Review of Supplemental Information Relevant to Habitat Management for the Northern Goshawk in Southwestern United States

for

The Southwestern Region of the USDA Forest Service

by

The Northern Goshawk Scientific Committee,

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SUMMARY: The Northern Goshawk Scientific Committee reviewed nine documents purported to contain new (subsequent to 1992) information on the use of habitat by northern goshawks (*A. gentilis atricapillus*) that was not considered in the 1996 Record of Decision (ROD) to implement the "Management Recommendations for the Northern Goshawk in the Southwestern United States" (MRNG) within the Southwestern Region of the USDA Forest Service. The Scientific Committee found that, while most of these documents contained information on goshawk habitat use in different study areas, none of the information was sufficiently different from information used in the development of the MRNG to warrant amending the MRNG. In fact, information in the nine documents strongly supported both the process used in developing the MRNG and the desired habitat conditions recommended in the MRNG. Furthermore, the Scientific Committee knows of no other articles, published since 1992, that contain new information sufficient for us to amend the MRNG.

BACKGROUND

In 1990, the Regional Forester for the Southwestern Region of the USDA Forest Service established the Northern Goshawk Scientific Committee (the Scientific Committee) to develop management recommendations for the northern goshawk. After two years of study and deliberation, the Scientific Committee published the "Management Recommendations for the Northern Goshawk in the Southwestern United States," (MRNG) (General Technical Report RM-217, 1992, USDA Forest Service). The MRNG describes a set of "desired forest conditions" (DFC) based on (1) habitat needs of the goshawk for reproduction and foraging, (2) the habitats of 14 main prey of the goshawk, and (3) the pattern and structure of three forest types in the southwestern United States (ponderosa pine, mixed-conifer, and spruce-fir) (MRNG p. 21-30). To ensure that the forest habitats of goshawk and their prey were sustained, the Scientific Committee used long-range planning (up to 328 years; MRNG p. 82, 83) and the natural plant species composition, structure, and pattern in each forest type as templates (MRNG p. 20) for assembling goshawk habitat and prey habitats within home ranges and in the matrix between home ranges (MRNG p. 30).

The MRNG specified that goshawk home ranges should contain a balance (on an area basis) of forest age classes (or vegetation structural stages, VSS) so that goshawk and prey habitats were always available within a home range (MRNG p. 2). Thus, the MRNG took into account the dynamics of forest development. Key findings in the MRNG were (1) goshawks need older forests with lifted canopies (open understories) for both nesting and foraging, (2) the majority of their prey species occur in mid-aged to old forests, (3) a minority of important prey species utilize small openings, and (4) total prey abundance is highest where there is an intermixture of forest age classes ranging from young (< 20-years-old) to old (> 200-years-old) forests (MRNG p. 16-19).

In summary, the DFC in goshawk home ranges is dominated by large trees within a mosaic (interspersion) of age classes that provide a broad spectrum of plant and animal species and ecosystem function. This mosaic is similar to the composition, structure, and landscape pattern that existed in southwestern forests before fire suppression and timber harvesting. In other words, the DFC for southwestern forests is a mosaic of forest age (VSS) classes that provide habitats for many species (plants and animals, both above and below ground) in the goshawk food web at three scales of spatial organization. The goshawk home range (broad-scale) consists of 5,000 - 10,000 acres and corresponds to the area used by a nesting pair of goshawks and their offspring from March through September. The forest in a home range consists of trees in groups (mid-scale), irregularly shaped, and with open areas with no more than 200 feet across. A group consists of clumps (fine-scale) of 3-6 closely spaced trees with interlocking crowns. Tree clumps are irregularly arranged within groups and are interspersed among small openings. The DFC included up to three large-diameter snags (standing dead trees) per acre, up to five large-diameter downed logs per acre, up to 15 tons per acre of coarse woody debris, and aspen regeneration -- all advocated for implementation in entire landscapes (goshawk home ranges and the matrix between known home ranges) to provide for expansion of goshawk populations and ecosystem restoration.

In June 1996, the Regional Forester, Southwestern Region, used the MRNG and additional information to issue an Environmental Impact Statement (EIS) and ROD for managing ponderosa pine, mixed-conifer, and spruce-fir forests on all Southwestern National Forests. In a civil lawsuit in the U. S. District Court for the District of Arizona, Center for Biological Diversity, et al. v. Bosworth, et al., No. CIV 00-1711 PHX RCB, plaintiffs claimed that information in nine documents regarding goshawk habitat use had not been considered in the ROD. In July 2001, the Southwestern Region of the Forest Service asked the Scientific Committee to assess these nine documents.

OBJECTIVES AND METHODS

Before convening on 6-8 August 2001, members of Scientific Committee received copies of the nine documents and independently reviewed them with the objective of determining whether or not they contained information on goshawk habitat use. In the independent review, each member identified portions of the documents that they felt contained information, whether new or not, regarding use of habitat by goshawks (area used, preference or avoidance of habitat, prey species). On convening, the Scientific Committee again reviewed each document with a focus on portions previously identified as pertaining to goshawk habitat use. By consensus, it was then determined whether any of the information in the documents was: (1) new (not included in the MRNG or ROD) and if the DFCs in the MRNG would be different had the information been available to us during its development; (2) new, but supportive of the DFCs; or (3) irrelevant to the MRNG or the process used in developing it.

For each document, we initially list in a "summary of pertinent data," the information we believe is pertinent to goshawk habitat use. We then discuss, in a "comparison with the MRNG," each item regarding the type, quantity, and quality of the information, how we believe it is useful for managing goshawk habitat, and how the information is similar to, or different from, information used to develop the MRNG. Last, we present a "conclusion" regarding whether or not the new information warrants up-dating or amending the MRNG.

It should be noted that only two (Hargis et al. 1994; Woodbridge and Detrich 1994) of the nine documents were published in peer-reviewed journals. The other seven consisted of unpublished progress reports to granting agencies (Beier 1994; Mannan and Smith 1993; Snyder 1995), unpublished agency reports (Crocker-Bedford 1994; Titus et al. 1994), an unpublished thesis (Austin 1994), and a published, but not peer-reviewed, abstract (Crocker-Bedford 1995). We reviewed these documents as if they had all been peer-reviewed. However, it is important to note that science is an endeavor of accumulating knowledge through an established process of inquiry, logic, validation, and publication. Peer-review of documents is critical in the scientific process because it helps assure the methods and analyses used were appropriate, sample sizes were sufficient, and the conclusions were logical and supported by the data. Non peer-reviewed documents are typically not cited within the science community because they have not passed the test of peer-review and, therefore, have not become part of the accepted body of knowledge.

THE DOCUMENTS

Austin, K. K. 1993. Habitat use and home range size of breeding northern goshawks in the southern Cascades. Unpublished M.S. Thesis, Oregon State University, Corvallis, OR. 56 pp.

Summary of pertinent data:

1. Austin investigated home range size and habitat use of adult, nesting goshawks with radio-telemetry in the southern Cascade Mountains on the Shasta/Trinity National Forests in northern California. Her study area comprised a diversity of forest types; mixed-conifer, ponderosa pine, lodge-pole pine, red fir, and white fir. The area also included large, dry meadows, brush fields, and barren lava flows, all of which fragmented the forest and created a patchy landscape mosaic. Her study area was further fragmented by past timber harvests with 50% of the area in young forest (pp. 1-18).

2. For 10 goshawks (5 males, 5 females), Austin determined a mean home range size for goshawks of 3,100 ha (7,657 acres) (Table 2, p. 20).

3. When Austin pooled the data from nine radio-tagged goshawks in her study [she did this because her sample of hawks was small (p. 16)], she found that goshawks used habitats within their home ranges non-randomly (p. 24). That is, goshawks avoided seedling/sapling/ grass-forb and open-small saw timber/mature habitat, and selected closed mature/old-growth (>21 in. dbh, and > 40% canopy closure) habitat (p.24). When she analyzed individual goshawks alone, however, Austin found no indication that goshawks used any one of five habitats preferentially (there was no difference in use vs. availability) (p. 24). However, there was a non-statistical trend (p. 16) in the data suggesting that seven of the nine goshawks preferred the closed-mature/old-growth habitat. Her analysis, suggesting that some goshawks selected the open-small sawtimber/mature habitat, was inconclusive because individual trend data did not support the results of the pooled data (p. 33). Some goshawks avoided certain habitat while others did not. Her results suggested that early-successional forests or unforested habitats were unimportant and recommended minimizing this habitat within goshawk home ranges (p. 39). Nevertheless, consistent with the MRNG, Austin recommended a similar proportion of the home range (8%) in sapling/seedling/grass-forb habitat, and she modeled other recommendations after the MRNG (p. 44).

Comparison with MRNG:

1. Austin's study contained similar forest types to those occurring in the Southwestern Region (Arizona, New Mexico), but her findings are more applicable to mixed-conifer forests than ponderosa pine forests because her study area was dominated by a mix of conifer species.

2. Austin reported a mean home range size that was 22 % larger than the largest North American home range reported in the MRNG (MRNG p. 9, Table 3). Because her study area was fragmented with barren lava flows and much young forest, these large home ranges were not surprising, as the goshawks probably had to forage over larger areas to find suitable foraging habitat. Nevertheless, the Scientific Committee recommended that entire landscapes (goshawk home ranges and matrix between home ranges), not just the areas within known goshawk home ranges in the Southwest, be managed according to the DFCs (MRNG p. 30).

3. The Austin findings on goshawk habitat use are potentially faulted because Austin failed to determine radio-telemetry bearing error and, therefore, she was unable to determine the error associated with placing goshawks at specific locations. As bearing error increases, the probability of a goshawk being at a specific location decreases; that is, the polygon where the goshawk could have been increases. The larger the error polygon in relation to the average habitat patch size, the greater is the chance of the polygon overlapping more than one habitat, making the goshawks' actual use of a specific habitat equivocal.

Nevertheless, in Austin's pooled analysis, goshawks showed avoidance of seedling/sapling/grass forb habitat and the open-small sawtimber/mature habitat, and preferred closed-mature/old-growth habitat; that is, goshawks avoided meadows and very young and open forests, and preferred older forests. Austin could not, however, statistically demonstrate any habitat avoidance or preference (no difference between use and availability) when she analyzed the use of habitats by individual goshawks (unpooled data). There was, however, a slight, non-statistical trend in the individual goshawk habitat use data suggesting an avoidance of meadow/young forest and preference of older, closed forests.

The Scientific Committee recognized the importance of mature and old forest for foraging goshawks (MRNG p. 18). The older forests were also important for most of the prey species of the goshawk (MRNG p. 19). Thus, the habitat conditions suited for below-canopy hunting by goshawks (large trees with lifted crowns, open understories) (MRNG p. 18) are the same conditions where the main prey species are likely to be most abundant (MRNG p. 18). Because of the importance of older forests, the Scientific Committee recommended that goshawk home ranges contain 20 percent of the forest area in the mid-aged class (VSS 4, trees 100 to 200- years-old), 20 percent in the mature class (VSS 5, 140 to 265-years-old), and 20 percent in the old class (VSS 6, 190 to 330 years-old) (MRNG pp. 23, 27, Appendix 5). Thus, in the MRNG at least 40 percent of a landscape (goshawk home ranges and matrix between home ranges) meets the preferred tree age conditions (VSS 5 and 6) identified in Austin's study, and we believe that the VSS 4, when intermixed with the VSS 5 and 6, is suitable for the goshawk and prey species because these VSS classes have interlocking crowns. Therefore, 60 percent of a landscape will be in suitable conditions for goshawks and their prey at any one time. However, to sustain the proportion of preferred forest structure, a balanced distribution of age-classes (young through old) is necessary in light of the growth and mortality of trees (MRNG p. 21, Table 5, p. 84). In sum, the Scientific Committee recommended as desired forest conditions trees within groups of the three oldest age classes that have interlocking crowns. These groups of trees (60% of a landscape) provide the closed (dense) forest conditions some of Austin's hawks preferred.

Conclusion:

Overall, the Austin study added new data that supported the desired forest conditions identified in the MRNG. In fact, we used Austin's preliminary findings when we developed the recommendations (see reference top of p. 15, MRNG). In accordance with the large home ranges in Austin's study, the Scientific Committee's recommendation to implement the MRNG in landscape (home ranges and matrix between home ranges) allows for such variable home range sizes (MRNG p. 30).

Beier, P. 1994. Selection of foraging habitat by northern goshawk on the Coconino National Forest. Unpublished Progress Report, Arizona Game and Fish Department Heritage Grant Project Number I-94025. 9 pp.

Summary of pertinent data:

1. This paper is an unpublished progress report for the Arizona Game and Fish Department Heritage Program. The study was conducted in ponderosa pine forests on the Coconino National Forest in Arizona. As stated by the author, the "results...are tentative and subject to further analysis" (p. 3).

2. The study's objective was to determine the importance of vegetation structure and prey abundance on selection (use) of foraging (hunting) habitat by northern goshawks. The study compared two years of bird and mammal prey census at sites where radio-tagged goshawks "seemed" to be foraging to sites where goshawks were not detected (p. 1).

3. Beier's preliminary results indicated that large bird and squirrels of all sizes did not differ in abundance at used versus unused plots (p. 4) -- suggesting that when selecting foraging sites, goshawks do not pay attention to prey density (p. 4).

4. Beier found that the areas where goshawks foraged contained enormous amounts of variation in vegetation structure (p. 4). Goshawks foraged in forest structures ranging from dog-hair thickets to widely spaced stands of large trees (p. 4). The range of sites goshawks used was impressively broad and comparable to the range of conditions found in unused plots (p. 4). However, despite wide variation in structure in used sites, the used sites differed in some characteristics from unused plots (p. 4). Compared to unused sites, used plots had more trees in the 8-16 inch and 16-inch dbh size classes, and more trees taller than 59 feet (p. 4).

5. Two important prey species (red squirrel, Abert's squirrel) were not observed and therefore not counted in used or unused sites.

Comparison with MRNG:

1. This study was conducted in southwestern ponderosa pine.

2. The findings in this unpublished progress report are potentially confounded by several problems. First, even though Beier used position-sensitive transmitters to help judge the activity of goshawks, he could not verify whether goshawks were actually foraging at a site. From the radio signal, one cannot distinguish whether a goshawk is feeding, preening, scratching, or flying (hawk in horizontal position), or is resting or actively searching for prey (hawk in vertical position). Second, Beier supplemented his suppositions of foraging with presence of prey remains. A potential problem with this is that goshawks often stop one or more times during a prey delivery to their nests to rest and pluck the plumage and pelage from the prey (Reynolds pers. obs.). Thus, the presumed site (based on "feeding" signal or prey remains) of prey capture may not have been the actual kill site. In fact, Beier was cautious in his choice of words when he defined "foraging location" (i.e., where the hawks "seemed" to be foraging) (pp. 1 - 2.) Third, Beier located a total of 67 foraging sites (14 in 1993, 53 in 1994) among 16 goshawks (7 in 1993, 9 in 1994). If the 16 goshawks were sampled equally (Beier did not report number of locations per goshawk), the data suggest that, on average, only 4.2 foraging sites were located per goshawk. It is probable that, with increased sampling, some of Beier's randomly-located "unused" sites would have been classed as "used" simply by increasing the likelihood of detecting goshawks at these sites. Goshawks use much more than four hunting sites within their home ranges (Kenward, R. E. 1982. Goshawk hunting behaviour and range size as a function of food and habitat availability. J. Anim. Ecol. 51: 69-80; Widen P. 1984. Activity patterns and time-budget in the goshawk *Accipiter gentilis* in a boreal forest area in Sweden. Ornis Fennica 61:109-112). Each of the above problems introduces an unknown error and lessens our confidence in the results.

3. Beier's finding that prey numbers were the same in used and unused sites does not necessarily support his conclusion that "goshawks did not pay much attention to prey density" (Beier p. 4). If foraging goshawks are, for some reason, not visiting some sites, how can they assess prey abundance at those sites? If they are not assessing prey abundance at some sites, then they cannot be making a choice between those sites based on prey abundance. An alternate possibility is that goshawks choose only from among foraging sites (as measured by revisits) based on prey abundance. If goshawks were choosing foraging sites based on prey abundance, there would have to be differences in prey abundance among the foraging sites. Unfortunately, Beier's sample of foraging goshawks was too small to detect whether revisits occur, and the Scientific Committee could not determine if there were differences in prey abundance on Beier's foraging sites because he pooled the foraging site abundance data in the report (Beier p. 3). Alternatively, Beier's sample of foraging sites (n = 67) might have been too small to detect abundance differences among foraging sites even if differences existed.

4. Beier's findings, that foraging goshawks prefer large trees and a diversity of vegetation conditions, are similar to the desired age class (VSS) diversity and interspersion identified in the MRNG (MRNG p. 22 - 30). The MRNG recognized the importance of old forest structures for

foraging goshawks (MRNG p. 18) as well as providing habitat for prey species (MRNG p. 19). Due to the importance of older forests for goshawks and many of their prey species, the Scientific Committee recommended that, of the forested area in ponderosa pine, 20 percent be in the mid-aged class (VSS 4, trees 100 to140- years-old), 20 percent be in the mature class (VSS 5, 140 to 185-years-old), and 20 percent be in the old class (VSS 6, 180 to 235 years-old) (MRNG p. 23, 27, Appendix 5). Moreover, the Scientific Committee recommended a high level of interspersion of the structural stages and advocated many clumps of large, old trees with interlocking crowns (dense patches).

5. A main focus of the MRNG was on the habitats and foods of goshawk prey species. Two very important prey species in the Southwest, the Abert's squirrel and red squirrel, were not observed in Beier's study. These missing species confound the significance of his results and point out why it is important to manage for a diversity of structural stages, suitable foraging habitat, and all prey species in each home range or landscape (home ranges and matrix between home ranges). The Scientific Committee believes that implementing the MRNG will increase the probability that the habitat of all goshawk prey species will be provided.

Conclusions:

Even with the small data set, the Beier data supports the MRNG with respect to the goshawks using a diversity of forest conditions, especially large trees. In the Scientific Committee's view, whether goshawks select foraging sites on prey abundance remains equivocal.

Crocker-Bedford, C. D. 1994. Conservation of the Queen Charlotte Goshawk in southeast Alaska. 1994. 39 pp. An unpublished Appendix intended for: Suring, L. H. D. C. Crocker-Bedford, R. W. Flynn, C. S. Hale, G. C. Iverson. M. D. Kirchoff, T. E. Schenck, S. C. Shea, and K. Titus. 1994. A proposed strategy for maintaining well-distributed, viable populations of wildlife associated with old-growth forests in southeast Alaska.

Summary of pertinent data:

1. Crocker-Bedford's paper is an unpublished literature review of published and unpublished documents. Based on his literature review, Crocker-Bedford made recommendations on goshawk management in southeast Alaska. Crocker-Bedford concluded that the management of forested landscapes through long rotations (minimum of 200 years) would be the most desirable strategy for sustaining goshawks in southeast Alaska. Crocker-Bedford also cited the MRNG in supporting this management approach (Crocker-Bedford, p. 30). In spite of Crocker-Bedford's concurrence with the approach used in the MRNG (long rotation of up to 330 years, MRNG p. 83, and home range and matrix application, MRNG p. 30), the Scientific Committee examined the pre-1992 literature that Crocker-Bedford cited and compared that literature against the literature cited in the MRNG. A total of 15 pre-1992 documents were not cited in the MRNG; three of these (discussed below) were in peer-reviewed journals.

Hoglund (1964) (Crocker-Bedford p. 20), which was in a German journal, reported the distance (> 30 mi) that many juvenile goshawks dispersed from their nests in northern Sweden. The MRNG is consistent with these findings, because the MRNG provided for habitat for nesting and foraging goshawks in their home ranges and in matrix landscapes (MRNG p. 21-30). Dispersing juveniles should, therefore, find appropriate habitat conditions to sustain themselves under the approach recommended in the MRNG.

Kostrzewa (1987) (Crocker-Bedford p. 10), also in a German journal, reported that in a study area containing only 16.4 % forests (in patches of old woods, islands of forest separated by agricultural areas and open-pit coal mines), goshawks nested further from openings than other hawks in Germany. In a desire to prevent southwestern forests from becoming highly fragmented by large open areas, such as in Kostrzewa's study area, the Scientific Committee recommended that home ranges be managed for overstory canopy cover up to 70% (MRNG p. 7, Table 1; p. 16) with openings no larger than 2 acre in size (no greater than 200 feet across).

Crocker-Bedford cited Shuster's (1976) (Crocker-Bedford, p. 40, Table 1) report on nesting density of goshawks in northern Colorado. Shuster reported, according to Crocker-Bedford's Table 1 (Crocker-Bedford p.40), that there were 3.0 pairs of goshawks per 10,000 acres in Colorado where there was little timber harvest. The point that Crocker-Bedford is trying to make in his Table 1 is that, as the level of timber harvest increased in the various study areas, the number of goshawk pairs per 10,000 acres declined. However, these comparisons of densities among studies conducted in areas as different as Alaska and Arizona are problematic because the studies were in different types of forests with different management prescriptions. It is also highly likely that the pre-management goshawk nest densities were different in these diverse areas. Furthermore, the number of years and level of effort (or intensity) of searches for nesting pairs were also highly likely to be different among the studies. This is important because, as shown by Reynolds (pers. obs.) in an intensive 11-year study of goshawks on the Kaibab Plateau in Northern Arizona, the proportion of goshawk pairs that laid eggs in a given year fluctuated from 22 percent to 87 percent, and that the proportion of pairs that laid can stay low (< 60 %) for periods up to 7 years. Pairs of goshawks that do not lay eggs in a given year stand a large chance of being missed in nest searches because pairs failing to lay eggs do not stay at their nests after failure -- goshawks are rarely seen in their home ranges except at their nests. If reproduction by pairs of goshawk is as irregular in other areas as on the Kaibab Plateau [in Alaska, the extent of annual variation in the proportion of pairs laying eggs is larger (Doyle, F. I., and J. M. N. Smith. 1994. Population responses of northern goshawks to the 10-year cycle in numbers of snowshoe hares. Studies of Avian Biology 16: p. 126)], then studies lasting less than 7 years have a high likelihood of missing pairs, resulting in artificially low density estimates. The duration of many of the studies cited in Crocker-Bedford's Table 1 (Crocker-Bedford p. 40) was less than 7 years, and the intensity of nest searches in these studies was variable. Thus, the densities reported in Crocker-Bedford's Table 1, and the test of his hypothesis (i.e., goshawk nest densities declined with increasing timber harvest), are equivocal.

Goshawk nest densities were not discussed in the MRNG. Nevertheless, if the MRNG is implemented in landscapes (goshawk home ranges and in the matrix between home ranges) as

recommended, then the likelihood that habitat is limiting local densities is reduced, and the goshawk population could potentially reach its local carrying capacity (MRNG p. 21-30).

In sum, the three peer-reviewed articles (Hoglund 1964, Kostrzewa 1987, Shuster 1976), as used in Crocker-Bedford (1994), do not provide any new or additional information that would have caused the Scientific Committee to change their recommendations in the MRNG.

2.. Crocker-Bedford's (1994) review also included 12 documents that were not published in peer-reviewed journals, and were not used or cited by the Scientific Committee in the development of the MRNG. The 12 are: Allen (1978), Crocker-Bedford (1987), Crocker-Bedford (1990a), Crocker-Bedford (1991), Erickson (1987), Fisher and Murphy (1986), Fowler (1988), Gamauf (1988), Marshall (1992), Patla (1991), Warren et al. (1990), and Woodbridge (1988). Below we provide descriptions on how Crocker-Bedford (1994) referenced these documents, as well as describing their relevance to the MRNG.

Allen 1978. This M.S. thesis reports on goshawks in the Adirondack Mountains of New York. Allen documented that nests are located in mature or old-growth forest stands with relatively dense canopies (Crocker-Bedford, p. 7). The information supports the nest area management recommendations in the MNRG; the MRNG provided for nest areas with mature to old trees and greater than 50% crown closure (MRNG, Table 1, p. 7; Table 5, p. 14). In addition, Crocker-Bedford used Erickson (1987), Fowler (1988), Warren et al. (1990), Patla (1991), and Marshall (1992) to support the contention that goshawks nest in dense old forests. These references add no new information to the MNRG. Rather, these references support the desired forest conditions for nest areas in the MRNG.

Crocker-Bedford 1987. This news article was from a wildlife newsletter sent to biologists in the Southwestern Region during the 1980s. Crocker-Bedford (1994) referenced this document in the context that timber harvesting, especially near nests, has the potential to adversely affect goshawks (C-B, p. 22). Similar findings were noted by Erickson (1987), Fowler (1988), Woodbridge (1988), Warren et al. (1990), Patla (1991), and Marshall (1992) in other western states. These and other findings led the Scientific Committee to provide for protection of both existing and future nest stands (MRNG p. 13, 21-22).

Crocker-Bedford 1990a. This paper was in an internal Forest Service Report describing the status of the Queen Charlotte goshawk in Alaska, and how the status of the Queen Charlotte goshawk might relate to clear-cut logging of its habitat. The Scientific Committee in the MRNG recommended against fragmenting southwestern forests with large clear-cuts (MRNG pp. 21-30). So, if there is a relationship between a decline in number of goshawks and level of habitat fragmentation caused by clear-cutting, then this paper supports the assumption made in the MRNG that large clear-cuts are detrimental to goshawks.

Crocker-Bedford 1991. This document is a non peer-reviewed abstract of a presentation. This paper provides no information that would have altered the MRNG; rather, the paper supports the MRNG. Crocker-Bedford (1994) uses this reference to imply that as timber harvesting increased within a goshawk home range, goshawk reproduction declined. The Scientific Committee recognized this issue (MRNG p. 10) and went to great lengths to describe forest treatments that will produce large old trees throughout each goshawk home range (MRNG p. 14-19, 21-30). These recommended treatments -- such as thinning from below, prescribed fire, snag retention -- are far different from the intensive timber management prescriptions applied to Southwestern forests before publication of the MRNG.

Erickson 1987. This paper is an unpublished M.S. thesis describing nest site selection by goshawks in South Dakota. Crocker-Bedford (1994) referenced this thesis to emphasize the importance of large trees for nesting (Crocker-Bedford, p. 8). This topic is well supported in the MRNG (Table 1, p. 7; Table 5, p. 14). Therefore, this paper adds no new information to the MRNG.

Fisher and Murphy 1986. This unpublished manuscript describes nesting habitat of goshawks in Utah. These authors note a general avoidance of younger dense forests by goshawks because they believe the potential exists that the goshawk's ability to hunt (capture prey) will be impaired (Crocker-Bedford p. 8). Fisher and Murphy, and Warren et al. (1990) also found that closed canopies and large trees improved overall prey abundance (Crocker-Bedford p. 11). The Scientific Committee recognized: (1) that fewer prey species use young forests (VSS 2, and 3) than older forests (VSS 4, 5, and 6); (2) that prey availability is probably lower in dense young forests; and (3) that a range of habitat conditions and age classes is needed to support the 14 major prey species of the northern goshawk in the Southwest (MRNG pp. 10, 12, 12, 15-19). The findings in the Fisher and Murphy document affirm the MRNG and add no new information.

Fowler 1988. This Forest Service report describes a habitat model for the northern goshawk that showed goshawks nest in big trees (Crocker-Bedford, p. 7). See the above discussion regarding Allen (1987) for more detail in the MRNG on the importance of large trees for nesting. The Fowler document adds no new information to the MRNG.

Gemauf 1988. This unpublished Ph.D. dissertation describes the habitat used for nesting and hunting by three species of raptor, including the European subspecies of goshawk (*A. gentilis gentilis*), in Germany. Crocker-Bedford cites Gemauf (1988), among others, for reporting that, in Germany, goshawks typically nest further from openings than do other hawks (Crocker-Bedford p. 10). Implementing the MRNG results in natural forest landscapes that are not highly fragmented by large, clear-cut openings (MRNG pp. 21-30). Furthermore, the MRNG suggests that there be three suitable alternative nest areas in each goshawk home range (MRNG p. 22). Thus, in MRNG landscapes, large openings created by tree harvests will not exist and goshawks can choose to nest in any one of three nest areas, each of which is likely to be embedded within continuous forests.

Marshall 1992. This report describes the status of the northern goshawk in Oregon and Washington. Crocker-Bedford referenced the report to indicate that logging and fire suppression decreased the goshawk's nesting and foraging habitat (Crocker-Bedford, p. 16). The MRNG recognizes the same potential impacts (MRNG, pp. 20, 21). Additionally, Marshall's paper implies that inadequate forest management in foraging areas can adversely impact the long-term viability of goshawk populations. The Scientific Committee recognized this possibility, and outlined intensive, detailed strategies and specific management recommendations for managing foraging areas to sustain goshawk populations into the future (MRNG, pp. 21, 26-30).

Patla 1991. This is a final report to the Forest Service on monitoring goshawks in Idaho. Patla (1991) concluded that timber harvesting in home ranges beyond the nest stand could affect occupancy of the nest stand (Crocker-Bedford, p. 22). The Scientific Committee recognized that past intensive timber harvesting practices may have had an impact on goshawk populations and developed a detailed strategy for managing habitats (MRNG, p. 10, 11). Thus, this monitoring report adds no new information that would alter the MRNG.

Warren et al. 1990. This paper is an internal Forest Service report describing habitat relationships of goshawks in the Northern Rockies. This report described nest stand characteristics (Crocker-Bedford p. 7) and the association of closed canopies to prey abundance (Crocker-Bedford p. 11). The Scientific Committee addressed these issues as discussed above in Allen (1978) and Fisher and Murphy (1986).

Woodbridge 1988. This manuscript was produced for a meeting of the Western Section of the Wildlife Society. This paper was cited by Crocker-Bedford (1994) regarding the effects of timber harvest on nest occupancy or reproduction (Crocker-Bedford, p. 22, 25). See the comments for Crocker-Bedford (1991) above for how the MRNG addresses the issues raised in this paper.

Conclusions:

All topics in the 15 documents reviewed by Crocker-Bedford (1994) were effectively addressed by the Scientific Committee in the development of the MRNG and were fully described in the MRNG. In conclusion, Crocker-Bedford (1994) cited the MRNG for 1) an appropriate strategy for landscape-scale management, and 2) for advocating long timber rotations that would provide adequate protection for "existing habitat while allowing degraded habitats time to recover" (Crocker-Bedford, p. 25, 30).

Crocker-Bedford, D. C. 1995. Northern goshawk reproduction relative to selection harvest in Arizona. Published Abstract, Journal of Raptor Research 29: 42-43.

Summary of pertinent data:

This is a non peer-reviewed, published abstract of a presentation. The abstract refers to a re-analysis of Crocker-Bedford (1990) data in which he considered an additional sample of 22 goshawk nest "clusters." The study area was the North Kaibab Ranger District in northern Arizona. The primary forest types on his study area were ponderosa pine and mixed-conifer.

1. Crocker-Bedford separated 53 nest clusters into four categories: 12 in assumed goshawk ranges having little or no harvesting; 14 having selection harvesting on 10-39% of each home range; 16 had harvesting on 40-69 % of the home range; and 11 with selection harvesting on 70-90 % of the home range. For the four categories, respectively, occupancy rates were 83%, 43%, 31%, and 9%. The harvesting occurred between 1973 and 1986.

2. These data could indicate some real decline in local breeding population and productivity, and/or represent movement of successful breeders from more logged to less logged areas.

Comparison with MRNG:

1. The MRNG recognized that logging has impacted goshawks along with other factors such as fire exclusion, grazing, and disease (MRNG p. 10). Even when the MRNG was in draft form, the Kaibab National Forest was no longer implementing the harvest treatments described in this Crocker-Bedford study. The Kaibab National Forest began implementing the MRNG in 1991, and ceased the intensive timber harvesting used in the 1970s and 80s. Thus, findings from Crocker-Bedford (1990) cannot be extended to the specific management described by the MRNG.

2. Goshawk research (1991-2001) on the North Kaibab Ranger District (same study area as Crocker-Bedford 1990, 1995), a 495mi^2 study area, identified nesting pairs of goshawks on 102 different home ranges (R. Reynolds pers. obs.). This constitutes the highest density of nesting goshawk reported for any area in North America, which suggests that a there has not been a recent decline in the breeding population on the Ranger District.

Conclusion:

This abstract describes similar findings to those reported by Crocker-Bedford (1990; Wildlife Soc. Bull. 18: 262-269) and therefore it presents no new findings since publication of the MRNG. Indeed, the Scientific Committee considered Crocker-Bedford (1990; Wildlife Soc. Bull. 18: 262-269) during its development of the MRNG (see citation of Crocker-Bedford 1990 on p. 10, MRNG).

Hargis, D. H., C. McCarthy, and R. D. Perloff. 1994. Home ranges and habitats of northern goshawks in eastern California. Studies in Avian Biology 16: 66-74.

Summary of pertinent data:

1. The Hargis et al. study area was in the Sierra Nevada Mountains of California, and included extensive tracts of Jeffery pine interspersed with lodgepole pine, quaking aspen, and sage/pumice flats (p. 67). Much of the study area was modified by timber harvests that removed large diameter trees; clear-cuts were uncommon (p. 67). Their study area was relatively open compared to other western forests due to xeric conditions imposed by poor soils and dry climate (p. 67).

2. Hargis et al. described nest sites on their study area as more open than typically reported in the literature, but local goshawks nested in sites with the highest density of trees available (p. 73).

3. Hargis et al. reported home ranges ranging from 15.5 km^2 ($\pm$ 8.9 km^2) (6,275 ac $\pm$ 3,600 ac) (p. 69).

4. The goshawk home ranges in the Hargis et al. study had a higher diversity ("interspersion") of seral stages when compared to randomly located areas within their study area (p. 69-70). Also goshawks selected areas with high vegetation diversity that contained aggregations of mature tree and riparian areas, and the goshawks used edges along pumice flats (p. 70).

5. Goshawk nest sites and telemetry locations in the home ranges had greater tree density (basal area), higher canopy cover, and more trees in the two larger diameter classes than random plots in the home ranges (p. 72). Forest structure within foraging areas was similar to forest structure within nest stands and both differed significantly from random plots (p. 72).

6. Twelve of the 14 prey species used in the development of the MRNG were found in the study area, and each of the 12 required an interspersion of vegetation seral stages (p. 72).

Comparison with MRNG:

1. Hargis et al. study included forest types that are typically more open than the southwestern ponderosa pine, mixed-conifer, spruce-fir forests considered in the MRNG. Thus, specifics such as percent canopy cover, tree sizes, species composition and landscape pattern are not directly comparable to those recommended in the MRNG. Implementation of the MRNG should result in restoration of the natural species composition, tree sizes and spacing (density), and landscape pattern in southwestern forests. Recommended tree densities and canopy cover in the MRNG are higher than tree densities and canopy cover reported in Hargis et al. study.

2. The MRNG recognized that nest area habitat typically has a higher tree density than surrounding forests (MRNG p. 13, Table 5). Goshawks use many forest types within their

geographic range whose tree densities and canopy cover vary greatly. Goshawks in these forests typically use the more dense stands available for nesting.

3. Hargis' mean home range size was only 4 % larger than the largest North American goshawk home range reported in the MRNG (MRNG p. 9, Table 3). The open conditions of forests and prevalence of pumice flats and other landscape features in Hargis' et al. study area may account for the slightly larger home range sizes there. However, the MRNG (MRNG p. 30) advocated that landscapes (goshawk home ranges and matrix between home ranges) be managed according to the MRNG (MRNG p. 30). The Scientific Committee recommended the implementation of the MRNG in the matrices between home ranges (MRNG, p. 30) so that local goshawk home ranges could expand or contract according to local ecological conditions (e.g., food availability).

4. The interspersion of seral stages and diversity of vegetation types in home ranges of goshawks studied by Hargis et al. support the vegetation stage interspersion identified in the MRNG (MRNG p. 18). In addition, the importance of edge and riparian habitat that Hargis et al. identify for goshawks and prey species is recognized in the MRNG (MRNG p. 15).

5. The basal area, canopy cover, and tree densities in areas preferred by Hargis' goshawks are similar to basal, canopy cover, and tree densities in the MRNG (MRNG Table 5, p. 14).

6. Hargis' et al. report on the potential prey available in California is similar to prey used in the MRNG for Arizona and New Mexico. Also, Hargis et al. hypothesized that use of areas with high vegetation diversity and seral stage interspersion by goshawks in their study areas may have been related to higher prey availability in those areas. This is similar to finding regarding prey habitats and prey availability in the MRNG (MRNG p. 18).

Conclusions:

The pertinent data reported in Hargis et al. strongly support the forest conditions specified in the MRNG. Furthermore, it is our understanding that this and all other goshawk papers in the Studies in Avian Biology 16 were reviewed for the environmental impact statement for the amendment of the forest plans the Southwestern Region.

Mannan, R. W., and D. J. Smith. 1993. Habitat use by breeding male northern goshawks in northern Arizona. Final Report, USDA Forest Service Cooperative Agreement No. 28-C1-558. 35 pp.

Summary of pertinent data:

1. This is an unpublished report describing the study of 14 male goshawks radio-tagged during two years on the North Kaibab Ranger District in northern Arizona. Forests on the District were mixed-conifer and ponderosa pine (p. 3-4).

2. Mean home range size reported by Mannan and Smith was 1,758 ha, (4,342 ac) (p.17). Mean telemetry location error was 98.3 m in 1991 and 68.5 m in 1992 (p. 17).

3. The main pattern reported in this study regarding habitat use by foraging goshawks is that the mean rank of relative preference of pooled goshawks increased with increasing canopy closure. However, the analysis of habitat (canopy cover was the only habitat variable measured) use by individual goshawks indicated that most used forest conditions within their home ranges randomly (no preference, no avoidance). Eight of the 11 goshawks studied used the canopy closure categories in proportion to their occurrence (no preference or avoidance by canopy closure). However, three of the 11 goshawks used forests with >55% canopy closure more than expected and areas <15% closure less than expected (p. 18).

4. Six of the goshawks used "forest edge" randomly (no preference or avoidance), and five goshawks used the edge categories non-randomly; four of five goshawks used forest edges less than expected, each preferring areas of varying distance (50-200 m) from open (<35% canopy closure) areas (p. 18). Woodlands were preferred more that open areas (p. 19).

5. Ten of the 11 goshawks used the diversity categories (canopy closure) randomly; only one goshawk did not (p. 19).

Comparison with MRNG:

1. This study was in a subset of forest types (southwestern ponderosa pine and mixed conifer) considered in the MRNG. Like many radio-telemetry studies of foraging habitat use by goshawks, this study has several shortcomings (Mannan and Smith p. 21). Nesting pairs were not selected at random but were selected for ease of study; therefore, a bias may result because the sample of nests and males may not be representative of the breeding goshawk population on the North Kaibab Ranger District (Mannan and Smith p. 4). As admitted by the authors, the habitat use data may have been confounded by several factors; goshawks may have been more easily observed in open areas, samples of radio-telemetry locations were small, goshawks may have been selecting habitat variables not measured, there was an unknown error associated with locating radio-tagged goshawks, and uncertainty about what the goshawks were doing when located (p. 21). Added to this, in our opinion, was sampling error associated with pinpointing the actual foraging location of the goshawks that were observed flying (Mannan and Smith p. 14, 17, 21). "Observed flying" constituted 46% of the hawk locations used in the study of habitat use (Mannan and Smith p. 17).

2. Mean home range size reported by Mannan and Smith is intermediate among the studies reported in the MRNG (MRNG Table 3, p. 9). Thus, there is no new information here.

3. The authors were only able to study goshawk use/avoidance of canopy cover categories; they were unable to partition their canopy cover categories by tree size or age, two habitat characteristics identified in other goshawk habitat studies as being the most important characteristic. Furthermore, their canopy cover categories were likely to be heavily biased higher

by a high density of seedlings and young trees in all age classes of forests (Mannan and Smith p. 11), the result of years of fire suppression on the Ranger District. We believe, therefore, that the authors may not have measured the habitat variables that are important to goshawks such as density and canopy cover of old trees (they admit this possibility; Mannan and Smith p. 21). Nevertheless, the Scientific Committee recognized the importance of relatively high canopy cover, especially in the older forest age classes in ponderosa pine and mixed-conifer, for several goshawk prey and the prey's foods (MRNG p. 19). For example, the Scientific Committee recommended that 60 % of landscapes be in groups of trees with interlocking crowns and canopy cover of 40+ % for ponderosa pine forests and 50+ % for mixed-conifer forests (MRNG pp. 23, 27; Appendix 5).

4. The determination of use or avoidance of "edge" in the Mannan and Smith study seems confounded. First, the Scientific Committee question Mannan and Smith's definition of "open area" -- areas with < 34 percent canopy cover (Mannan and Smith p. 13). By using this definition, Mannan and Smith likely classified some areas as "open" that were likely forested because southwestern ponderosa pine forests are typically open with canopy cover frequently less than 35 percent. Thus, in light of Mannan and Smith's definition of opening, the Scientific Committee questions the relevance of Mannan and Smith's concept of "edge" with respect to goshawk habitat use. Second, because the authors could not partition canopy cover categories by some tree or stand characteristic (e. g, size, age, composition, or structure) they could not determine whether the goshawks were actually avoiding "edge" or selecting some other habitat characteristic (see item 3 above). Third, the error rate of categorizing tree stands into their canopy cover classes on aerial photos was quite large (as much as 48%) and increased as canopy cover increased (Mannan and Smith p. 12). No correction for this error seems to have been made. Fourth, we wonder how the authors' measure of "distance to edge" was affected by "smoothing" the original canopy closure overlay. Smoothing resulted in an averaging of canopy cover values among the 3 - 4 different habitat categories that Mannan and Smith typically found in the 90 m radius areas (their radio-telemetry error polygon) containing the goshawk locations (Mannan and Smith p.15). The Scientific Committee could not evaluate Mannan and Smith's finding regarding "distance to edge" because of the high probability that edge around small openings within the 90 m radius error polygon was lost in their averaging. Using the Mannan and Smith definitions of "opening" and "edge" and their smoothing, the Scientific Committee finds that Mannan and Smiths could only show that goshawks avoided *large* areas with <34 % canopy cover. The distinction is important because, while the MRNG recommends against the creation of large openings, the MRNG shows that edge, created by the interspersion of small patches of different forest age classes, benefits goshawks by benefiting many of their prey species.

Because of the problems identified above, we do not think that Mannan and Smith adequately determined the effects of edge on goshawk habitat use. We, therefore, think it premature to amend the MRNG according to their findings.

5. Mannan and Smith's finding that 10 of the 11 goshawks used the canopy cover diversity categories randomly suggests that forest landscapes that contain a diversity of forest tree densities

appear to be suitable for goshawk foraging. The MRNG provide for all tree age classes and a diversity of tree density conditions.

Conclusions:

Overall, the Mannan and Smith findings support the MRNG recommendations of 40 - 60% canopy closure in ponderosa pine forests (MRNG p. 23) and 60 - 70% in mixed-conifer forest (MRNG p. 23) within goshawk home ranges. Moreover, Mannan and Smith support the MRNG concerning the likely importance of canopy cover to goshawk prey. The measured response to edge in the Mannan and Smith report is equivocal. Nevertheless, other than natural edge between non-forest and forest, there will be little recognizable edge with implementation of the MRNG. None of the information in the Mannan and Smith report is sufficiently different from that in the MRNG to warrant amending the MRNG.

Snyder, H. 1995. Apache goshawk conservation biology in southeast Arizona. Arizona Game and Fish Department Heritage Grant-in-Aid project I92065. Final Report April 1995. 35 pp.

Summary of pertinent data:

1. The Snyder report is based on visits to goshawk nests with a history of occupancy (p. 5). Some survey work was conducted to locate new nesting pairs (28,722 acres surveyed) over 3 yrs. The study occurred in southeastern Arizona and included Madrean Evergreen Forest and Woodland (Emory Oak and oak-pine), Riparian Deciduous Forest and Woodland, and Ponderosa-Chihuahua Pine associations and mixed conifer (p. 7).

2. Goshawks are reported to prefer nest sites on flat terrain based on 20 historic records dating back to the late 1960's (p. 12). Snyder reported a minimum 50% canopy closure for nest areas (p. 13), a distance of 3.2 miles between active nest areas (mean of pooled data from Table 2, p. 16), with the largest distance being 4.8 mi, alternate nests averaged 260 yards apart (p. 17), and the mean distance for 31 nest sites to water of 172 yards (p. 23).

3. An important prey item was Mearn's quail (25% of all prey, p. 27).

4. Snyder believes there is some circumstantial evidence suggesting that goshawk numbers declined in the last 10 years based on non-use of nests and her failure to locate other nests within 1.6 miles (p. 28). Snyder did point out that she observed three single males, but no nests, in three of the territories (p. 28), but "it could be argued that this does not represent a change in numbers, but is only the result of a general shift in nest-area locations" (p. 29). Also, Snyder states that goshawk population changes in the last 10 years may be in response to changes in the prey numbers (p. 30), or due to a decrease in habitat quality for many prey species on the Coronado resulting from fire suppression (p. 31). The status of the goshawk in Madrean Evergreen Forest and Woodland on the Coronado National Forest accordingly remains uncertain.

Comparison with MRNG:

1. The MRNG does not address the Madrean Evergreen Forest and oak woodland. However, Snyder's habitat management recommendations (p. 32) are similar to the MRNG with respect to recommendations for nest areas, post-fledging family areas, and foraging areas (MRNG, p. 22-30), and for limiting human disturbance around goshawk nests, and the use of thinning and prescribed fire to improve habitat of preferred prey (MRNG p. 32).

2. The Scientific Committee recommended canopy cover in nest areas of 50% and greater for ponderosa pine and 60 % and greater for mixed species, both of which are in line with Snyder's recommendation. The distance between territories (central area of home range defended by a pair of goshawks) and alternate nests within territories is within the ranges of values reported in the literature that was considered in preparation of the MRNG.

3. Mearn's Quail were not considered in MRNG. Because the forest types and suite of goshawk prey species in the Coronado National Forest are different from elsewhere in the Southwestern Region of the Forest Service, the Scientific Committee suggests that local management recommendations be developed for the Coronado National Forest to take into account habitat requirements of the Mearn's quail using the same approach as was used in the MRNG.

4. With respect to perceived declines in goshawk populations, it is important to note that in northern Arizona, 55-75% of goshawks that laid eggs in a year moved to alternate nests within home ranges (R. Reynolds, pers. obs.). As a result, a great deal of annual searching of home ranges is necessary if goshawks that moved to alternate nests are to be found. If extensive searches are not conducted, then samples of known pairs of goshawks will decay over time giving the erroneous perception of a decline. Also, in poor prey years, large percentages of goshawk pairs will not lay eggs. This can also give the erroneous impression of a population decline, especially if prey populations remain low over a period of years (R. Reynolds pers. obs.). Finally, the Scientific Committee recommended using prescribed fire to develop desired forest conditions for both the goshawk and its prey species (MRNG, pp. 22, 24, 26, 29, 31).

Conclusions:

With the exception of reporting a different species in the diets of goshawks, the findings reported in the Snyder report are supportive of the desired forest conditions identified in the MRNG. The different forest types and suite of prey (suggested by the Mearn's quail) on the Coronado National Forest argue for developing a unique set of management recommendations for that forest using the MRNG as a template. We found nothing in this report that suggests a need for amending the MRNG.

Titus, K., C. J. Flatten, R. E. Lowell. 1994. Northern goshawk ecology and habitat

relationships on the Tongass National Forest (goshawk nest sites, food habits, morphology, home range, and habitat data). Final Annual Rpt, P.O./C.A./Contact Number 43-0109-3-0272, USDA Forest Service, Alaska Region, Tongass National Forest. 32 pp.

Summary of pertinent data:

1. This is an unpublished report that compiles a 1993 Progress Report, an April 1994 Final Annual Project Report, and is a continuation of research on the goshawk begun in 1991 in southeast Alaska. The study had five objectives, but only one pertains to the Southwest and that was goshawk home range determination and habitat associations (p. 2). The study area included portions of the Tongass National Forest, and included forests (Sitka spruce/ Western Hemlock/Western Red-cedar/Yellow Cedar) considerably different from the ponderosa pine and mixed-conifer forests of the Southwestern Region of the Forest Service.

2. Of 18 nest sites, 15 were in old-growth and 3 were in 90 + year-old second growth. Slope at the nests was flat to moderately steep.

3. Distances between alternate nests within territories were greater (120 m - 24 km) than in California (80 m - 2.8 km) (p. 3). Nest sites were in found in old-growth stands (p. 4).

4. The most common prey included jays, grouse, thrushes, woodpeckers, and red squirrels (p. 6). Habitat locations for pooled individuals, that were assumed to be foraging, were most commonly in old-growth forest with the highest volume classes (p. 24).

Comparison with MRNG:

1. The differences in species composition and structure between the forests in southeastern Alaska and the southwestern U.S. limit direct comparisons of habitat use by goshawks in the two regions. Therefore, extrapolations regarding forest conditions used by goshawk in Alaska to the southwestern forests should be with caution since southwestern forests cannot produce or sustain the tree densities, tree sizes, and landscape pattern found in southeastern Alaska.

2. Habitat structure in Alaskan goshawk nest sites and nest areas fit the structural pattern of nesting habitat used by goshawks throughout their range. Thus, the Scientific Committee recommended nest areas with relatively dense overstories, large trees, and mature and old forest conditions (MRNG Table 5, p.14).

3. The Titus et al. study shows that older aged/high volume forests are preferred by goshawks in Alaska (p. 24). The few other radio-telemetry studies of habitat use by goshawks in other forests also suggest a preferential use of older forests during activities away from the nest. The desired forest conditions described in the MRNG were based on analyses of the habitat needs of the goshawk (mature-to-old forest for nest sites; older, tall forests with lifted canopies and open understories for hunting) as well as the habitats needed by 14 of the major prey species in southwestern forests (MRNG Table 1, p. 7, 16-19).

4. The main habitat of the important Alaskan prey species, many of which also occur elsewhere in the geographic range of goshawks, is in mid-aged (VSS 4) to old forests (VSS 6) (MRNG Table 7, p. 19). Thus, it is not surprising that this and other radio-telemetry studies identified a preferential use of older forests by hunting goshawks (Titus et al. p. 2). The intent of the MRNG was to have as much sustaining older forest (VSS 4, 5, and 6) in home ranges to maximize the amount of habitat for goshawks and the majority of goshawk prey (MRNG p. 18).

Conclusion:

Goshawks in southeast Alaska nested and foraged in older forests (mature to old-growth) and captured prey species similar to those described in the MRNG. Both of these points support the MRNG (MRNG Table 1, p. 7, 16-19).

Woodridge, B., and P. J. Detrich. 1994. Territory occupancy and habitat patch size of northern goshawks in the southern Cascades of California. Studies in Avian Biology 16: 83-87.

Summary of pertinent data:

1. This study was conducted in the Klamath National Forest in northern California (p. 84). Sierran Montane Forest, Upper Montane Forest, and lower elevation forests (ponderosa pine with white-fir) are the primary forest cover types (p. 84). The study area has a long history of tree harvests, but there are scattered patches (apparently of variable sizes) of unmanaged mature forests dispersed among thinned or regenerated stands that apparently had been clear-cut (p. 84). Thus, it appears that most of their study area was highly fragmented by timber harvests. Study area forest types are similar to forest types in the Southwestern Region. Fire suppression has resulted in an increased density of understory trees, mostly white-fir.

2. The authors monitored occupancy and reproductive success of goshawks in relation to nest stand size (area) (p. 84). Mean nest stand size was 28 ha (p. 85). The frequency of occupancy of individual nest stands was positively correlated with stand size (p. 85). Nest stands less than 10 ha (25 ac) were only occasionally occupied.

3. Occupancy of nest clusters (a cluster of alternate nests within a territory) that totaled less than 20 ha (49 ac) combined was less than 50%. No significant relationship between stand size and productivity was noted (p. 85). Up to nine alternate nests have been used by nesting goshawks in a single home range over a period of 10 years (p. 84).

Comparison with MRNG:

1. The forest types in the Woodbridge study were similar to the types in the Southwestern Region.

2. The Scientific Committee wished to avoid the extensive fragmentation of forests that resulted from intensive management of large blocks of land that typified the Woodbridge and Detrich study area (MRNG p. 21). Partially for this reason, the Scientific Committee recommended small (≤ 4 acres) regeneration cuts in both ponderosa pine (MRNG Table 1, p. 7, p. 28) and mixed-conifer (MRNG Table 1, p. 7, p. 29) within goshawk home ranges, exclusive of nest areas. Because the natural forest composition, structure, and landscape pattern was used as a template for assembling goshawk and prey habitats into desired landscapes, the Scientific Committee recommended forests whose structure and pattern mimic the natural conditions (MRNG p. 8). Natural conditions were desired because these were the conditions to which goshawk prey species were adapted and were also suited to goshawk hunting tactics (p. 16-18).

3. The Scientific Committee recognized the importance of nest areas, nest sites, and nest trees in breeding by goshawks. Therefore, the Scientific Committee recommended the protection and maintenance of historical nests areas, sites, and trees (MRNG p. 22).

Conclusions:

Ponderosa pine and mixed-conifer forest fragmented by large clear-cuts affect nest site occupancy of goshawks and ultimately goshawk fecundity. Because implementation of the MRNG does not cause large-scale fragmentation of the forest, the findings published by Woodbridge and Detrich are not pertinent and, therefore, do not suggest amending the MRNG.

OVERALL CONCLUSION

The Scientific Committee found that most of the nine documents contained some new information on goshawk behavior and habitat use. Much of the new information, however, appeared to reflect relatively minor geographic variations in goshawk home range size and habitat use that may be associated with either different forest types, forest management histories, or variations in local conditions such as food abundance or weather in the various study areas. Geographic variation in behavior and habitat use by goshawks was also evident in the documents considered during the development of the MRNG. Nonetheless, the Scientific Committee found that none of the information in the nine documents was sufficiently different from information used in the MRNG to warrant amending the recommendations for the three forest types discussed in the MRNG. In fact, much of the new information presented in the nine documents strongly supported both the process used in developing the MRNG and the desired habitat conditions recommended in the MRNG.