From Single Species Management to Ecosystem Management, "The Goshawk"

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Abstract

Natural resource management in the United States is in a state of flux now more than any time in history. Many of the concerns about forest management are related to the enforcement of the Endangered Species Act. This act focuses forest management on preserving the habitat of a single species. But, for the northern goshawk (*Accipiter gentilis*) because it is a habitat generalist and a predator of over 50 birds and mammals, a multiple species approach was used for developing management recommendations. Even with this approach, however, several animal and plant species were not explicitly covered. To ensure that plant and animal species, known and unknown, are conserved and that ecosystem processes, elements, and functions are not overlooked, an ecosystem approach to managing lands occupied by northern goshawks appears to be appropriate. Large landscape units can be designated and analyzed at a variety of spatial and temporal scales offering treatment alternatives that sustain not only the northern goshawk but all forest components.

Introduction

The values, attitudes, and wishes of society and resource managers are in a state of flux now more than ever before in the history of natural resource management (Kennedy and Quigley 1993). What was once perceived as the right course for forest management, that is the production of goods and services, is no longer considered the right direction by many people in natural resource management as well as many in the general public. These changes are causing many shifts in organization, mission, and philosophy within several natural resource agencies.

Within the USDA Forest Service, the foundation for many of these changes started in the late 1960's with the controversies over management of the Bitterroot and Monongahela National Forests (Kennedy and Quiqley 1993). Since the 1960's, various issues have influenced forest management from clearcutting to allowable sale quantities. But, none has had a greater impact than the Endangered Species Act (ESA). In many national forests, enforcement of this act is the culmination of the early concerns about forest management.

Past forest management practices often concentrated on timber production; similarly, the ESA focuses forest management on a single species. The grizzly bear (*Ursus horribillis*), northern spotted owl (*Strix occidentalis caurina*), pine martin (*Martes americana*), chinook salmon (*Oncorhynchus tshawytscha*), and northern goshawk (*Accipiter gentilis*) (goshawk) represent but a few of the ever-increasing list of species that require money and effort for analysis and protection. Unfortunately, it is not always evident that the addition of another species to the list is for species protection but rather an attempt to stop timber harvesting or some other forest use. The changing issues being emphasized in natural resource management led by the ESA are creating concerns at all levels of society, from the small town to the Congress and Administration of the United States (Anon. 1993).

The Forest Service and other Federal and State resource agencies are responding to these issues. Ecosystem management, evolving from New Perspectives, has been the Forest Service's response. Because a portion of society and some individuals within resource organizations do not want change, adjustments in management are difficult to make. These challenges make natural resource management a very exciting and dynamic profession at this time.

Single Species Management

Most approaches to managing sensitive, rare, or endangered species involve preserving species habitat. For example, the first approach to managing the northern spotted owl and the goshawk was to dedicate areas of the forest specifically for the species restricting all other uses. This entailed reserving 3- to 500-acre buffers around goshawk nests (Reynolds 1983, Crocker-Bedford

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1990). Similarly, 1,000- to 3,000-acre buffers were established for the northern spotted owl (Thomas and others 1990). In both cases, timber harvesting and other activities were restricted in these areas. The rationale for these decisions, especially for the goshawk, was that information about nest areas was relatively easy to obtain compared to information on other habitat components. Merely preserving the goshawk nests did not appear to be adequate for maintaining the species. Even with protecting goshawk nests, there was evidence that the species was declining because of forest changes and timber harvesting (Crocker-Bedford 1990). In addition, more information was being assembled on the behavior, habitat, and forest types the goshawk occupies, providing a basis for improved management strategies.

The goshawk is a habitat generalist living throughout North America in a variety of forest types from ponderosa pine (*Pinus ponderosa* Dougl. ex Laws.) to subalpine fir (*Abies lasiocarpa* Hook.) (Reynolds and others 1992). Three components of goshawk habitat have been identified: the nest area, post fledging-family area (PFA), and foraging area. Goshawk nest areas (approximately 30 acres in size) which include the nest tree are usually located in one or more forest stands containing relatively big, mature trees. More than one nest area is usually located in each goshawk home range. The nest areas are used year after year by returning goshawks. Adult goshawks and fledglings intensively use an area around the nest. These PFA's provide food, cover, and learning experiences for goshawk fledglings (Kennedy 1988). The average size of these areas is 420 acres and contain a wide variety of vegetation and forest structures. A nesting pair of goshawks can forage over large areas (5,400 acres) depending on the forest type and prey (fig. 1). The foraging area needs to supply a goshawk family (two adults and two fledglings) approximately 400 to 500 pounds of food per year. This area is a

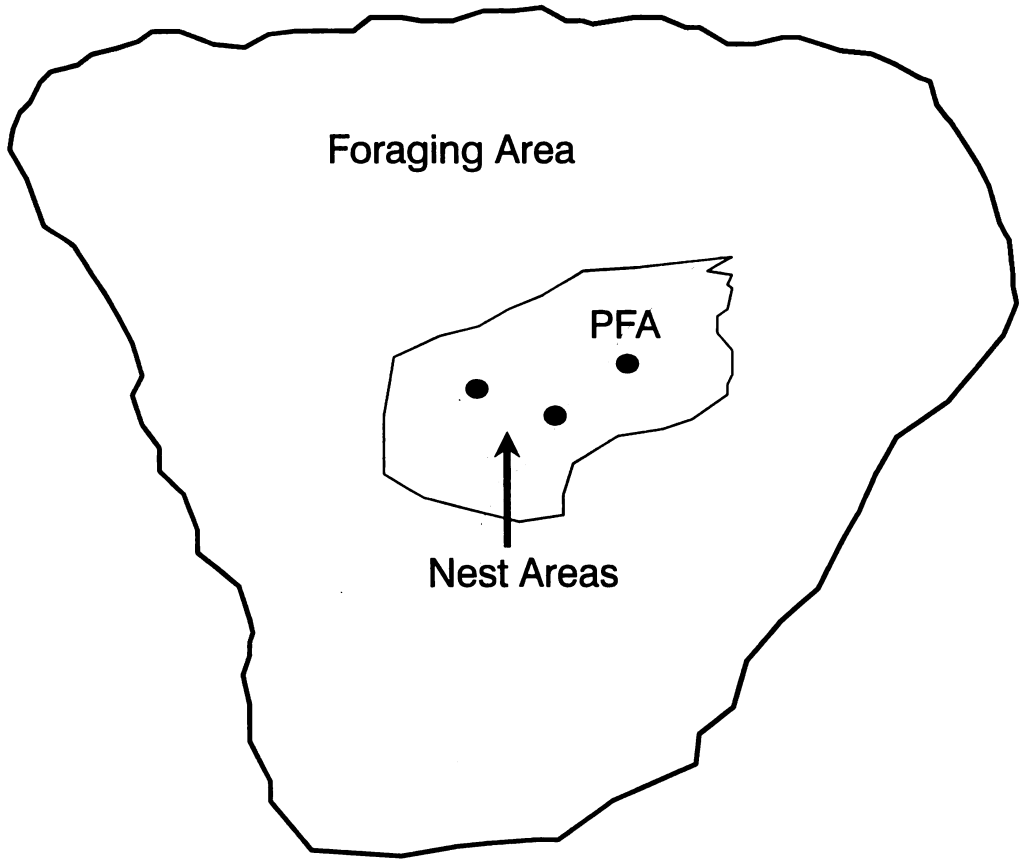

Figure 1—Arrangement of nest areas (30 acres), post fledging-family area (PFA) (420 acres), and foraging area (5,400 acres) for the northern goshawk in the southwestern United States.

forest mosaic containing a variety of trees, shrubs, grasses, snags, downed logs, and other components. Instead of preserving 3- to 500-acre nest areas for sustaining goshawks, the issue became more complex and involved tracts of forest lands approaching 10,000 acres. Consequently, the management of a top-level consumer like the goshawk is difficult because of its complex habitat and the dynamic forests it occupies.

The forest habitat for sustaining goshawks requires a nest area, PFA, and foraging area. The size and structure of the foraging area is defined by the habitats of goshawk prey. The goshawk preys on a wide range of 50 or more birds and mammals ranging from the blue grouse (*Dendragapus obscurus*) to the tassel-eared squirrel (*Sciurus aberti*) (Reynolds and others 1992). In order to maintain viable populations of goshawks, the habitat requirements of the goshawk and the habitats of the prey need to be integrated. Therefore, the management of the goshawk evolved from a single species issue to the management of forests for multiple species.

Multiple Species Management

For a select number of prey species found in the southwestern United States, common habitat attributes include large trees, downed logs, openings, snags, and understory vegetation (fig. 2). A goshawk home range that contains these components will also conserve other forest processes and functions. For example, downed logs and coarse woody debris provide habitat for many small animals and birds. These decomposing materials are important sites for nitrogen fixation and ectomycorrhizae (Harvey and others 1987). In addition, the fruiting bodies of ectomycorrhizal fungi are important in the food chains of many small animals (Maser and others 1986).

Vegetative structural stages (VSS) were used to describe goshawk and prey habitat. VSS are an integrative approach for describing forests ranging from openings (regeneration) to old trees and associated components (Thomas and others 1979; Reynolds and others 1992). VSS are based on tree diameter (table 1) and assume that trees increase in

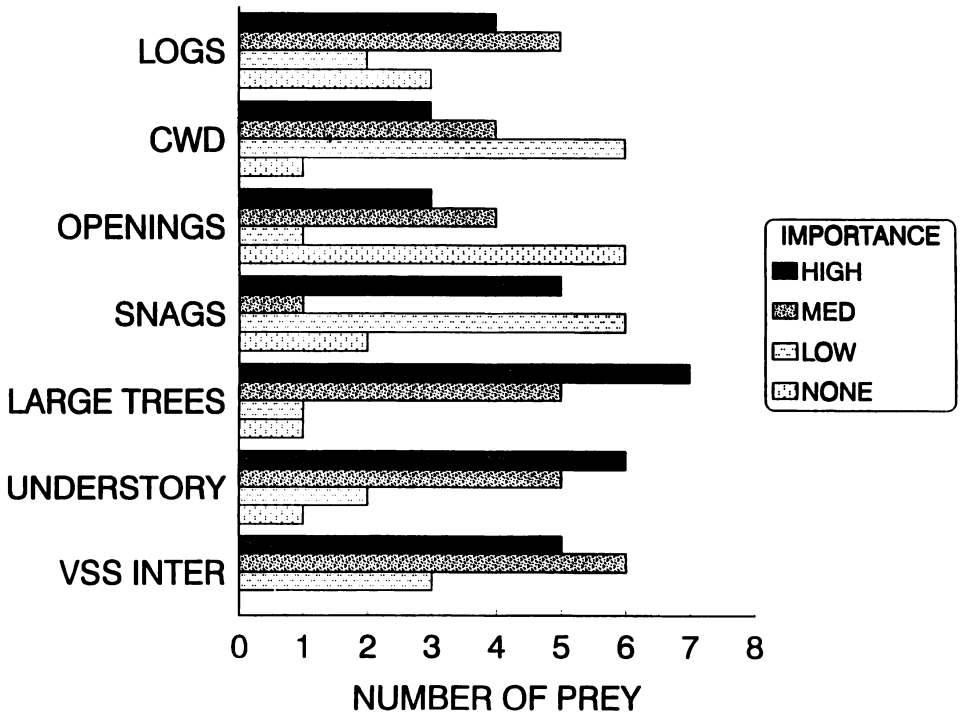

Figure 2—Importance of special habitat attributes for maintaining sustainable populations of selected northern goshawk prey. Snags = dead trees >18 inches in diameter and >30 feet tall; downed logs = >18 inches in diameter; CWD = coarse woody debris >3 inches in diameter; opening = break in forest canopy; large trees = live trees >18 inches in diameter; understory = presence of herbaceous and shrubby species; VSS inter = interspersion of vegetative structural stages (Reynolds and others 1992).

Table 1—Estimated tree diameter growth rates, years in vegetative structural stage (VSS), accumulated age, and proportion of the foraging area in each VSS for selected forest types

	Vegetative structural stage and tree diameter					
	Grass/forb/ shrub 0-1 in	Seedling/ sapling 1-5 in	Young forest 5-12 in	Midaged forest 12-18 in	Mature forest 18-24 in	Old forest 24+ in
			Ponderosa pine (PP)			
10-yr. dia. grth. (in)[a]	0	1.91	1.76	1.64	1.4	1.1
Years (Acc-yrs)[b]	20 (20)	21 (41)	40 (81)	37 (118)	43 (161)	45 (206)
Percent in VSS[c]	10	10	19	17	20	24
			Mixed species (MS)			
Percent in VSS	8	15	22	18	20	18
			Spruce-fir (S-F)			
Percent in VSS	8	14	23	17	19	19
General pct. in VSS for PP, MS, S-F forests[d]	10	10	20	20	20	20

[a]Diameter growth rates from Edminster and others (1991).
[b]Years (Acc-yrs): Number of years in vegetative structural stage and accumulated years.
[c]Proportion of foraging area in each VSS required to sustain a forest indefinitely.
[d]Generalized proportions for sustaining ponderosa pine (PP), mixed species (MS), and spruce-fir forests (S-F) in the Southwest.

diameter as they age. The time a forest tract spends in a VSS depends on forest growth.

Although a goshawk home range is a mosaic of vegetative structural stages, the preferred habitat for many of the prey species are mature and old forests (fig. 3). Therefore, it would be desirable to sustain the majority of the forest in these VSS. But forests are mortal—they regenerate, grow, and die. Consequently, to sustain a large amount of mature and old trees, a mosaic of VSS including regeneration, young forests, and midaged forests are required.

To sustain a large amount of old ponderosa pine in the Southwest depends on the length of the regeneration period, growth rate, site, tree longevity, stand density, and tree size (table 1). In these forests, it usually takes 10 to 20 years to fully regenerate a ponderosa pine stand (Pearson 1950). Between 20 and 40 years are spent in each intermediate VSS, ultimately taking up to 200 years to reach the mature and old forest stage. Consequently, around 10 percent of the forest would need to be regenerated every 20 years to sustain 40 percent in mature and old forests (table 1). In doing so, various proportions of the other forest stages would also be present (seedling/sapling, young, and midaged). A forest maintained for the goshawk would also provide a variety of conditions that would sustain many other wildlife species.

Maintaining Goshawk Home Ranges

Forest dynamics necessitate that the amounts of VSS in a forest or goshawk home range be flexible. The key to maintaining goshawks is to sustain a mosaic of differing VSS, ultimately maximizing the amount of old forests. Unfortunately, the desired proportions of the VSS for individual home ranges were often used exclusively for determining goshawk viability. If forest conditions did not meet the recommendations or a planned forest management activity altered the forest structure outside the recommended proportions, it was considered detrimental to the goshawk.

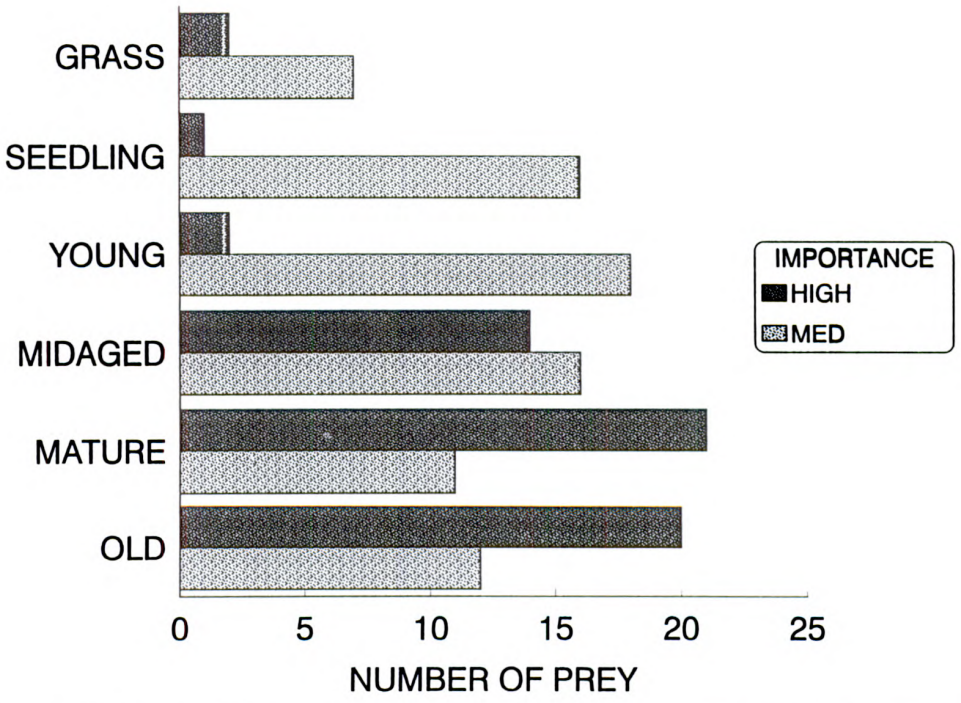

Figure 3—Importance of vegetative structural stages for habitat of selected prey species. The VSS were defined as grass/forb/shrub, 0- to 1-inch trees; seedling, 1- to 5-inch trees; young forest, 5- to 12-inch trees; midaged forest, 12- to 18-inch trees; mature forest, 18- to 24-inch trees; old forest, 24-inch trees and larger (Reynolds and others 1992).

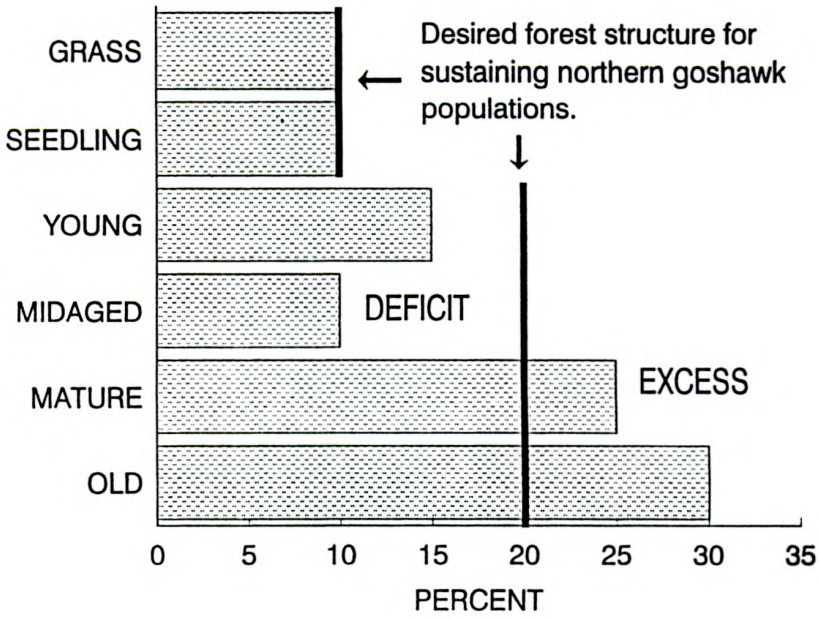

Figure 4—An example of the distribution of VSS showing an excess of trees in the mature and old forest classes and a deficit in the young and midaged forest classes. This type of forest structure would lend itself to regenerating a portion of the mature and old age classes.

The VSS proportions should be used as a reference for planning forest treatments. For example, if more than 40 percent of a goshawk home range was in mature and old forests, treatments could be planned to regenerate a portion of these areas to direct the forest towards the desired structure (fig. 4). As a reference, the VSS proportions for managing goshawk home ranges do not replace sound forestry and site specific prescriptions. In the Southwest, because of timber harvesting, fire exclusion, and grazing, large tracts of ponderosa pine forests have multiple canopies often containing a high proportion of white fir (*Abies concolor* Lindl.) and Douglas-fir (*Pseudotsuga menziesii* (Mirb.) Franco.) understories. Removing the ponderosa pine overstory from these forests, using the desired VSS as a guide, would leave a suppressed, disease and insect susceptible forest (fig. 5).

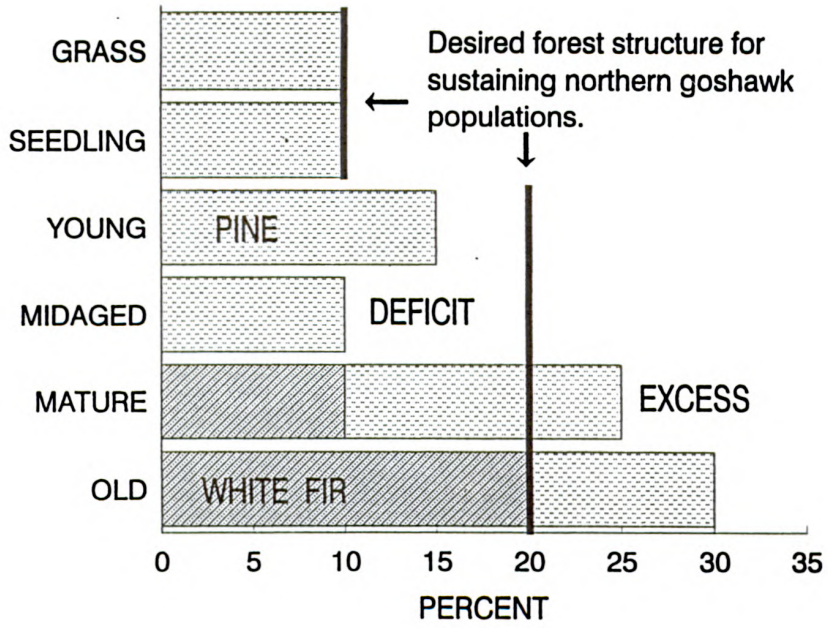

Figure 5—An example of the distribution of VSS showing an excess of trees in the mature and old forest classes, but a portion of these classes are white fir, a species prone to disease and insect attack. If the ponderosa pine were removed leaving these trees, an undesirable and unstable forest would result.

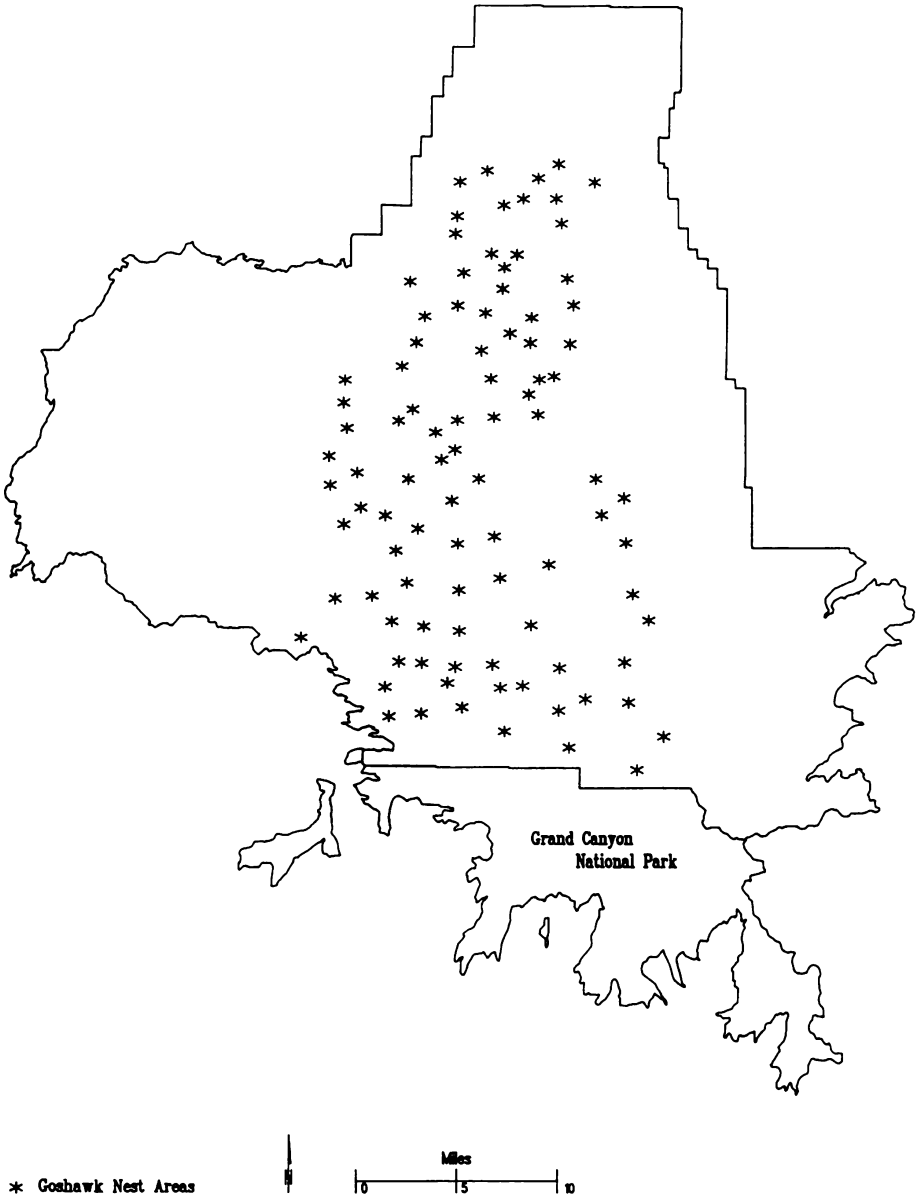

Figure 6—Map showing goshawk nest area locations with potential overlapping of foraging areas.

Goshawk home ranges can occur at densities greater than one per 5,400 acres as assumed in the recommendations (Reynolds and others 1992). Goshawks do not choose nests randomly but they are chosen based on forest conditions. Because of the forest conditions on the northern side of the Grand Canyon on the Kaibab National Forest, the density of goshawks is approaching one nest area per 2,000 acres, leading to overlapping foraging areas (fig. 6). It would be difficult to apply the recommended VSS distribution and sustain goshawk habitat on these small areas, but, unfortunately, it is being attempted.

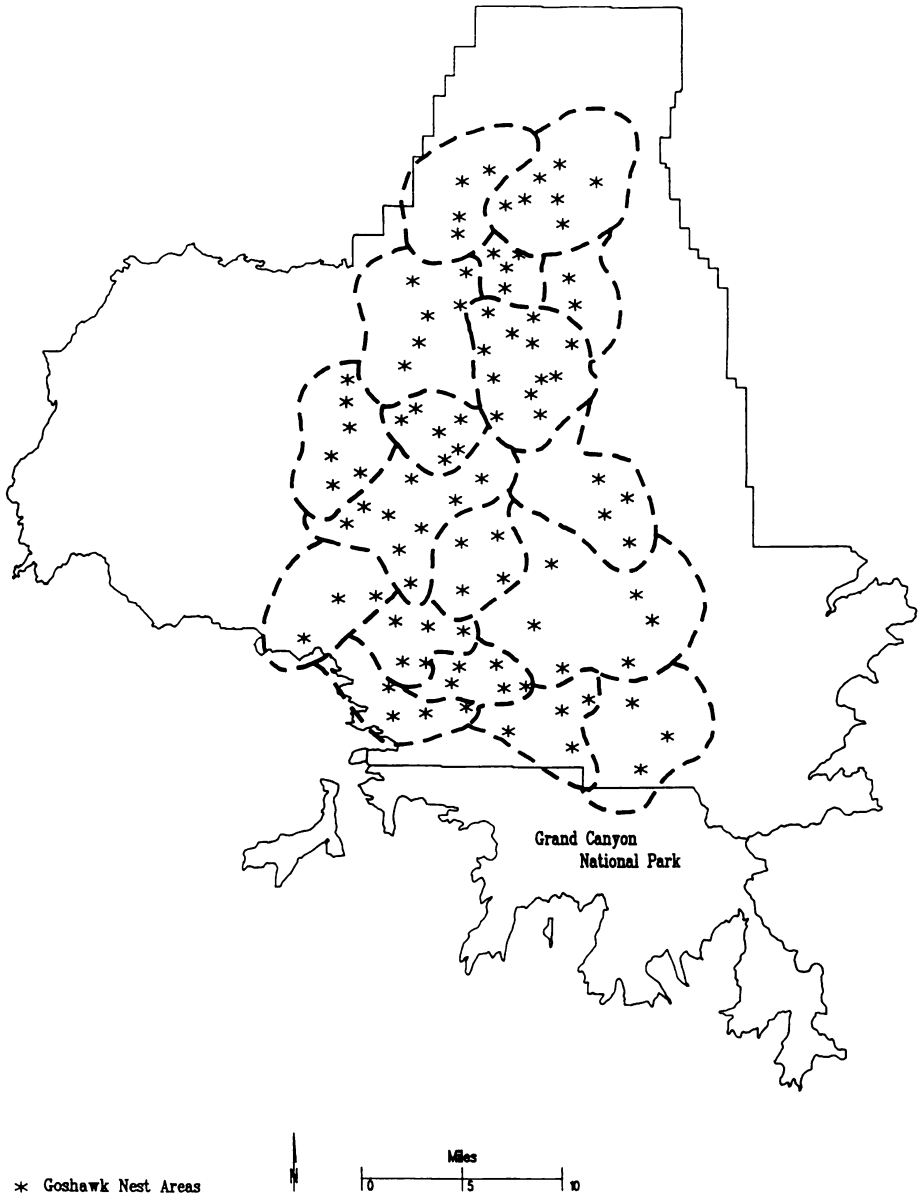

Figure 7—Map showing the grouping of goshawk nest areas, post-fledging family areas, and foraging areas.

An alternative to analyzing and managing these small discrete goshawk home ranges would be to group them into larger units. Units might include 5 or more home ranges and be as large as 10,000 acres (fig. 7). Areas of this size could be more easily managed using the goshawk recommendations (Reynolds and others 1992). Even though the recommendations offer a design that can be used at a landscape level, which is a departure from traditional forest management in the Southwest, they do not include many attributes of ecosystem management.

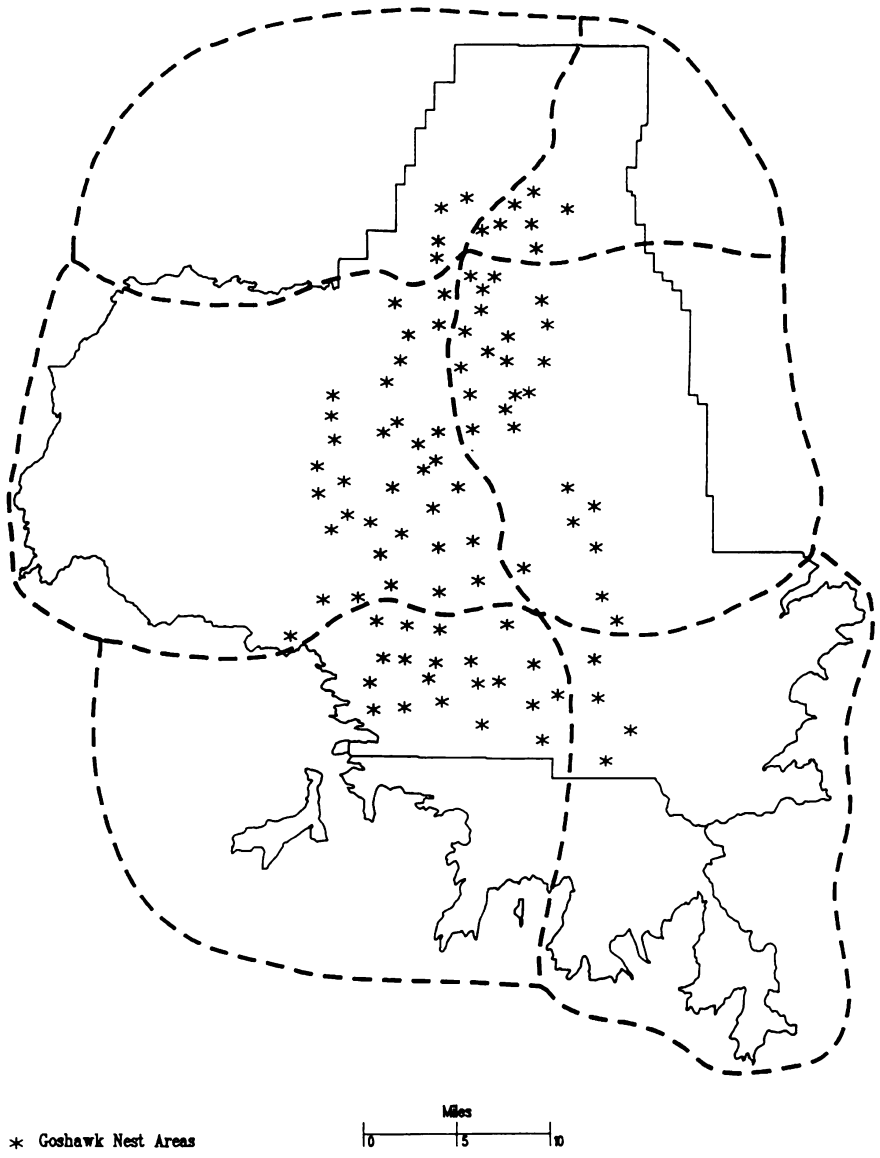

Figure 8—Map showing the development of ecological assessment and management areas of enough size to include and sustain a wide range of ecosystem processes and functions. These units could cross vegetation types, land ownership, and political boundaries.

Ecosystem Management

Ecosystem management which is evolving, can be viewed as blending the economic, social, and ecological needs when managing forest lands. Although the goshawk recommendations included many of these characteristics, they still did not provide a complete framework for ecosystem management. The best approach for accomplishing ecosystem management should use large areas encompassing watersheds or multiple watersheds as the primary analysis unit. For example, on the Kaibab National Forest an alternative to managing and analyzing individual goshawk home ranges, or even groups of home ranges would be to analyze and manage landscapes encompassing not only national forest lands but include other Federal, State, and private lands (fig. 8).

An ecosystem approach on these large landscapes would involve spatial and temporal analysis within a hierarchy of scales (global to site and past to future). This methodology entails developing reference conditions based on the structure and function of ecosystems at the various scales (Bourgeron and Jensen 1993). Ecosystem elements in the analysis could include, for example, insect and disease activity, patch size, vegetative and seral

stages, and the risk of fire. Reference conditions for these elements could be determined using historical information, studies on past forest development, forest process models, and other information (Swanson and others 1993). These reference conditions could be compared with existing conditions at different landscape scales to determine if treatments would be advised for directing ecosystem development towards more sustainable conditions (fig. 9). In addition, this analysis technique could be used to show the consequences of management alternatives (campground development, high yield forestry, etc.) especially when multiple agencies and landowners would be involved.

Conclusions

The recommendations for managing goshawks started by using a single species approach, but it soon became apparent that this strategy was not appropriate. The goshawk and its prey involved many different habitats, vegetative structural stages, and forest landscapes. Although the recommendations did not explicitly include other important wildlife, they provided the impetus towards ecosystem management in the Southwest. It became apparent that in order to effectively maintain goshawks, forest ecosystems had to be sustained and the practice of silviculture could provide the tools to do so.

The practice of silviculture has always been closely linked with the production of timber products (Fernow 1916). In producing timber products, silviculturists developed a tremendous amount of knowledge on forest ecology for regenerating and tending forests. As shown by the goshawk recommendations, silvicultural practices can readily be used to create stand and forest structures for sustaining a wide variety of wildlife. Because of the changes in forests caused by natural processes, timber harvesting, fire exclusion, grazing, and urban encroachment, it is likely that some type of active management beyond fire control is going to be required for sustaining western forests. The silvicultural practices used for the production of forest crops can also be used to develop silvicultural systems for sustaining forest ecosystems. In the past the practice of silviculture was associated with the production of forest crops, today it should become intimately associated with ecosystem management.

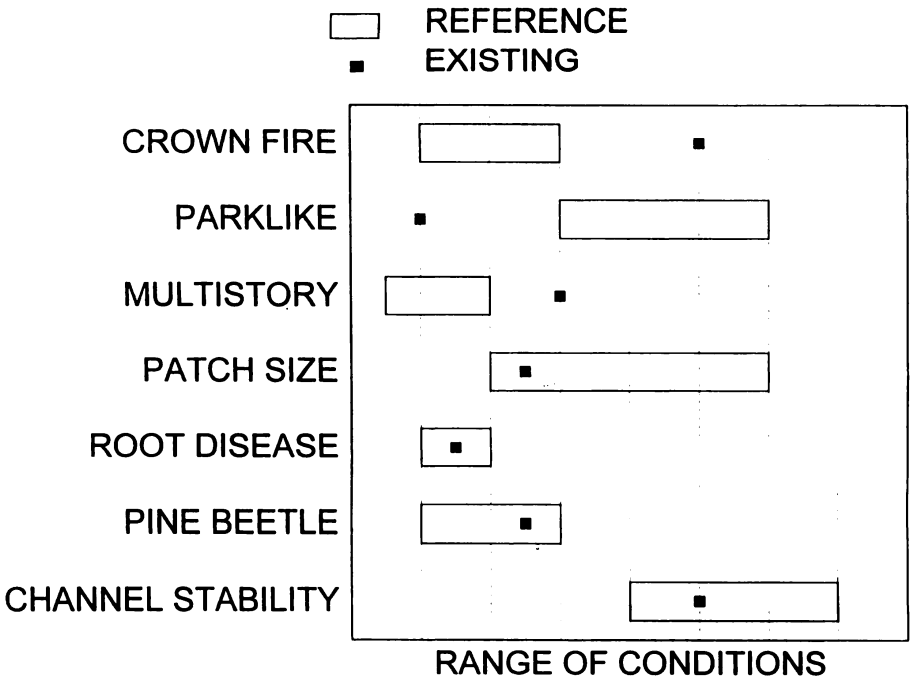

Figure 9—An example of how reference conditions could be used to evaluate if existing forest conditions would be outside the range of conditions that might be sustainable.

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