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DETERMINING THE STATUS OF NORTHERN GOSHAWKS IN THE WEST:
IS OUR CONCEPTUAL MODEL CORRECT?

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In federal district court in Tucson, Arizona recently, a case was heard regarding the status of the Endangered Cactus Ferruginous Pygmy-owl (*Glaucidium brasilianum cactorum*) and development in the Tucson basin (Defenders of Wildlife vs. Amphitheater School District). The western population (Arizona) of the Cactus Ferruginous Pygmy-owl had been listed in 1997 under the Endangered Species Act (ESA), and a local school district wanted to build on an area allegedly used by one or more

owls. Defenders of Wildlife, as the plaintiff, was suing to stop the development. Owls had been seen just north and south of the boundary of the property in question, and the attorney for the defense built part of her case on the fact that an owl had not actually been seen inside the property boundary. She used this "uncertainty" about the owls' use of the property, as well as other aspects of its little-known ecology in Arizona, to her advantage and stated in court "there comes a point where the

best evidence available isn't good enough" (Nintzel 1998).

That statement is a big problem for biologists in court, and one that could always be used against us. The "best evidence available" will always involve uncertainty because our best data are usually sample data, which, by definition, contain uncertainty (Ramsey and Schafer 1997), and we will rarely have all the data we need. "Uncertainty" is not a negative concept in science, but part of the process (Murphy and Noon 1991, Williams et al. 1996). The courts, however, view uncertainty as equivalent to "a shadow of doubt." If conservationists are always charged with the burden of proof, we will more often than not lose in court, which is where conservation and resource management decisions are made with increasing frequency.

The status of the Cactus Ferruginous Pygmy-owl has implications for a small part of the world—the few parcels of undeveloped land in the unplanned and overdeveloped Tucson basin of southern Arizona. The status of another raptor, the Northern Goshawk (*Accipiter gentilis atricapillus*) has much broader implications. The goshawk is distributed in forested areas throughout much of North America, and the implications of listing this species as Threatened or Endangered under the ESA are far-reaching and important, perhaps even more so than the listing of the Northern Spotted Owl (*Strix occidentalis caurina*) as a Threatened Species in 1990. Like the Northern Spotted Owl, the goshawk is a forest raptor dependent, at least partially, on older forest, and thus millions of dollars worth of timber are involved. This certainly heightens the interest of the public, the Congress, and the courts. In addition, the goshawk occurs over a much broader geographic area than the Northern Spotted Owl. Regardless of the final decision to list or not list the goshawk, court is likely where we are headed.

This paper represents some thoughts on the status of goshawks in the West, including a review of recent events that helped shape the debate over Endangered Species management, a summary of available data on goshawk ecology, some suggestions for additional data that could or should be collected, and some questions on how professional biologists, environmental groups, and society in general invoke and use the ESA. It is also a forum for me to air some of my own uncertainties regarding the status of this species and some suggestions for courses of action for its management and conservation. I hope that any or all of this fosters additional discussion. I focus on goshawks west of the 100th meridian, and refer to this as the West, because that has been the geographic scope of recent listing petitions (U.S. Fish and Wildlife Service 1998b) and includes the area where most of the recent ecological and demographic research has occurred (Block et al. 1994, Kennedy 1997, Squires and Reynolds 1997). Finally, I make liberal use of the pronoun "we" throughout the paper to emphasize the idea that conservation issues are the concern and responsibility of all cit-

izens, and to deemphasize the concept of "us" vs. "them" that so often plagues conservation debates.

A RECENT HISTORICAL PERSPECTIVE

Northern Spotted Owl as Conservation Model. It would be a mistake to evaluate the status of any candidate species for listing under the ESA, and particularly any forest raptor, without first considering the history and implications of the Northern Spotted Owl issue in the Pacific Northwest. Yaffee (1994) called the spotted owl controversy a "watershed event" in resource and environmental policy. In many ways we entered a new era in conservation, with myriad implications in policy, politics, and public relations. Important among them was a stronger focus on ecosystems as the public, through the media, saw the extent of the destruction of old-growth forest (i.e., native forest unaltered by human activities with natural processes [e.g., hydrology, succession, wind-throw, fire] intact). The alteration of ecosystems in North America was not new—consider, for example, wetlands, prairies, and deserts—but the focus and level of attention was something different. Equally important was a demonstration of the power and reach of the ESA. This law became a potent tool for environmentalists; any citizen could petition for a listing (Rohlf 1989), and if listing occurred, there was legal power to alter the rate of resource extraction.

Bridging concerns over the loss of old-growth forests and the power of the ESA to change that trend was perhaps an ideal species: a somewhat mysterious but easily photographed (and thus newsworthy) owl that was an old-growth obligate (Forsman et al. 1984). The listing of the Northern Spotted Owl under the ESA as a Threatened Species brought harvest of old-growth timber in the region to a standstill, an environmental issue to the attention of the nation, and a president to Portland, Oregon for a national meeting. The old growth-Northern Spotted Owl model of controversy, confrontation, and conservation became a template for protection of nature.

A Parallel Course? During the latter stages of the spotted owl issue, Crocker-Bedford (1990) published a paper on goshawk reproduction and forest management in Arizona, citing a correlation between excessive timber harvest and loss of goshawk breeding territories. Petitions to list the goshawk soon followed (Kennedy 1997). At issue again was not only concern for the continued existence of a species, but a desire to stop logging in old-growth forest: not just the mesic forests of Douglas-fir (*Pseudotsuga menziesii*), western hemlock (*Tsuga heterophylla*), and firs (*Abies* spp.) west of the Cascade Range, but the much more widespread drier forests of Ponderosa pine (*Pinus ponderosa*), lodgepole pine (*P. contorta*), and mixed conifers of the interior West. We had just seen a demonstration of the power of the ESA to slow the pace of timber harvest to the benefit of Northern Spotted Owls; perhaps this was the best course for the goshawk.

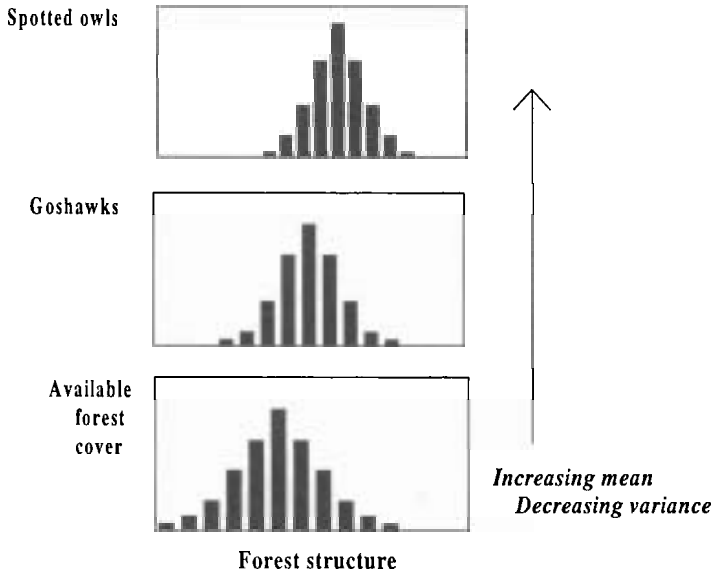


Figure 1. Theoretical graphs comparing Northern Spotted Owl and Northern Goshawk use (e.g., for nest or roost sites) of old-growth forest structure (e.g., density of large trees, high overstory canopy closure) to forest structure available on the landscape. Preponderance of old-growth characteristics increases to the right of the x-axis. Northern Goshawks use a wider range of forest structural stages than Northern Spotted Owls, but use older forest more than it is available on the landscape. See text for additional discussion.

GOSHAWKS AND OLD-GROWTH FOREST

Early petitions to list the goshawk prompted a thorough examination of past studies and a host of new studies by independent researchers in several western states (Squires and Reynolds 1997, Daw et al. 1998). Most of these studies focused on nesting habitat, partly because of the importance of breeding biology to the ecology and management of goshawks, but also because it was difficult to approach research on this elusive species in any other way. These studies may be criticized as a duplication of effort, but when one examines them as a group, an interesting and important pattern emerges: goshawks, regardless of region or forest type, tend to select stands with large trees (e.g., >53 cm dbh; Daw et al. 1998) and relatively high canopy closure (e.g., >50–60%; Ward et al. 1992, Daw et al. 1998) for nesting (see Daw et al. 1998 for a summary of research).

I believe it was a combination of our recent experience with Northern Spotted Owls and the pattern of goshawks nesting in forest stands with old-growth characteristics that led many to believe that the goshawk was an "old-growth species." Reynolds et al. (1992) described what might be optimal goshawk habitat in the southwestern U.S.: it included not only a large percentage of the landscape in older forest, but also a mix of stand types and ages that provides for a variety of prey and takes into account forest stand dynamics (Graham et al. 1994). Importantly, the southwestern management guidelines in-

corporated timber harvest as a mechanism to achieve the desired mix and distribution of forest structural stages.

Fig. 1 illustrates, in a very general way, one idea of how Northern Spotted Owls, goshawks, and forest cover may relate to one another over a broad geographic scale. The x-axis can be any forest structure variable or combination of variables that characterize old-growth forest (increasing size of trees, density of large trees, and/or overstory canopy closure); the further right one goes on the x-axis the more prevalent are those characteristics. The y-axis represents increasing frequency of occurrence; for owls or goshawks it could be number of nest or roosting sites; for available forest cover it is the frequency of occurrence for a particular structural stage on the landscape. Although these graphs are theoretical, data exists to support them (Ripple et al. 1991, Siders and Kennedy 1996, McGrath 1997). The top graph shows that Northern Spotted Owls are found mostly in older forest, with limited variation around the mean, indicating the importance of older forest to their existence. The second graph shows goshawks as being found in a wider variety of forest structural stages compared to spotted owls. Older forest is important to goshawks, but goshawks are more of a forest generalist than are spotted owls. Finally, the third graph illustrates general forest structure across much of the West, based on measurements taken at random points as an index of "availability" (Manly et al. 1993). Compared to the graph for goshawks, the mean is cen-

tered over younger forest and there is wider variance. The relative positions of these three graphs probably would be expected even for pristine forests. Today, however, forests in the West have clearly been forced to earlier structural stages (i.e., forest structure has been "pushed" to the left side of the graph).

The changing structural stage of forests is a trend that should and does concern us. Setting forest succession back through clearcutting old-growth forest west of the Cascade Range has had important implications for Northern Spotted Owls—enough to list the species as Threatened. The effect that multiple entry selective cutting on Ponderosa pine and other dry forest tree species has had on goshawks is also of concern, but the implications are less clear. Given that forest management practices are likely affecting even this relatively versatile forest raptor, the question becomes how to respond to that concern. One possible response is to list the goshawk as an Endangered Species, which would likely stop or at least slow the cutting, as it did for the Northern Spotted Owl. Based on this logic, a series of petitions by environmental groups to list various segments of the goshawk population in the West began in the early 1990s and has continued unsuccessfully well into the decade (U.S. Fish and Wildlife Service 1998b).

THE DATA WE HAVE

Demography. In response to the petitions to list, Kennedy (1997) reviewed the available published literature on the subspecies *A. g. atricapillus* in North America and conducted analyses on demographic data from two populations in New Mexico and Utah. She evaluated the claim that goshawk populations were declining in North America, stating that evidence of a decline would include range contractions, decreases in density, or decreases in fecundity or survival, which might translate into a negative rate of population change (λ). Based on this approach, she concluded that there was no evidence to support the contention that goshawk populations were declining. Importantly, she stated that this result could be interpreted in two ways: goshawk populations are not declining, or goshawk populations are declining but the decline has not been detected. The latter interpretation would be a Type II error and, as such, is of concern to conservation biologists (Steidl et al. 1997).

Kennedy's (1997) review was an important and necessary step in examining the status of goshawks. Cole Crocker-Bedford and Shawn Smallwood have taken issue with Kennedy's approach and have pointed out problems that can arise in collecting and interpreting demographic data. However, demographic information, as difficult as it is to collect, is vital to understanding population dynamics: the available demographic data on any species considered for listing must first be assessed (*sensu* Kennedy 1997) before collection of additional demographic data can be improved (*sensu* Smallwood 1998).

Habitat. Goshawks can be found in a variety of forest

cover types throughout the West (Squires and Reynolds 1997), and in that sense can be viewed as forest generalists. For any given forest cover type, however, goshawks tend to nest in stands with large trees and high canopy closure; their choice of nest sites could relate to microclimate, protection from predation, or something else, but the pattern is well-documented (Daw et al. 1998). Older forest may also be important in the postfledging family area (PFA) (Kennedy et al. 1994, Daw 1997). As one looks at forest cover at increasing distances from the nest, however, older forest becomes less prevalent (Daw 1997, Desimone 1997), and possibly less important (McGrath 1997). While older forest may be less prevalent on the landscape in general because of past timber management activities, older forest away from the nest may be less important to breeding goshawks than older forest immediately around the nest.

Prey. Goshawks hunt in older forest and may even prefer it if it is available (Bright-Smith and Mannan 1994, Beier and Drennan 1997), but they also hunt in a variety of vegetative cover. For example, in eastern Oregon it was not uncommon to see goshawks hunting in open sagebrush (*Artemisia* spp.), and we often found ground-squirrels (*Spermophilus* spp.) in prey remains (Cutler et al. 1996). In addition, some of the most important prey of goshawks are lagomorphs and grouse, particularly snowshoe hares (*Lepus americanus*) and Ruffed Grouse (*Bonasa umbellus*). These species provide more biomass than most other prey, and reproductive output in goshawks may be negatively affected when large-biomass prey are not available (Doyle and Smith 1994, Iverson et al. 1996). Snowshoe hares and Ruffed Grouse inhabit early successional stage forest and are key species in the ten-year cycle in northern North America (Doyle and Smith 1994). There are also very important relationships between prey abundance and availability for foraging goshawks, and forest structure plays an important role in goshawk foraging habitat (Beier and Drennan 1997, DeStefano and McCloskey 1997).

THE DATA WE NEED

Demography. Demographic data are vital, but studies must be properly designed and be long-term or the results are difficult, if not impossible, to interpret (DeStefano et al. 1994). A study of goshawk demography and habitat use on the Kaibab Plateau, which is probably the longest running study on the species to date, is approaching a long-term basis. However, funding waxes and wanes as the threat of listing the goshawk comes and goes (R.T. Reynolds pers. comm.). Unreliable funding for needed long-term studies is short-sighted and counter-productive. The U.S. Forest Service and other federal agencies must commit to studies that run greater than 10 years, as the answers we need cannot be determined in two to three years. Estimating the rate of population change (λ) for a species such as the goshawk may simply be too difficult and take too long for the listing process. Nonethe-

less, data on reproductive rates and survival are critical to understanding the ecology of goshawks and their likely response at a population level to changes in their habitat. It is worth considering if and how one can design and implement good demographic studies on goshawks before we dismiss them altogether.

Related to this, listing decisions based on migratory counts of goshawks would also be problematic, given the importance and influence of cyclic prey in the boreal forest and the capability of goshawks for long-range movements in response to declining prey. It would be difficult to assess trends in goshawk numbers based on migratory count data alone, even over a long period of time. However, migratory counts combined with other demographic data could provide important additional information on goshawks (Bildstein 1998).

Habitat. With some exceptions (e.g., *A. g. laingi* in southeast Alaska, *A. g. apache* in the Southwest), another study on nesting habitat of goshawks in the West may not be necessary. However, there remains plenty to learn regarding how juvenile goshawks use habitat within PFAs and how adults use habitat to forage. Also, very few habitat studies have been conducted in winter.

Documenting the distribution of all forest structural stages, including mature or old-growth forest, across the West would be an important step in the status review process. Such documentation will be important for a number of wildlife species, including goshawks, and has been suggested by Crocker-Bedford (1998) and Smallwood (1998). Recent efforts of the U.S. Fish and Wildlife Service in the latest review of the status of goshawks in the West showed how poorly information on forest stand structure is documented and/or available in a usable format (U.S. Fish and Wildlife Service 1998a). Low response rates on questionnaires sent to land management agencies and a wide variety of documentation, both in quality of information and methods used, make decisions on goshawk status based on habitat availability problematic. Although methods to gather and compile data on current forest conditions across the West need to be improved, future decisions on the status of goshawks ought not to be made based on the availability of old-growth forest alone. Concurrent data on demography and distribution of goshawks are also needed.

Prey. Because prey resources are so important to the population dynamics and distribution of goshawks, additional information on prey use, and the influence and interaction of prey abundance, availability, and habitat structure on goshawk populations, is needed. A multi-species approach, which includes predators, prey, and competitors, also moves us away from single-species management and more toward community and ecosystem approaches (Squires et al. 1998).

DISCUSSION AND CONCLUSIONS

There is little doubt that we have destroyed, fragmented, and otherwise altered old-growth forest in North

America (Norse 1990). In frustration to conserve remnant patches of old-growth, or any native ecosystem, the strongest tools of persuasion are going to be the ones most used. One such tool is the ESA. In the case of the Northern Spotted Owl and the temperate old-growth rainforest of the Pacific Northwest, this approach was prudent and necessary; listing the owl was the right course of action. However, before we take this action for the goshawk and list it as Threatened or Endangered, we need to ask if it is in the best interest of the species and the ESA itself. Listing decisions should be made regardless of politics (Sidle 1998), but politics are surely a part of the process, and political opposition to the ESA is real and strong. I am *not* advocating a weak stance on protecting species, just a reasoned one that considers our credibility as scientists and a judicious use of the ESA.

So, am I concerned about the status of goshawks in North America? Yes. Am I concerned about the loss of old-growth forest? Definitely. Should we list the goshawk to protect it and old-growth forest habitat? Probably not. This position may sound contradictory, given the case made for goshawks' use of old-growth forest, but it hinges on several considerations, such as the variety of structural stages that goshawks use, the importance of some early successional stage forest prey, the overwhelming pressure to list many species in the U.S.—several of which are truly threatened with extinction—that taxes our limited resources, and a concern that we invoke the ESA judiciously.

I recommend a different approach. I think there is time and opportunity to manage for goshawks in the West without listing. However, goshawks may currently be in the same position that spotted owls were in one to two decades ago. That is, some options remain, but if action is not taken now, far fewer options will be available later. To exercise some of our options now, I suggest the following: (1) provide funding and support to maintain current research similar to that on the Kaibab Plateau, and perhaps two or three additional and coordinated studies in other regions; (2) continue coordinated efforts to identify and map areas of remaining older forests across the West; (3) support the testing and evaluation of empirical habitat models that have been developed in the Southwest (Reynolds et al. 1992) and Northwest (McGrath 1997); (4) conduct on-site experiments to measure goshawk responses to silvicultural treatments; and (5) defer listing the goshawk under the ESA in favor of a coordinated national effort to assess habitat conditions, monitor populations, and evaluate habitat models and silvicultural treatment experiments (see Marzluff and Salabanks 1998, Squires et al. 1998). Federal and state land management agencies as well as the timber industry should be involved in this process. We should keep in mind, however, that listing remains an option and perhaps a necessity, but one that should be based more on coordinated scientific efforts than political agendas from either side of the issue. Resource agencies need to make

firm commitments now to avoid listing the goshawk later. It would also be beneficial to avoid court, where "truth" is not always based on the best science, but rather the most forceful argument.

There is growing dissatisfaction with single species approaches to conservation and management. We need to pursue research and management at all levels of organization: populations, communities, and ecosystems. The goshawk is a good candidate for this multilevel approach. However, if we were to base our plans for the conservation and management of old-growth forest solely on the goshawk, we may not like what we get. It is true that mature forest is important around nest sites and as a component of foraging habitat, but ideal goshawk habitat may include a sizeable portion of the landscape in early seral stage forest to encourage high populations of important prey such as lagomorphs and Ruffed Grouse. The distribution of seral stages that may be good for goshawks, however, may actually include less old-growth than some other species require (possibly Pileated Woodpeckers [*Dryocopus pileatus*] and American marten [*Martes americana*]).

Implementing the above recommendations would take our collective will and effort, and it would mean that the land management agencies most involved with goshawks would need to be proactive and support research, adaptive management, and monitoring for more than a few years. Terms like "proactive" and "adaptive management" are often used, but these concepts would need to be translated into action on the ground (Marzluff and Sallabanks 1998). Such actions, of course, will take quite a bit of money, but I couldn't agree with Smallwood (1998) more when he states that adequate funding should be made available to ensure the viability of wildlife populations.

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