partial-migrant species response to food availability; in low food years there are more migrants than in high years (Kennedy pers.

comm.). Irruptions to southern extremes in the species' range occur on roughly a 10-year cycle (Palmer 1988), often concurrently with great-horned owls (*Bubo virginianus*) and often last two years (Palmer 1988). Irruptions may consist mostly of adult-plumaged hawks, because in prey-poor years, few young may have been produced (Palmer 1988).

For the states in the southern portion of the Region (Ohio, Indiana, Missouri, Illinois and Iowa), nearly all of the data regarding goshawks pertain to wintering and migration. With the exception of one record from Illinois (Lux 1892), no nesting records were found for any of these states.

Population Cycles

Goshawks prey on some species that exhibit cyclic population fluctuations. Goshawk populations increase in response to increases in populations of their prey (Mueller and Berger 1967). It remains to be demonstrated whether the breeding population fluctuates cyclically or whether the adults shift between the breeding cohort and the non-breeding cohort as the prey cyclically fluctuates.

While migrations past banding sites, such as Hawk Ridge in Duluth, Minnesota, show variations in numbers, cyclic variation in population size in the regional breeding populations has yet to be fully demonstrated. Variations from high to low points in the population level are presumed to be greater in the northern latitudes than in the southern (Doyle and Smith 1994).

Any references to population trends in the Region are based on limited geographic areas and should not be considered representative. Erdman *et al*. (1998) reported cyclical trends in goshawk population size during more than two decades of monitoring, and related changes in goshawk breeding numbers to cyclical changes in prey abundance in their Wisconsin study area.

Postupalsky (1997) reported a greater fluctuation in nest area occupancy between high points and low points in the cycle in the Upper Peninsula of Michigan than in the Lower Peninsula. He also reported that, in his observations, mean brood size changes little throughout the cycle, but the proportion of occupied nests raising at least one young was the principal component of reproductive success that changed between high points and low points of the cycles (Postupalsky 1997). He noted that while these amplitude fluctuations are less than those reported in some Canadian studies, these fluctuations must be taken into consideration when undertaking any attempts to estimate demographic parameters.

Predation

Goshawks are susceptible to predation by a suite of species (Ward and Kennedy 1996, Squires and Reynolds 1997). Predation on goshawks by avian and mammalian predators has also been reported in the Region. Erdman *et al*. (1998) suggested that fisher predation is a major cause of nest failure and adult female mortality in northeastern Wisconsin with annual turnover rates of nesting females exceeding 40%. The sample sizes and methods for this determination are uncertain. Erdman *et al*. (1998) recovered the carcasses of four breeding females at nest sites while monitoring 17 sites in 1990 and reported an incident of a great horned owl feeding a female goshawk to its young (Erdman 1993). Metal baffles have been used on nest tree trunks since 1988 to reduce predation, (Erdman *et al*. 1988), but the effect on reproductive success has not been reported.

Postupalsky (1993) also reported goshawk predation by great horned owls in Michigan, but the degree to which this occurs was unspecified. Bowerman *et al*. (1998b) reported three of eleven banded young subsequently died due to predation. Five breeding areas failed during the nestling period due to mammalian predation (Bowerman *et al*. 1998b). Duncan and Kirk (1995) reported that great horned owl, raccoon (*Procyon lotor*) and fisher are the most significant predators of goshawks in Canada. Preliminary information from Minnesota in 1998 indicates some predation of nesting goshawks by other raptors (Boal pers. comm.). Fisher predation at goshawk nests has also been reported in Minnesota, but specifics were not given (Harrington pers. comm.).

Disease

Although a wide variety of diseases and parasites have been found in raptors, with effects from slight to fatal, their significance to wild populations is far from clear (Newton 1979). Ward and Kennedy (1996) reported a nestling death due to severe fibrinous pericarditis caused by *Chlamydia tsittaci* and *E. coli*. Beebe (1989) listed other diseases from a clinical standpoint. Mortality from diseases may often be exacerbated by food shortage (Newton 1979).

Redig *et al*. (1980) reported 49% of goshawks tested at Hawk Ridge during migration carried *Aspergillus fumigatus*. They speculated that stress caused by agonistic interactions, reduced prey abundance, and migration during invasion years may increase susceptibility to *Aspergillus fumigatus* (Redig *et al*. 1980).

Trichomoniasis, also known as frounce, has been reported in goshawks in Great Britain (Cooper and Petty 1988) and in Arizona (Boal pers. comm.). The disease can be transmitted to raptors that ingest infected prey, usually columbids (e.g. pigeons, doves) which are hosts to the causative agent, *Trichonomonas gallinae*, a parasitic protozoan. In the Region, Erdman (pers. comm.) reported trichomoniasis among goshawks in areas where pigeons are abundant.

One case of “stagnant irreversible shock” was reported in the literature (Blomme 1981) as the cause of death for a goshawk following a struggle with a raven (*Corvus corax*).

Siblicide/Cannibalism

Siblicide and cannibalism appear to be infrequent and associated with food deprivation (Schnell 1958, Boal pers. comm.). Dick observed the cannibalism of a goshawk nestling at a Minnesota nest, but the cause of death was unknown (Dick pers. obs.).

Prey Use

As is true for most raptors, prey abundance and availability are potential limiting factors for goshawk populations (Squires and Reynolds 1997). Prey abundance is the number of prey items inhabiting a given area whereas prey availability is the number of these prey items which may actually be harvestable by the goshawk given potential constraints to hunting in a given cover type. For example, hare abundance may be high but their availability to goshawks may be low if they are inhabiting dense aspen regeneration sites where the goshawks cannot fly. Raptor populations are often limited by prey populations and the choice of foraging habitat by goshawks is predicated, at least in part, by prey abundance and accessibility (Reynolds *et al*. 1992). More important than prey abundance may be prey availability. Squires and Reynolds (1997) reported that prey availability strongly affects occupancy and productivity. The goshawk is frequently classified as a prey generalist or as an opportunist, capturing a wide diversity of prey, depending on region, season, and availability (Squires and Reynolds 1997).

Reynolds *et al*. (1996) reported that a typical suite of prey species may contain eight to 15 species and recommended combining management strategies that maintain these species as well as foraging areas and nest sites. Casson (1996) has applied this technique in the Biological Evaluation of the Third River timber salvage sale on the Chippewa NF.

The suite of prey species available to goshawks on the southern edge of their range may be greater than that found at higher latitudes, resulting in dampened extremes in the population cycle (Postupalsky 1997). Many records of goshawk prey items are available for the Region, but an intensive, quantitative diet study is lacking. Any future diet study must be planned carefully in order to address bias in prey remains analysis (Boal pers. comm.). Most diet information in the Region was collected in conjunction with nest observations or habitat measurements. While most prey observations have been made during the nesting season, prey use, availability and abundance during the winter should also be examined.

The following prey species reports were compiled from anecdotal information and a variety of sources and should be interpreted cautiously.

Apfelbaum and Haney (1984) concluded that a goshawk pair nesting in Cook County, Minnesota, during 1979-1981 relied almost exclusively upon ruffed grouse (*Bonasa umbellus*), based on prey remains and two castings. Apfelbaum and Haney (1984) also suggested that goshawks, alerted by courtship behaviors, may have selectively taken male grouse: five of seven grouse were believed to be males. Eng and Gullion (1962)

reported that 63% of grouse killed by goshawks in their Minnesota study were males in the vicinity of drumming logs and goshawk predation was the most important mortality factor for adult ruffed grouse. However, Eng and Gullion (1962) detailed some of the difficulties in accurately quantifying the extent of grouse predation by goshawks. Problems included: 1) goshawks may leave signs from a single kill in multiple locations, overrepresenting individual kills: 2) meat is typically eaten from the bones, so bones are underrepresented in castings; 3) uncertainty in identifying the responsible predator.

Table 2 lists the goshawk prey species reported in Minnesota by Eng and Gullion (1962) and Gullion (1981a). Gullion (1981b) stated that goshawks are a major cause of grouse mortality and that goshawk predation influenced the color phase composition of the Cloquet grouse population.

Davis (1979) listed common crow (*Corvus brachyrhynchos*) and ruffed grouse as the most common food items. Also noted were unspecified flicker, blue jay (*Cyanocitta cristata*), downy woodpecker (*Dendrocopos pubescens*) red squirrel (*Tamiasciurus hudsonicus*), gray squirrel (*Sciurus carolinensis*) least chipmunk (*Eutamius minimus*) (Davis 1979). Davis (1979) discussed the limitations of the data. Some of these items were probably also reported by Gullion (1981a) because they were simultaneously working in the vicinity the Cloquet Forestry Center. Prey items collected in Minnesota by others included: ruffed grouse, red squirrel, blue jay, northern flicker, and common crow (Dick pers. obs.). Casson discovered remains of northern flying squirrel (*Glaucomys sabrinus*) beneath a plucking perch (Martell and Dick 1996). Backstrom (1991) reported an adult goshawk killing and eating a sharp-tailed grouse (*Tympanuchus phasianellus*).

Erdman *et al*. (1998) listed the two main prey species in northeastern Wisconsin as ruffed grouse and snowshoe hare (*Lepus americanus*) but do not specify the results of the diet analysis that resulted in their conclusions. Under one Wisconsin nest in Juneau County, Haug (1981), reported finding feathers of green-backed heron (*Butorides striatus*), blue jay, common crow, ruffed grouse and blue-winged teal (*Anas discors*), and the remains of a mustelid. Gratson (1982) reported goshawk predation on radio-tagged sharp-tailed grouse in Douglas County, Wisconsin in 1977 and Burnett County, Wisconsin in 1979. A note in Errington (1933) from Wight reported a goshawk taking quail (*Colinus virginanus*) in winter southwest of Ann Arbor. In Michigan, Postupalsky (1997) listed prey items he has observed as snowshoe hare, tree squirrels, chipmunks, ruffed grouse, blue jay, flicker, robin (*Turdus migratorius*), and crow. A grouse kill by a goshawk was noted by Hamilton (1979) in Lake County, Michigan in November. Duncan and Kirk (1995) cited a personal communication from Naylor stating that the spruce grouse (*Dendragapus canadensis*) is a major prey species in Ontario.

Table 2. List of Goshawk prey species reported in Minnesota by Eng and Gullion (1962) and Gullion (1981a).

	Common name	Scientific name
Eng and Gullion (1962)		
	Snowshoe hare	*Lepus americanus*
	Cottontail rabbit	*Sylvilagus floridanus*
	Red squirrel	*Tamiasciurus hudsonicus*
	Flying squirrel	*Glaucomys* spp.
	Blue-winged teal	*Anas discors*
	Common nighthawk	*Chordeiles minor*
	Pileated woodpecker	*Dryocopus pileatus*
	Northern flicker	*Colaptes auratus*
	Blue jay	*Cyanocitta cristata*
	Eastern meadowlark	*Sturnella magna*
	American robin	*Turdus migratorius*
	Common crow	*Corvus brachyrhynchos*
	unidentified duck	
Gullion (1981a) (additional species to those listed above)		
	Porcupine	*Erethizon dorsatum* (in 1963 and 1978)
	American woodcock	*Scolopax minor*
	Franklin's ground squirrel	*Spermophilus franklinii*
	Pine grosbeak	*Pinicola enucleator*
	Black-backed, three-toed woodpecker	*Picoides spp.*
	Rock dove	*Columba livia*
	Green-backed heron	*Butorides striatus*
	Domestic chicken	*Gallus gallus*

GEOGRAPHIC DISTRIBUTION

Various subspecies of the species *Accipiter gentilis* are found in both New and Old Worlds, from near treeline in the Northern Hemisphere south to California, Mexico, Pennsylvania, Morocco, Sardinia, Iran, Tibet, and Japan (Brown and Amadon 1968). Goshawks winter throughout the breeding range in North America, south to southern California, northern Mexico, and Texas (Johnsgard 1990). In North America, *A. g. atricapillus* (Wilson) has the largest distribution, including the Western Great Lakes Region (Figure 1). *A. g. laingi* (also *langi*; Taverner) is found on the Queen Charlotte Islands off British Columbia, north to the Gulf of Alaska (Palmer 1988) and *A. g. apache* (van Rossem) occurs in southern Arizona and New Mexico, south in western Mexico to Jalisco (Brown and Amadon 1968, Johnsgard 1990).

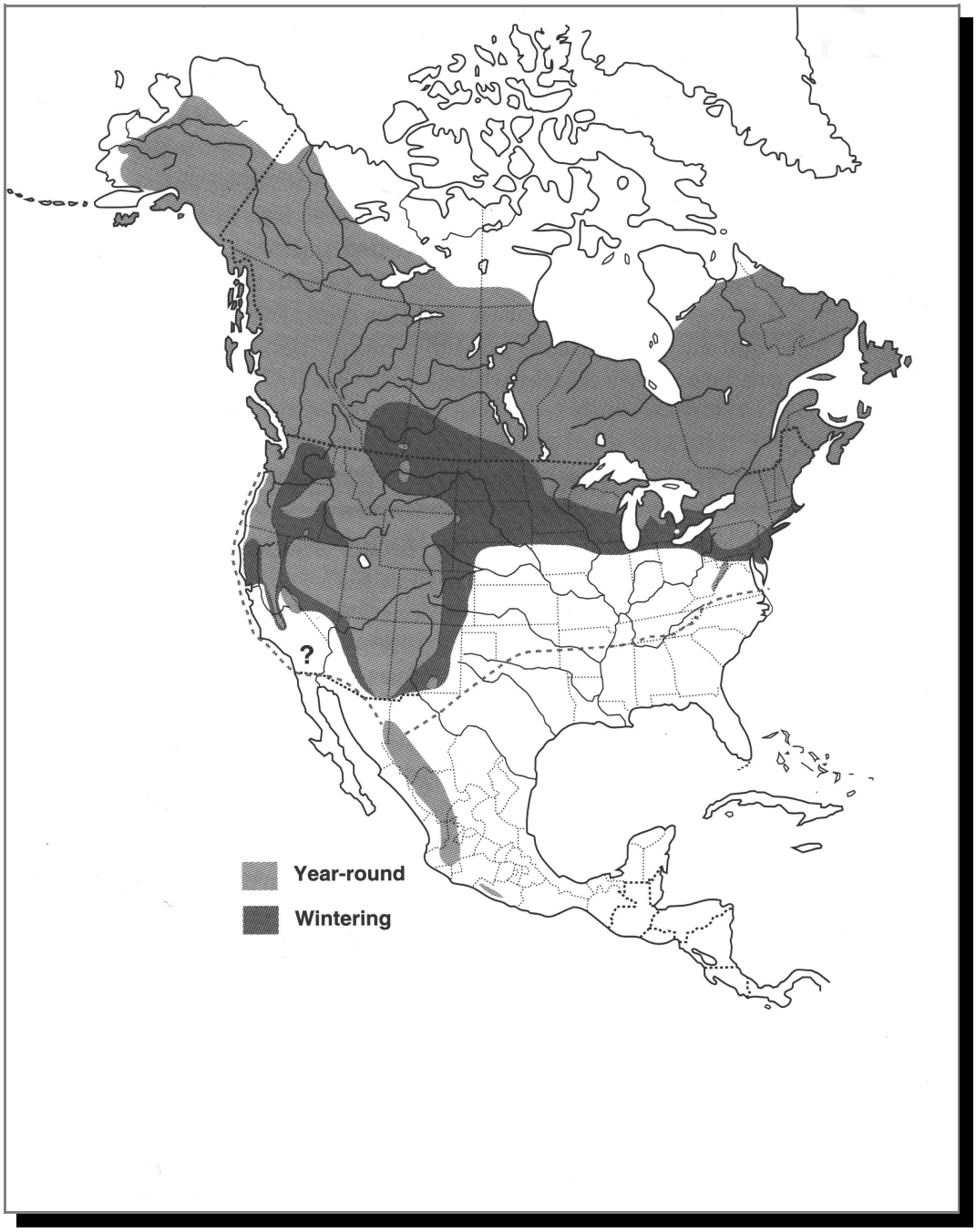

Figure 1. Approximate North American distribution of the Northern Goshawk as reported by Squires and Reynolds (1997). The species winters irregularly south to the dotted line.

CURRENT AND HISTORICAL RANGE

Kennedy (1997) suggested that range contraction and rate of population decline may be seen as potential evidence of a species in trouble. Factors that limit the southern extent of goshawk range are unknown (Kennedy 1997). Evidence that eastern goshawk populations may be expanding or reoccupying their former range should be interpreted cautiously given that the reported expansion or reoccupancy could merely reflect an increased search effort (Kennedy 1997). The idea of a population increase may be more of an assumption than a documented expansion in the eastern United States (Boyce pers. comm.).

Many historical maps of regional breeding distribution are based on assumptions of what is appropriate habitat for goshawks. A clearer delineation of range is necessary for population trend analysis. In the Region, as in the eastern United States, it has been suggested that the species' range may be expanding southward into previously occupied areas as timber stands age (Postupalsky 1997). Figure 2 shows an approximate breeding distribution in the Region (based on Rosenfield *et al*. 1991). No studies have delineated, through searches or surveys, the southern limits of goshawk distribution on a regional scale.

Historical Range In The Region

Bent (1937) described the breeding range of the “eastern goshawk” as extending south to Michigan (Isle Royale, Mackanic Island). Lux (1892) reported a nesting pair of goshawks in Illinois, but Boss (1997) reported no known nests on national forest lands in the southern tier states in the Region. We solicited the American Museum in New York, the Bell Museum in St. Paul, the Field Museum in Chicago, the University of Michigan in Ann Arbor, and the Richter Museum in Green Bay for data on historical goshawk nesting information. Little information was available.

Information on the historical abundance of goshawks in the Midwest is lacking or nonexistent (Rosenfield *et al*. 1991). Erdman has collected egg and nest data from several major museums and is in the process of summarizing the data (Erdman pers. comm.).

Breeding Bird Atlas (BBA), Breeding Bird Surveys (BBS) and CBC are often used to identify ranges for many species. Andersen (1997) suggested information from the BBS and CBC are not useful for monitoring goshawks. Intensive breeding season surveys, nest plot surveys, and/or road and foot broadcast counts are the only known methods available for monitoring this species (Andersen 1997). The Wisconsin Department of Natural Resources has attempted to analyze the reports of northern goshawk sightings submitted through the Wisconsin Checklist Project from 1983-1993 (Rolley 1995).

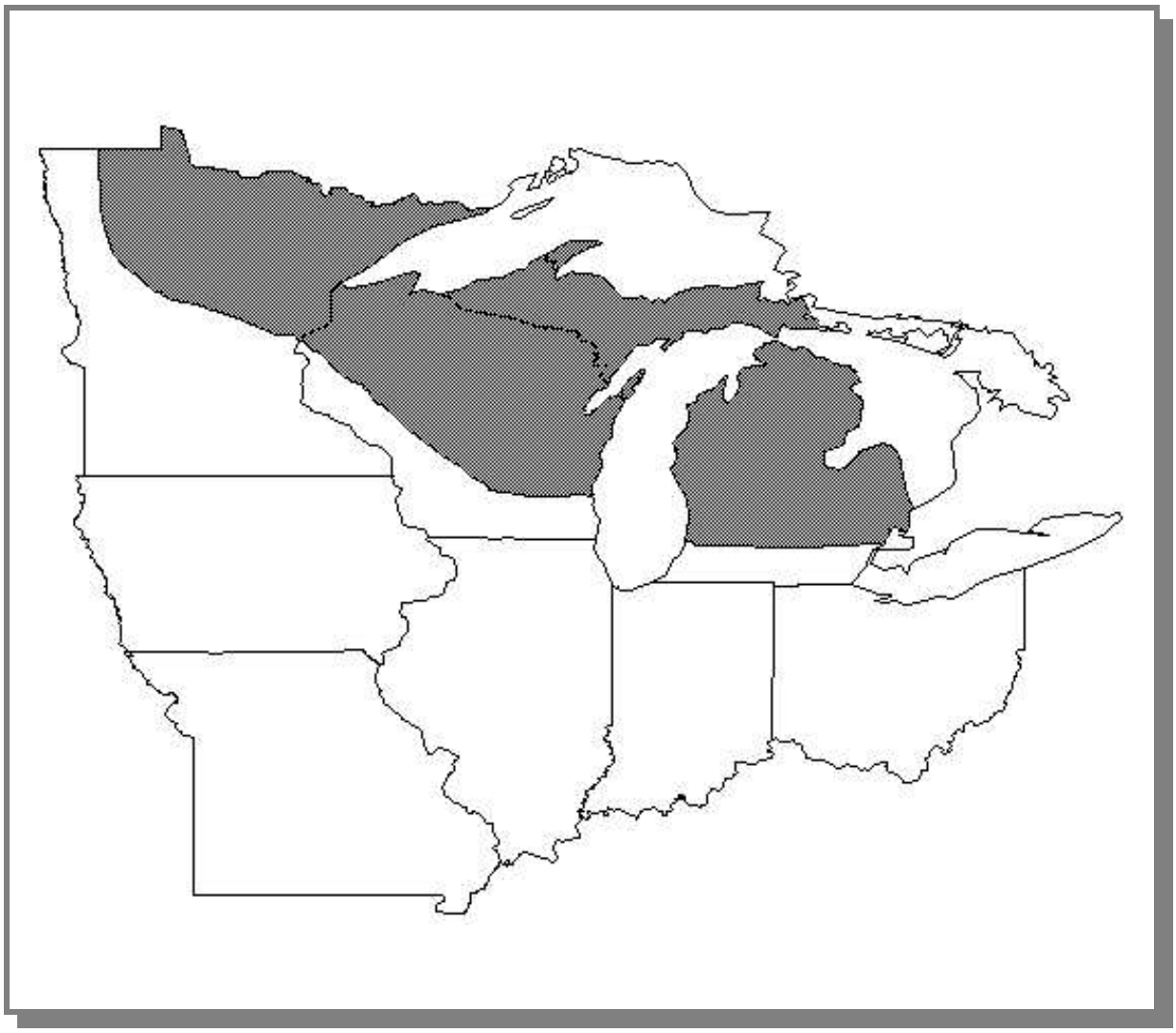

Figure 2. Approximate breeding distribution of *A. gentilis* in the United States portion of the Western Great Lakes Region. Shaded areas indicate occupied range (adapted from Rosenfield *et al*. [1991] and other information).

Illinois Historical Range

Most of the information from Illinois is summarized in the migration section of this paper. One goshawk nest was reported in Tazewell County (Lux 1892). Three eggs were collected, and dimensions seemed to be consistent with goshawk eggs. This is the only nest record found for Illinois.

Michigan Historical Range

Postupalsky (pers. comm.) has documented nesting in 11 Upper Peninsula and 21 northern Lower Peninsula counties since 1971. Postupalsky (1991) reported breeding records for seven counties by the 1940s, and the species was considered a local summer resident from Roscommon Co. northward (citing Van Tyne 1938, Wood 1951). The Huron/Manistee National Forests have information on historical goshawk nests from each of their districts (Ennis *et al*. 1993).

Michigan Current Range

Postupalsky (1993, 1997) suggested that the range of goshawks in Michigan is expanding southward, but cautioned that more scientific analysis was needed. Ennis *et al*. (1993) reported a similar southward range expansion, but did not provide evidence. Postupalsky (1991) reported nest records for several northern counties in the 1960s and a goshawk breeding range that extended south to Mason and Clare counties. In 1991, the breeding range extended south to Mason, Midland, and Arenac counties (Postupalsky 1991). Postupalsky (1991) also reported nests found in Ottawa, Tuscola and Kalamazoo counties. Kalamazoo County is in the southwest portion of the Lower Peninsula. The breeding range in Michigan is as poorly delineated as it is in Wisconsin and Minnesota.

Minnesota Historical Range

Historical records for Minnesota were gathered from a number of sources: the MOU, the MNDNR Natural Heritage Database, MNDNR nongame files, the Bell Museum of Natural History, and Janssen (1987). As is the case with other birds of prey, there were few attempts to document the extent of goshawk breeding in Minnesota during the early 1900s. Nutter (1892) recorded a goshawk nest in Hennepin County, far south of any other nest site in Minnesota. The record gives no distinguishing characteristics for the raptor other than “the beautifully and uniquely marked breast of the goshawk” (Nutter 1892). Roberts (1936) wrote that Nutter (1892) was an exceptional record, but found no reason to doubt the identity of the bird. Roberts (1936) described the goshawk as rarely a summer resident and listed four nest records for the state: three from Roseau County and the one from Hennepin County reported in Nutter (1892). The three from Roseau county were all from 1926 or 1927. Johnson (1982) reported a total of 61 records for the state. More recently, Johnsgard (1990) listed the goshawk as breeding in northern Minnesota.

Eng and Gullion (1962) reported that the first recorded nest on the Cloquet Forestry Center, Carlton County, was in 1934 as reported by Morse (1934, 1942). The MNDNR

Natural Heritage Database lists fourteen nests from 1926 to 1980 with some more recent additional records. These records are from the following counties: Beltrami (N=1), Carlton (N=1), Clearwater (N=1), Cook (N=1), Hennepin (N=1), Hubbard (N=1), Lake (N=1), Lake of the Woods (N=1), Pine (N=1), Roseau (N=3), and St. Louis (N=2). Overlap between databases means multiple listing of some sites. For example, the Hennepin County nest record is the same 1892 record listed in Nutter (1892) and Roberts (1936). The nests from Roseau County are also listed in Roberts (1936), the MNDNR Natural Heritage Database, and in the Bell Museum database. Itasca State Park has a history of nesting dating to the fifties as reported by Parmelee (1982).

Minnesota Current Range

Janssen (1987) provided an approximate Minnesota breeding range extending from the Canadian border south to central Pine County, central Crow Wing County, west to central Roseau and central Mahnomen Counties. Nesting was verified since 1970 in Mahnomen, Crow Wing, Pine, Itasca, Koochiching, Lake of the Woods, Lake, Beltrami, Clearwater, and Hubbard Counties. Squires and Reynolds (1997) incorrectly reported the historical range in Minnesota as expanding northward and westward from southeastern Minnesota into east central, central, northeast and north central regions of the state citing Janssen (1987) as the source.

As the amount of searching and reporting has increased in the past three years, more goshawk nest sites have been discovered. Martell and Dick (1996) verified nesting for the following counties (number of separate breeding areas in parentheses): Beltrami (N=6), Cass (N=3), Itasca (N=2), Clearwater (N=1), and Morrison (N=1). All of these were active (eggs were laid and incubation observed) in at least one of the years from 1994 to 1996. One additional active site was reported in Cass County in 1997 (Ohlander pers. comm.). Further monitoring efforts by MNDNR and USFS personnel in 1997 verified nesting at additional sites in Itasca County (N=2). One site was reported in 1997 as having been active in 1996 in Carlton County. Hines (MNDNR) and Gallagher (USFS) have been coordinating efforts to monitor these sites. Minnesota falconers have also verified nesting goshawks at sites in the following counties: Aitkin (N=1), Becker (N=1), Itasca (N=1), Lake (N=1), St Louis (N=1), and Pine (N=1) (Weaver pers. comm.). Nesting activity was verified on 13 breeding areas in 1998 (Boal pers. comm.). These areas have not been included in the above totals. At least 15 females were believed to be on eggs in Minnesota in early May 1999 with more sites to be checked(Andersen pers.comm.).

Wisconsin Historical Range

Gromme (1935) summarized briefly the history of known nesting in Wisconsin. Gromme cited Kumlien and Hollister's (1903) classification of the goshawk as a rare summer resident. Gromme (1935) also cited Schoenebeck (1902) as reporting four nests in Oconto County. He also reported observations of a nest in Rusk County in 1933. An active nest in Juneau County in 1980 was reported by Haug (1981). Robbins (1991) listed published nesting records for Bayfield, Vilas, Oconto, and Ashland Counties for the years between 1943 and 1958. Historical range in Wisconsin is

reported by Robbins (1991) as encompassing the northern one-third of the state. Rosenfield *et al*. (1996) interpreted the goshawk range reported by Robbins (1991) as presumed but not thoroughly documented.

Wisconsin Current Range

Reports of goshawk nests south of the published, estimated range boundary have been recorded in recent years. In 1997, an active nest was reported in the city of Sheboygan (Sheboygan County) (Erdman pers. comm.). The range in Wisconsin, as in Minnesota, probably varies temporally and is poorly delineated. Counties with active nests in 1996 included: Ashland (N=1), Bayfield (N=1), Door (N=3), Douglas (N=1), Florence (N=1), Forest (N=4), Juneau (N=2), Oconto (N=3), Oneida (N=1), Price (N=1), Sawyer (N=2), Shawano (N=2), Taylor (N=3), and Vilas (N=3) (Matteson 1996). Rosenfield *et al*. (1996) reported that while the majority of nests examined by Wisconsin researchers in 1996 were within the range depicted by Robbins (1991), two nests, found in Juneau County, were south of the traditional range boundary. One of these nests was reported from the Necedah National Wildlife Refuge and one near the town of New Lisbon (Erdman pers. comm.). Rosenfield *et al*. (1998) reported goshawk nests in 1996-97 were widely distributed in the northern two-thirds of Wisconsin.

Ontario Historical Range

Peck and James (1983) suggested goshawks in Ontario breed at low density in the forests throughout most of the province, but not in the extreme south due to the lack of large unfragmented tracts of forest. Likewise, Weir (1988) reported that in Ontario, the goshawk "breeds throughout the forested areas in sparse numbers, frequenting either deciduous, mixed, or coniferous woodland." There is no record of the northern goshawk ever nesting in the extreme south of the province (Weir 1988).

Ontario Current Range

Little census or survey data were available from Ontario. Duncan and Kirk (1995) reported the goshawk to be "found in all forest types and is probably most common in the north." Godfrey (1986) described the breeding range in Ontario as "south to Thunder Bay district, Mount Albert, north of Toronto, and Mallory Town landing on St. Lawrence River." Fyfe (1976) reported, "For Ontario and southern Quebec and prairie provinces the trend was stable, with relative abundance medium to high." More Ontario breeding range information may become available upon the completion of a pending thesis (Naylor pers. comm.).

POTENTIAL THREATS

While no evidence exists to support claims that goshawk populations are declining on a regional scale, there is also no evidence that they are not declining. A number of factors have been cited as being potentially detrimental to current and future goshawk viability in the Region. The lack of data clouds most determinations of impact on the population in the Region. Discussions of these issues and how to evaluate their impact may be found in:

- Proceedings of the Northern Goshawk Management Workshop (Anonymous 1993),
- Proceedings of a Workshop on the Status of the Northern Goshawk in the Midwest (USFWS 1997a), and
- Minutes of the St. Paul Research and Monitoring Protocol Meeting (MCFWRU 1998).

To organize a list of these potential threats, the following five headings are taken from Guidance for Conducting Status Assessments for Taxa which are Under Consideration for Listing as Threatened or Endangered Species (USFWS 1996a).

A. The present or threatened destruction, modification, or curtailment of goshawk habitat or range.

Concerns over destruction or modification of goshawk nesting, fledging, foraging and wintering habitat in the Region have been raised at the aforementioned meetings and in other discussions.

The following issues have been cited by researchers, agency personnel and others as potential threats to habitat caused by various silvicultural treatments (Anonymous 1993, USFWS 1997a, MCFWRU 1998):

- Forest fragmentation.
- The creation of more even-aged stands.
- The potential increase in acreage of younger age classes.
- The loss of tree species diversity.

B. Overutilization for commercial, recreational, scientific, or educational purposes.

Disturbance, particularly during the breeding season, by recreational and other forest users has been cited as a potential threat at meetings (MCFWRU 1998). The take of goshawks for falconry has been cited as a potential threat by Erdman *et al*. (1998) and others at various meetings (Anonymous 1993, USFWS 1997a, MCFWRU 1998).

C. Disease or predation.

Increased susceptibility of nesting goshawks, eggs and young to fisher (*Martes pennanti*) and raptor predation has been suggested as a potential threat by Erdman *et al*. (1998) and others (Anonymous 1993, USFWS 1997a, MCFWRU 1998). The potential for increased susceptibility may be due in part to results of habitat modification listed under section A (above) and also to increased predator densities.

Although diseases have been documented in Midwestern goshawks (Redig *et al*. 1980), disease has not been suggested frequently as a primary potential threat to goshawk populations in the Region.

D. Inadequacy of existing regulatory mechanisms.
The lack of nest site protection and inadequate buffer zones have been cited as potential threats to habitat at the meetings cited above. Reporting procedures for falconry take have been perceived by some as inadequate, and possibly conceal illegal harvest (Erdman pers. comm.).

E. Other natural or manmade factors affecting the species continued existence.
Increased urbanization and pesticide poisoning were discussed briefly at the St. Paul Research and Monitoring Meeting (MCFWRU 1998). It has been suggested that the goshawk is somewhat less susceptible to pesticide accumulation than its congener, the Cooper's Hawk, due to the goshawk's consumption of prey species that tend to accumulate less pesticide in their tissues (Rosenfield *et al*. 1991). Neither of these factors have been cited at meetings as frequently as some of the other potential threats.

MANAGEMENT ACTIONS NEEDED TO PRECLUDE THE NEED FOR LISTING AS ENDANGERED OR THREATENED

Until sufficient data are collected to assess the population status and trend, the need for management actions cannot be determined. Since the impacts of specific threats have not been identified and effectiveness of management actions have not been evaluated in the Region, it would be premature to recommend any management action other than the collection of additional data.

CURRENT PROTECTIVE STATUS UNDER STATE/PROVINCIAL/ FEDERAL LAWS AND REGULATIONS

Strategies that allow for future viability of goshawk populations along with other land management objectives depend on improved monitoring and research within the Region. Management of the goshawk in the Region also depends, in part, on decisions made in other parts of North America. The following sections summarize the recent history of Federal decisions regarding the status of the northern goshawk followed by state, provincial, USFWS, and USFS classifications in the Region.

United States Federal Status

Since 1991, petitions have been filed to have populations of the northern goshawk listed as endangered under the Endangered Species Act of 1973 (USFWS 1992a). On 19 July 1991, the Maricopa Audubon Society and ten co-sponsoring groups filed a petition to list the northern goshawk as endangered in Utah, New Mexico, Colorado and Arizona (USFWS 1992a). On 30 December 1991, the USFWS finding stated, "the petition did not present sufficient information that the action may be warranted primarily because the petition has not presented substantial information indicating that the northern goshawk (*Accipiter gentilis*) in Utah, Colorado, New Mexico and Arizona constitutes a listable entity" (USFWS 1992a). The finding stated that the petitioned region covered portions of the range of *A. g. atricapillus* and *A. g. apache*, and that the goshawks in this region have not been shown to exhibit genetic or morphological distinctness or geographic isolation (USFWS 1992a).

However, in the same finding the USFWS also noted that "the petition did present substantial information indicating that goshawk population declines and loss and/or modification of its habitat may be occurring." As a result, the USFWS elevated the species *Accipiter gentilis* to a Category 2 (C2) status. "[C2] taxa are those for which information now in the possession of the Service indicates that proposing to list it as endangered or threatened is possibly appropriate, but for which conclusive data on biological vulnerability and threat are not currently available" (USFWS 1992b). Initiation of a planned goshawk status review was announced in the same issue of the USFWS (1992c)

On 26 September 1991, the Maricopa Audubon Society and ten co-sponsoring groups filed a letter to amend their petition of 19 July 1991, to list the goshawk as endangered throughout the "forested west" (the forested United States west of the 100th meridian). Because of the changes to the specified region, the USFWS considered this as a separate petition. The USFWS ruled against the petition on 25 June 1992, because the potential for gene flow and interchange with transcontinental Canadian populations and between the Canadian populations and those in the eastern United States prevented the goshawks west of the 100th meridian from constituting a listable distinct population (USFWS 1992b).

The petitioners sued to have this finding set aside as arbitrary and capricious under the Administrative Procedures Act. The finding was vacated and a new 90-day determination was ordered. The second 90-day finding on 6 June 1996, also was against the petition based on the grounds that the area listed included the home ranges of more than one subspecies and, as such, was not a listable distinct population (USFWS 1996b). The petitioners again filed suit on the same grounds and the judge again ruled that the finding was arbitrary and capricious and returned the finding to the USFWS with instructions not to incorporate the subspecies argument in its next finding. On 22 August 1997, the petition was amended to include goshawks west of the 100th meridian and in the 48 contiguous United States. As announced on 29 September 1997, "The Service had determined that a substantial 90-day finding on the petition to list the northern goshawks in the contiguous United States west of the 100th meridian is appropriate at this time in order to be responsive to the court ordered remand and to allow for a thorough status review of this species" (USFWS 1997b). The finding of the review was that a listing was not warranted (USFWS 1998). In February 1999, a coalition of nonprofit organizations led by the Center for Biological Diversity filed suit in Oregon against the finding calling it erroneous, arbitrary, and capricious (Lewis, pers.comm.).

In May 1994, a petition was presented by the Southwest Center for Biological Diversity and several co-sponsors to list the Queen Charlotte subspecies. The USFWS announced in August of that year that the action may be warranted (USFWS 1994). Comment period on this action was extended through February 1995. Following this period, the USFWS ruled that the petition was not warranted. The review of the finding (USFWS 1995a) stated that while the USFWS was concerned about the long-term survival of the Queen Charlotte goshawk, there was "opportunity to manage for the long-term viability of the goshawk through the implementation of [interim management guidelines] and [a revised forest management plan for the Tongass National Forest]." The Queen Charlotte goshawk was retained as a C2 species (USFWS 1995a). However, the C2 classification of candidate species has since been eliminated (USFWS 1996c).

The status of goshawks in Canada has repercussions in the United States. The 1997 90 day finding requiring a status assessment on goshawks west of the 100th meridian used the United States-Canadian border as the delimiting boundary (USFWS 1997b). According to the finding, this definition of a boundary for a discrete population is based on the limit of "international governmental boundaries within which differences in control of exploitation, management of habitat, conservation status, or regulatory mechanisms exist that are significant in light of Sec 4(a) (1)(D) of the Act" (USFWS 1997b). This ruling brings to light the importance of sharing information across international boundaries. The goshawk is also protected under the Migratory Bird Treaty and Act.

Forest Service Eastern Region Status

The northern goshawk is classified as a sensitive species by the USFS Eastern Region (Lewis 1997). The Sensitive classification means extra care is taken but there is no legal requirement to protect (Boss 1997). Boyce (1997) reported that some forests in the North Central Region list the goshawk as sensitive and 37 National Forests nationwide list the goshawk as a Management Indicator Species. In light of the elimination of the C2 classification, the Region will likely reexamine its sensitive status (Boss 1997). The USFS also considers the Nature Conservancy global ranking when considering listing of species (Boss 1997). The goshawk is a forest-sensitive species on the Huron-Manistee, and the Nicolet National Forests.

Nature Conservancy Global Ranking

The Nature Conservancy and the Natural Heritage Network have established a conservation status ranking system to prioritize conservation needs. The global rankings are classified as follows (http:\\www.consci.tnc.org/library/pubs/rptcard/assessing.html):

GX Presumed extinct; not located despite extensive searches.
GH Possibly extinct; of historical occurrence, still some hope of rediscovery.
G1 Critically imperiled; typically five or fewer occurrences or 1,000 or fewer individuals.
G2 Imperiled; typically six to 20 occurrences or 1,000 to 3,000 individuals.
G3 Vulnerable; rare, typically 21 to 100 occurrences or 3,000 to 10,000 individuals.
G4 Apparently secure; uncommon but not rare, some cause for long-term concern, usually more than 100 occurrence and 10,000 individuals.
G5 Secure; common, widespread and abundant.

The northern goshawk is ranked as a G5 species (Refsnider pers. comm.).

Smith (1993) reported state rankings. The state rankings were defined as:

S1 Critically imperiled in the state because of extreme rarity (5 or fewer populations or very few remaining individuals) of because of some factor(s) making it especially vulnerable to extirpation from the state.
S2 Imperiled in the state because of rarity (6 to 20 populations or few remaining individuals) or because of some factor(s) making it very vulnerable to extirpation from the state.
S3 Rare or uncommon in the state (21-100 populations).
S4 Apparently secure in the state with many populations.

At the time, Wisconsin ranked the goshawk as S3, Michigan as S4, and Minnesota ranked the goshawk as SU (assumed to be unknown).

Fish and Wildlife Service Region 3 Status

Based on its C2 classification, the USFWS added the northern goshawk to its list of migratory nongame birds of management concern in 1995 (USFWS 1995b). While this is not a legal designation, it does ensure that the species receives special conservation attention by the Service (Lewis pers. comm.).

Michigan Status

The goshawk is a species of special concern in Michigan and has been listed as such since 1991 (Weise 1997). Although there has been limited discussion about elevating its status to threatened, it is expected the goshawk will remain a species of special concern following the current review (Weise 1997).

Minnesota Status

The goshawk is afforded no special status in Minnesota (Baker pers. comm.). Baker (1997) noted that the lack of data regarding distribution, abundance or population trend make it impossible to classify the species as endangered, threatened or of special concern.

Wisconsin Status

In the recent past, consideration has been given to listing the species as threatened in Wisconsin (Smith pers. comm.). The basis for this consideration was concern over the turnover and productivity rates reported by researchers and a perceived loss of habitat. In 1997, Rosenfield (pers. comm.), made several suggestions regarding this consideration for listing: 1) the broad distribution of the goshawk in Wisconsin is not commensurate with range contraction, 2) goshawks breed successfully in a variety of wooded tracts and also in agricultural landscapes, 3) recently collected data (Rosenfield *et al*. 1996) on average number of bandable-aged young are comparable to data collected from 1977-82 and within normal variation for goshawks in general as reported in Squires and Reynolds (1997). Rosenfield (pers. comm.) believed the data show no sign of an imperiled breeding population of goshawks in Wisconsin at this time.

Canadian Federal Status

In Canada, Duncan and Kirk (1995) recommended that *A. g. atricapillus* be classified as "not at risk," and that *A. g. laingi* be listed as threatened. They also noted a paucity of data on goshawks in Canada.

Ontario Status

In Ontario, the goshawk is protected under the provincial Game and Fish Act (Armstrong pers. comm.). It has not been granted any special status, and is not considered threatened or rare (Armstrong 1997).

Regulation of Falconry in U. S.

The impact of falconry on regional goshawk populations has been discussed at several meetings in the past five years. The lack of information available to land managers and biologists often leads to speculation as to how many eyasses are taken on an annual basis. There are no data currently available to evaluate the number of goshawks that can be harvested from this population sustainably.

Falconry is allowed in forty-eight of the fifty states. Of the states where falconry is legal, only Michigan does not allow resident licensed falconers to take native raptors from the wild (Ohlander pers. comm.). Wisconsin is one of four states in the contiguous United States that allow a non-resident to take goshawks (Smith 1993). Minnesota rules allow take of up to two goshawks per year by general and master falconry resident permittees only (Baker 1997). Table 3 summarizes, by state, permit requirements and activities allowed in the Region.

Bulander (1993) reported 645 falconry permits in the Region in 1993 and 781 in 1997 (Bulander 1997). For most states in the Region, a joint Federal/State Falconry permit is issued (with the exception of Missouri). Annual Federal reports of goshawks held by falconers were discontinued in 1989, at which time 63 goshawks were reported as in possession in the Region (Bulander 1993). For the years 1990-1992, 21,10, and 21 goshawks were acquired by falconers who were residents of states within the Region. The number of goshawks taken within the Region was unspecified.

Minnesota falconers have been a source of nest site information, field assistance, and financial support for research projects. Some falconers from the Region take eyasses in Wyoming (Ohlander pers. comm.). Most Minnesota falconers in the MFA, who wish to take a goshawk from the wild, trap migrating passage goshawks (Ohlander pers. comm.). Table 4 summarizes data on falconry take by falconers residing in the Region.

Ohlander (pers. comm.) reported the take of eyasses during spring/summer 1997 by Region falconers as: Wisconsin resident falconers (7-all taken in Wisconsin), Ohio (1-taken in Maine), Michigan (2-taken in Wisconsin), Indiana (1-taken in Wisconsin), Illinois (2-taken in Wisconsin), Missouri (1-taken in Wyoming), Iowa (2-taken in Wyoming). The total eyass take in the Region was 16. Twelve of these were taken in from Wisconsin; 7 by Wisconsin resident falconers and 5 by non-resident falconers. The 1997 total for Minnesota was three passage goshawks taken (Ohlander pers. comm.).

Ohlander (pers. comm.) also reported that new Wisconsin Falconry regulations were implemented as of December 1997. These regulations require:

- Falconers must provide exact nest site locations, in writing, to the forest supervisor prior to take on USFS lands (applies only to NF lands-reports to the state are also required for other lands, but not prior to take).
- The USFS may also designate areas that are off-limits to take by falconers.
- In addition: at least one eyass must be left in each nest.
- A falconry license is required prior to take, for both residents and non-residents

- Non-residents cannot take any raptor which is listed as threatened or endangered in Wisconsin.
- Residents must report the number of young goshawks remaining in the nest from which they remove birds for falconry.
- Residents must also report the exact location of any raptor nest from which birds are taken.
- Seasons are specified for take of birds.

Regulation of Falconry in Canada

The take of goshawks from the wild for falconry in Ontario was not allowed until recently, although falconers were allowed to possess birds legally obtained from other jurisdictions (Armstrong pers. comm.). Ontario has now passed falconry legislation which will allow the take of native Ontario raptors, including goshawks, by falconers (Ohlander pers. comm.). This legislation was implemented in June, 1998 (Ohlander pers. comm.). Manitoba also has new falconry laws legalizing the sport and the taking of native raptors by falconers in Manitoba, including goshawks (Ohlander pers. comm.).

Table 3. Summary of State Falconry Regulations-Region 3 (Buhlander 1997).

Regulation	IL	IN	IA	MI	MN	MO	OH	WI
Non-res. take allowed	YES	YES	YES	NO	NO	YES	YES	YES
Annual reports required	NO	YES	YES	NO	YES	NO	YES	NO
Imp/export permit required	NO	NO	YES	YES	YES	NO	NO	NO
Capture permit required	YES	NO	YES	N/A	NO	YES	YES	NO
Permit restrictions	NO	YES	YES	YES	YES	YES	YES	NO

Table 4. Sources and Numbers of Goshawks Taken for Falconry in Service Region 3, 1992-1996 (Ohlander 1997).

States with Resident Falconers	No. of Falconers	Goshawks Taken for Falconry From These States													Annual Average
		MN		WI		IL		IN		Other		Total		Combined	
		E	P	E	P	E	P	E	P	E	P	E	P		
Minnesota	133	3	21	0	0	0	0	0	0	0	0	3	21	24	4.8
Wisconsin	109	0	0	8	10	0	0	0	0	0	0	8	10	18	3.6
Illinois	168	0	0	3	2	0	10	0	0	1	1	4	13	17	3.4
Indiana	70	0	0	1	2	0	0	0	0	9	0	10	2	12	2.4
Missouri	122	0	0	0	0	0	0	0	0	9	1	9	1	10	2
Michigan	73	0	0	3	4	0	0	0	1	2	0	5	5	10	2
Ohio	62	0	0	0	0	0	0	0	0	1	0	1	0	1	<1
Iowa	44	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total	781	3	21	15	18	0	10	0	1	22	2	40	52	92	18.4
Annual Average		<1	4.2	3	3.6	0	2	0	<1	4.4	<1	8	10.4		

E=eyass P=passage Based on data from USFWS and State Regulatory Agencies.

PAST AND CURRENT CONSERVATION ACTIVITIES UNDERTAKEN TO BENEFIT THE SPECIES OR ITS HABITAT

Boss (1997) reported all seven lake state National Forests have monitoring programs and protection measures for active goshawk nests in place and several have published habitat management guidelines.

Habitat

Michigan

Michigan DNR handles management prescriptions on a case by case basis and the USFS checks timber sales for goshawk activity (Weise 1997). Michigan researchers and agency personnel have formed a woodland raptor group, are holding hawk nest identification classes and are using spring turkey hunter announcements to help find nests (Weise 1997). Ennis *et al*. (1993) recommended the following timber sale contract guidelines:

- Delete a 12.1 ha (30 ac) nest area from the sale with the concurrence of the contractor.
- Evaluate the sale area for opportunities to do possible volume adjustments (adjust the amount of timber removed) with the concurrence of the contractor.
- Restrict sale activity for 0.8 km (0.5 mi) around the site from March through August.

The Ottawa NF has set a 121+ha (300+ac) buffer around active nests (Weise 1997).

Minnesota

No nest site protection guidelines are currently being implemented at any level in Minnesota. MNDNR has no nest-site protection guidelines, although internal guidelines do recommend planning for retention of nesting habitat and limiting disturbance for all raptors between March and July (Baker 1997). The Chippewa NF has no management guidelines and handles the management of each nest site on a case by case basis (Williamson pers. comm., Gallagher pers. comm.). Appeal of the Third River salvage timber sale over loss of goshawk habitat resulted in modifications to the sale. The MNDNR, the Chippewa NF, and cooperators have also been compiling data on goshawk nest activity and productivity since 1994. The Superior NF had no known active nests and no standard management guidelines as of 1998, although historical nests on the forest have been reported to various databases in the past (Dick pers. obs.).

Wisconsin

No nest protection guidelines exist for county or private lands in Wisconsin (Erdman *et al*. 1998). The WIDNR Woodland Raptor Management Guidelines call for a protection area of 65 ha (160 ac) around each nest, but these guidelines have not been implemented (Anonymous 1993). The Nicolet NF listed the goshawk as a “sensitive species” in 1986 (Erdman 1993) and has protection guidelines in place. These

guidelines were first developed for woodland raptors in the Eastern Region of the USFS and were outlined by Zimmer (1993) as follows:

- Incorporate nest site into a stand with a minimum size of 8.1 ha (20 ac) to be designated as potential old growth.
- Avoid clear-cutting stands immediately adjacent (within a minimum of 91.4 m, 300 ft) to the designated territory, if practical silvicultural alternatives are available.
- Avoid building new roads or reconstructing existing ones in the designated territory or within 91.4 m (300 ft) of nests. Existing roads will be closed where possible.
- Eliminate or reduce human disturbance between 1 February and 1 August.
- Analyze the effects on raptor territories through the Integrated Resource Management implementation process.

The Nicolet NF also has a 16.2 ha (40 ac) clear-cut limit, and existing roads in goshawk breeding areas are gated off.

Ontario

Ministry of Natural Resources staff and contracted tree markers report all stick nests observed (Armstrong pers. comm.). These nests are monitored and the species identified (Armstrong pers. comm.). A general outline of Ontario guidelines was supplied by Armstrong (1997) as follows (all distance zones are radii measures from the nest):

- Identified nest sites are classified as areas of concern within forest management plans.
- Guidelines for these areas around goshawk nests include a 150 m (487.5 ft) concern designation around the nest tree. These are composed of a 50 m (162.5 ft) reserve and 100 m (325 ft) modified cut zones.
- Within the outer 100 m (325 ft) zone, partial timber harvest is permitted that retains at least a 70% crown closure. In clear-cut logging, there would be a 150 m (487.5 ft) no-cut reserve, in shelterwood or selection cuts, some harvesting would be permitted in the outer 100 m (325 ft).
- No activity is allowed within the area of concern from 1 March to 31 July. Inactive nests are protected with tree length reserves.

Naylor (1994) listed central Ontario guidelines for several species of raptors. James (1984) provided goshawk nesting area guidelines for Ontario. A guide has also been produced to aid field personnel in locating and identifying nests (Armstrong pers. comm.).

Monitoring

It is important not to underestimate the amount of effort required to adequately monitor a goshawk population. Monitoring goshawk populations requires extensive searches over large areas for the alternative nests of the many goshawks that change nest location to avoid mislabeling breeding areas as 'unoccupied' or 'abandoned' (Boyce 1997). Monitoring programs require about five persons per 40 territories, and 10-13 persons per 80 territories (Reynolds and Joy 1998).

Andersen (1997) reported on the development of monitoring strategies at an international workshop, and suggested following a similar outline for the potential development of any regional goshawk monitoring program. Andersen (1997) also examined the current state of goshawk knowledge in the Region in light of this outline. Some issues of importance to the development of a regional goshawk monitoring program were listed by Andersen (1997) as follows:

- The Western Great Lakes Region is at the southern extent of the current breeding range of northern goshawks. This has important implications for population dynamics and, in turn, population monitoring.
- Northern goshawks over much of this region likely forage on prey species whose populations are cyclic (hare and grouse). This has important implications for population dynamics of goshawks.
- Little is known about the ecology of goshawks outside of the breeding season. Factors affecting survival and physical condition outside the Great Lakes Region may have impacts on population dynamics.
- Fall/Winter invasions of goshawks from populations that breed farther north in the boreal forest of Canada and Alaska may influence population dynamics of Great Lakes goshawks.

Monitoring of goshawks in the Region has been limited primarily to checks of known nest sites during the breeding season. As of August 1998, there was no comprehensive plan in place at the regional level. If a useful monitoring plan is to be developed for the Region, objectives need to be clarified, the population in question needs to be defined, and methods need to be standardized.

Although many of the national forests in the Region monitor productivity of known nests to some extent (Boss 1997), no forest, state or province in the Region is currently collecting the data necessary to maintain a reliable, ongoing monitoring program. Without long-term population data, trends in population and their significance are difficult to evaluate.

Research

Ongoing Research

To enhance the usefulness of goshawk data obtained through individual research and monitoring efforts, a regional oversight committee acting to standardize data collection and reporting would be beneficial. Standards should be developed for estimating habitat and demographic parameters so that data from different studies are comparable. Sharing information, especially data summaries, is important and could be done through an oversight committee or through regular goshawk sessions at the annual Midwest Raptor Management Symposium. A team of researchers was formed in the winter of 1998 to investigate goshawk issues in the Western Great Lakes Region. Headed by Kennedy and Andersen, this team plans to investigate research, management, and monitoring objectives for the Region. A comprehensive report on research needs and protocol was completed by this team in 1998, and is available from the MCFWRU.

In addition to the research already discussed, some projects in the Region are underway or have been recently completed, but were unavailable at the time of this writing. Preliminary use of radio-telemetry and Geographic Information Systems (GIS) have been initiated by researchers in Wisconsin (Doolittle 1997, Erdman pers. comm.). Some biologists on the Chippewa NF, in coordination with the Leech Lake Band of Ojibwe, have begun to analyze landscape level habitat surrounding nest sites (Casson pers. comm.).

Bowerman *et al*., Doolittle, Erdman *et al*., Postupalsky, and Rosenfield *et al*. continue to collect and analyze goshawk data in the Western Great Lakes Region. Bowerman planned to submit a manuscript regarding studies on the Upper Peninsula (Bowerman pers. comm.). A graduate student in Ontario is preparing a thesis on goshawk nest site analysis (Naylor pers. comm.). Christiansen, a graduate student at Northern Michigan University, has completed a thesis investigating goshawk ecology in Upper Michigan. Erdman, Bowerman and others formed a working group to deal with goshawk research in Michigan and Wisconsin (Erdman pers. comm.). Boal, the Chippewa NF and cooperators initiated a telemetry study in northern Minnesota in 1998 and issued a progress report in January of 1999. Cooperators and sponsors on this project included Boise Cascade, the Leech Lake Band of Ojibwe, Potlatch, USFWS, MCFWRU, MNDNR, The Raptor Center at the University of Minnesota, the National Council for Air and Stream Improvement (NCASI), the MFA and the National Forest Foundation (NFF). Roberson, a graduate research assistant working with the MCFWRU began goshawk field work in 1999 in northern Minnesota. Efforts should be made by all researchers to keep others informed of findings.

Research Needs

One of the original goals of this report was to prioritize research and monitoring needs required to adequately assess the status of the goshawk population in the Region. The authors of this review have chosen to defer to the expertise of the team of Andersen and Kennedy who are concurrently developing a research and monitoring paper for the Region. A draft of their paper was available in August, 1998. Research agendas for the Region are

discussed in Anonymous (1993), USFWS (1997a), and MCFWRU (1998)

To reiterate an important point, no data exist that support a claim that goshawk populations are declining on a regional basis, although there is also no evidence to support a claim that they are not declining. Much research remains to be done and no valid regional status determination may be made given the current body of knowledge.

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