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THE VALUE OF DEMOGRAPHIC AND HABITAT STUDIES IN DETERMINING THE STATUS OF NORTHERN GOSHAWKS (*ACCIPITER GENTILIS ATRICAPILLUS*) WITH SPECIAL REFERENCE TO CROCKER-BEDFORD (1990) AND KENNEDY (1997)

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Northern Goshawks (*Accipiter gentilis atricapillus*) have long been associated with mature forests, an attribute that has brought them into recent debates over forest management practices. Bent (1937) associated goshawks with extensive forests and large stands of big trees, and more recent research on their nesting habitat found an association with relatively large trees and relatively dense canopies (Shuster 1980, Reynolds et al. 1982, Moore and Henny 1983, Speiser and Bosakowski 1987, Crocker-Bedford and Chaney 1988, Hayward and Escano 1989). Reynolds (1989) described the foraging habitat during the breeding season as older, tall forest where goshawks can maneuver in and below the canopy while foraging. Most of the investigators cited above deduced that timber harvesting could impact goshawks, while others concluded that timber harvest actually had reduced goshawk abundance in portions of some states (Reynolds and Meslow 1984, Mannan and Meslow 1984, Bloom et al. 1985, Kennedy 1988).

I (Crocker-Bedford 1990) reported that the rate of nest reoccupancy in logged areas was 20–25% the reoccupancy rate in areas not logged, despite nest buffers having been left intact in the logged areas. This finding, along with deductions on the effects of timber harvest on the size of the local population, catalyzed additional research (Squires and Reynolds 1997) and debate. Many scientists (seemingly including Kennedy 1997) and forest managers were left confused over the methods and results of my research. Herein, I assess the strengths and weaknesses of my 1990 paper in order to move the debate on methodologies toward implementation of more productive resource management practices.

Kennedy (1997) emphasized the use of demographic studies in determining whether goshawks warrant Threatened or Endangered status under the United States Endangered Species Act (ESA; United States Government 1988); however, I assert that demographic statistics are unlikely to ever provide sufficient information to determine goshawk status under the ESA. In light of limitations in technology, funding and other problems, this paper suggests an alternative approach to status assessment Finally, hypotheses are presented on landscape-level habitat needs of goshawks, for use in goshawk status assessment, and as suggestions for further study.

REVIEW OF CROCKER-BEDFORD (1990)

My study area was the North Kaibab Ranger District of northern Arizona. I started nest monitoring in 1982 under a study plan having the objective of comparing the efficacy of different-sized no-cut nest buffers for goshawk

habitat protection. During 1973–84, U.S. Forest Service personnel located at least one goshawk nest within each territory discussed in my 1990 paper. I reported on reoccupancy during 1985–87 of individual nest trees and territories. I defined a territory as the area associated with a cluster of nests and reoccupancy as a nesting attempt. In most cases reoccupancy was proven by seeing a goshawk in a nest, but in some cases reoccupancy was inferred by detection of new greenery in the nest along with seeing goshawks nearby, or by finding recent goshawk feathers or egg fragments at the nest. Despite speculation (Kennedy 1997) that some of the located territories might originally have been occupied by other species, goshawks were seen on nests in 97% of the studied territories, while the single remaining nest cluster was presumed to belong to goshawks due to nest and stand characteristics plus goshawk activity near the nest.

Nests were located within timber sale assessment areas chosen by foresters: areas which I termed "locales." Timber sale preparation involved assessing every individual tree over roughly 83% of each locale, including all trees in nearly 100% of the stands suitable for goshawk nesting (described by Crocker-Bedford and Chaney 1988), so there was a high likelihood of finding at least one of the nests of a territory. Once a nest was located, the vicinity was extensively searched for alternate nests.

Harvests of dead and dying trees occurred almost everywhere in my study area from 1945–70. Control locales ($N = 9$; the smallest contiguous block was 4700 ha) did not incur timber sale harvest from 1970 until after nest monitoring was completed in 1987. Treatment locales ($N = 6$; the smallest contiguous block was 1000 ha) were harvested after treatment territories were located but before 1985. Nineteen control territories (nest clusters) were located within the control locales, while 12 treatment territories were located within the treatment locales. I did not include 40 other goshawk territories known by 1987 because they did not fit the above criteria. Partial harvests and selection harvests, not clearcuts, removed about one-third (range = 15–50%) of the sawtimber volume from about 79% (range = 73–86%) of the hectares in treatment locales. No-cut buffers were left around goshawk nests (small buffers were 1–3 ha; large buffers were 16–200 ha).

One strength of my study was that I demonstrated long-term nest-tree fidelity in the absence of habitat degradation. For individual nest trees in control locales, reoccupancy at least once in 1985–87 was equal between nests found in 1973–78 (67%) and those found in 1981–84 (65%). Despite no-cut nest buffers, I found that the average reoccupancy rate from 1985–87 in treatment locales was only 20–25% the rate in control locales. In 1987, the two nests occupied after treatment (occupied treatment nests) had zero and one nestling, while the 12 occupied control nests averaged 2.1 nestlings. No-cut nest buffers were similarly ineffective, whether small or large. Prior to the publication of my results, goshawk management recommendations concentrated on nesting habitat (Reynolds et al. 1982, Crocker-Bedford and Chaney 1988, Kennedy 1988). After my paper was published, the critical importance of hunting habitat throughout the home range was recognized (Crocker-Bedford 1990, Warren et al. 1990, Reynolds et al. 1992). The differences in breeding and reproduction between treatment and control locales were consistent with the extent of the timber harvests as well as literature showing that mature forest with denser than average canopy is the most selected foraging habitat (Widen 1989, Austin 1993, Bright-Smith and Mannan 1994, Hargis et al. 1994, Iverson et al. 1996, Beier and Drennan 1997).

These results were consistent with results I reported for the same study area (Crocker-Bedford 1987, Crocker-Bedford 1995). In the 1987 paper, I considered only nests known to be occupied in 1982–83, and compared their reoccupancy in 1984–85 according to whether logging occurred after they were occupied in 1982 or 1983. In the 1995 paper, I analyzed 1987 reoccupancy and reproduction from a larger number of territories ($N = 53$) in relation to the amount of timber harvest during 1973–86 within circles of 2.7-km radius around the center of each nest cluster.

Breeding population projections, based on results from my studies, were consistent with a nearly complete census of the study area made by Reynolds and Joy (1998). Given the reduced reoccupancy in logged locales, along with the amount of habitat logged, I (Crocker-Bedford 1990) estimated that by 1988 nesting pairs were probably reduced to half the 1972 breeding population. In the 1990 paper, I only considered breeding density surveys through 1985 because they had already been published (Crocker-Bedford and Chaney 1988) However, by 1987 I had goshawk survey data from six tracts totaling 270 km^2 which had not been harvested since 1970, and which averaged a breeding pair density of 12 or 13 pair per 100 km^2 (Crocker-Bedford unpubl data). Given 1200 km^2 within the breeding range of goshawks on the North Kaibab Ranger District, about 150 pairs may have existed circa 1972. If half were lost by 1988, the remaining breeding population would have been about 75 pairs. Data presented by Reynolds and Joy (1998) demonstrate that the comparable figure was somewhere between 49 and 73 pr during 1991–96. From a census of 95% of the goshawk habitat on North Kaibab Ranger District, Reynolds and Joy (1998) reported that 95 territories were occupied at least once between 1991–96, so about 100 territories remained on the District. Their mean annual rate of occupancy (defined as at least one goshawk seen at least twice within a territory; not necessarily a nest attempt as in my studies) was 73% Whereas 100% of my occupied control territories produced young, only 67% (range = 44–92%) of the occupied territories produced young in 1991–96 or, in other words, an average of only 49 pairs were successful from 1991–96.

My results also showed changes in the raptor community associated with treatment territories. While I never found another raptor nesting within 1 km of any control nest, other raptor species used nests or nesting stands formerly occupied by goshawks in seven of 12 treatment territories.

Comparisons of my 1990 paper involved the same years, and control and treatment locales were well distributed over the study area. As a result, comparisons were less likely to be confounded by factors such as weather conditions (Penteriani 1997), prey cycles (Doyle and Smith 1994), and inherent site productivity; these can confound correlations between demographic statistics and habitat differences over time.

My study was not biased by an inappropriate or inadequate nest search effort. The number of nest trees known per territory was the same for reoccupied controls (2.33), unoccupied controls (2.25), reoccupied treatments (2.33), and unoccupied treatments (2.44), which demonstrates that search effort was appropriately balanced. Furthermore, I reported the largest number of goshawk territories (71) and nest trees (157) of any published paper through 1990. Thirty-one of the territories, including 73 known nest trees, met the criteria for inclusion in my analyses, yielding the largest sample size of any study by 1990 on *A.g. atricapillus*. The differences between treatment and control locales were highly significant in terms of goshawk reoccupancy ($P = 0.001$, 0.003 and 0.01), number of nestlings ($P = 0.003$ and 0.001), and use by other raptor species ($P < 0.001$).

Despite its strengths, there were also several weaknesses in my 1990 paper. The difference between the number of nestlings found in occupied treatment and control territories may have been due to sample size. Few nests were occupied in treatment locales. As in almost all raptor research, my studied territories were neither randomly selected nor randomly assigned as treatments or controls. Therefore, the results should be considered correlative and not a true hypothesis test for cause and effect relationships.

Perhaps most importantly, the study was not designed to assess effects at the population level. In 1982, I was directed to compare the efficacy of small and large no-cut nest buffers for maintaining goshawk nest site usefulness. The 1990 paper should have explicitly stated implicit assumptions regarding estimates of population change. Despite no-cut nest buffers, some goshawks which had been nesting in the treatment locales before logging might have moved to unlogged areas for nesting. If so, the total nesting population may have been stable. Also, if breeders packed into unlogged areas, then surveys of pair density prior to treatment may have been artificially high. Moreover, the estimate of the size of the breeding population prior to any significant logging (circa 1945) was likely flawed, in that it was an extrapolation based on densities in the two locales harvested the least prior to goshawk surveys. The locales were too few and too small (1000 ha and 2750 ha) to provide a reliable estimate.

Some of my study's results may have been temporary The 1990 paper discussed how forest birds and tree squirrels (*Sciurus aberti* and *Tamiasciurus hudsonicus*) were reduced in numbers by selection harvests. However, I did not consider that other species might eventually increase in the more open forest, so that prey composition might shift (Boal and Mannan 1994).

COMMENTS ON KENNEDY (1997)

A species may be listed as Threatened or Endangered under the ESA due to any one of five criteria (United States Government 1988). Kennedy (1997) only dealt with the range contraction portion of one of these criteria, the present or threatened destruction, modification, or curtailment of its habitat or range (United States Government 1988).

Kennedy provided a literature review that, for the eastern U.S., showed that goshawks there were reduced in abundance during the 19th century and, since 1950, goshawk abundance has increased and the species' range has apparently expanded, logically due to reoccupancy as forested landscapes have increased and matured following the extensive deforestation of the 19th century. Perhaps she thought it obvious, but she should have explicitly stated that goshawks can be reduced in number and apparently even extirpated in landscapes where timber harvesting is too great, and that for most of western North America extensive timber harvesting did not begin until the 20th century.

Kennedy (1997) went to great lengths to present demographic statistics related to the rate of population change (λ). However, except in situations where the rate of population change is far different from neutral ($\lambda = 1.0$), it is usually impossible to calculate a meaningful λ for a sparsely distributed species. The number of samples, needed by each age class to calculate rates of pairing, natality, survival, emigration, and immigration, are typically so few from a sparsely distributed species that the calculated λ shows a confidence interval ranging from population increase to population decrease.

Demographic statistics generated from goshawk studies have additional problems. Some results vary with prey cycles (Doyle and Smith 1994) and weather (Penteriani 1997). Immigration and emigration may also vary (Squires and Reynolds 1997) and are affected by the degree of population isolation. DeStefano et al. (1994) describe problems associated with marking and resighting goshawks at nests, such as potentially underestimating survival. Maguire and Call (1993) determined that a λ based on data from existing goshawk nest sites can be biased high, so that a declining trend in habitat carrying capacity, where 1% is lost each year, produces certain extinction in populations whose growth rates are otherwise stable or increasing.

Reynolds and Joy (1998) could not determine λ,

though their study is so far the most intensive in North America on goshawk demography. Also, they held the advantage of starting with a large number of territories (known from the work of Crocker-Bedford 1990 and Zinn and Tibbitts 1990). In addition, because the study was conducted in one of the most isolated tracts of goshawk habitat, it should have been less affected by immigration and emigration. Since Reynolds and Joy's (1998) intensive and exacting demographic study could not determine λ for a relatively discrete and small study area, it is unlikely that sufficient technology and funding exist to determine whether regional populations are increasing, stable, or decreasing. Moreover, due to effects of weather and prey cycles, demographic data collected during one time period might have little relevance to another.

Kennedy proposed overcoming sample-size problems by pooling published and unpublished goshawk data into a metaanalysis. However, even a metaanalysis is unlikely to overcome the problems described above to a degree that would yield a rate of population change meaningful for a status review (i.e., a λ with a small confidence interval which is applicable over the long-term and an entire region). Furthermore, demographic data are not collected or stored by a consistent protocol. Finally, because the areas where goshawks have been studied have not been randomly selected and because some landscapes are probably population sources while others are likely population sinks, combining studies will not likely represent the true mean of a region.

These problems may explain why the U.S. Congress did not include a documented population decline as a criterion for listing a species under the ESA (United States Government 1988). Some scientists (e.g., Braun et al 1996, Kennedy 1997) seem to believe that results from demographic studies should prove that goshawks are decreasing over a large portion of their range before the species is entitled to special management. However, I suggest that some scientists may be so involved with demographic data and statistical analyses as to occasionally overlook the importance of deductive reasoning in management.

Kennedy also used unpublished demographic data from her goshawk studies, an approach which was inconsistent with her determination to not include results from non-peer-reviewed literature. Given her standard for others, I would have expected to see her studies peer-reviewed and published separately before appearing as summaries in her 1997 paper. Her presentation of unpublished studies was so brief that the quality of the methods, data and analyses, and appropriateness of the conclusions and inferences, could not be evaluated. For example, the increase in the number of territories found over the first five years of the Ashley study likely was meaningless with respect to population change. Moreover, three of the marked populations described by Kennedy have had little or no habitat modifications within about 90% of individual goshawk territories since the individual demographic studies began (Desimone 1997); therefore, it is not surprising that the studies did not provide evidence of population decline. Kennedy did not cite several agency reports that indicated reduced nest occupancy or reproduction, even though these had undergone more peer review than her demographic analyses (Bloom et al. 1985, Patla 1991, Ward et al. 1992, Arizona Game and Fish Department 1993, Maguire and Call 1993, Patla and Trost 1995).

She also neglected the extensive literature on the habitat relationships of goshawks, even though such literature is critical for evaluating the amount of habitat destruction or modification, a key listing criterion of the ESA (United States Government 1988). Goshawks apparently prefer stands of relatively large trees with relatively dense canopies for nesting and foraging (Moore and Henny 1983, Speiser and Bosakowski 1987, Crocker-Bedford and Chaney 1988, Widen 1989, Austin 1993, Bright-Smith and Mannan 1994, Hargis et al. 1994, Iverson et al. 1996, Beier and Drennan 1997). Typically, they select larger stands or less-fragmented landscapes (Bent 1937, Widen 1989, Speiser and Bosakowski 1987, Falk 1990, Bosakowski and Speiser 1994, Bright-Smith and Mannan 1994, Woodbridge and Detrich 1994), though some nesting stands are surrounded by areas that are naturally treeless (Swem and Adams 1992, Younk and Bechard 1994).

One purpose of the ESA is to provide a means whereby the ecosystems upon which Threatened and Endangered Species depend may be conserved (United States Government 1988, Sec. 2[b]). Ecosystem conservation may be one reason why any species, or any distinct population segment of any species (United States Government 1988, Sec. 3[15]), needs to be likely to become an Endangered Species within the foreseeable future in only a significant portion of its range (United States Government 1988, Sec. 3[19]) in order for the entire species or segment to be listed. What constitutes a significant portion of its range is debatable for the Northern Goshawk or the population segment west of the Great Plains. Because the goshawk is an indicator of ecosystem health (a predator of forest birds and medium-sized mammals), I would be concerned if its abundance was seriously declining in areas far smaller than during the 19th century in the eastern U.S. For the Northern Goshawk, I suggest that 100 000 km^2 is significant where forest cover once dominated the landscape, while a disjunct forest as small as 1000 km^2 might also be significant under the concepts of the ESA.

Kennedy concluded, "Although the concerns about overharvest of forested communities is certainly justifiable, listing a species for which there is no evidence of a population decline would be a misuse of [ESA] legislation." The ESA does not require evidence of population decline. Moreover, if concerns about overharvest of forested communities are justifiable, then this assertion by Kennedy supports one of her alternative conclusions that

"it is possible the goshawk is declining and the decline is going undetected because of the paucity of data on temporal trends in mortality and abundance." If forests in some regions are being harvested faster than goshawk habitat is developing, then goshawks in those regions will be impacted long before demographic analyses indicate problems such as those described by Widen (1997).

Kennedy did not fully report the data from my publications. The correct figure from Crocker-Bedford and Chaney (1988) for the number of nests studied was 74. Kennedy shows a question mark instead of the data. It appears that she might have intended the *N* in her Table 1 to be number of occupied nests. If so, then the correct figure for Crocker-Bedford and Chaney (1988) was 24 because the average occupancy rate of nests was 33%. She defined nest success as the proportion of occupied territories that produce at least one young of bandable age. She reported the figure as unavailable in Crocker-Bedford (1990). In fact, I reported 1.00 for occupied control territories and 0.50 for occupied treatment territories.

A Habitat-based Status Review

Kennedy concluded that a detailed analysis of 20th century deforestation and reforestation rates throughout North America would provide additional indirect information on potential temporal changes in the goshawk's range. I strongly support this recommendation. However, because reforestation generally refers to development of seedlings and saplings, I recommend analyzing forest maturation rates in order to emphasize habitat useful to goshawks.

In addition, for each North American region and forest type, goshawk habitat requirements should be estimated at three scales: the amounts of important habitats necessary to support a productive breeding pair; the composition within a landscape for a stable or increasing local population; and the composition within a region for a stable or increasing regional population. To estimate the habitat requirements, a committee of goshawk experts should be convened. These experts should represent diverse views and different regions. The committee should be chaired by a scientist who has not been influenced by the North American goshawk debates. Although the chairperson should be a strong facilitator of group consensus, the committee report should present alternative hypotheses.

Goshawks tend to hunt in mature forests, especially larger stands with relatively dense canopies, and goshawks are more likely to kill prey in mature forests. Nevertheless, goshawks may successfully forage in some open habitats (Kenward 1982, Reynolds et al. 1992, Swem and Adams 1992, Younk and Bechard 1994). This dichotomy is part of the current philosophical debate over whether management of publicly-owned forests should emphasize timber production, or emphasize pristine conditions including many stands of old trees and large tracts left to nature. Even if a silviculture system can produce both timber and goshawks, some people question whether it is appropriate for wildlife on publicly-owned wildlands Managers of public forests address such questions as they implement laws passed by elected politicians. To provide information for both philosophies, the committee of diverse goshawk experts should address management by silviculture to develop adequate habitat within a forest scheduled for logging, as well as management by habitat reserves including the sizes, shapes, structures, and spacings of old stands and large tracts to be left unharvested in perpetuity.

I hypothesize that home ranges are larger and territories are more widely spaced in landscapes where less area exists in stands useful for foraging. Kenward (1982) reported that home range size of goshawks varied to encompass a sufficient amount of prime foraging habitat. Breeding season home ranges typically vary from 6 to 35 km^2 (Squires and Reynolds 1997), although one adult in California ranged over 69 km^2 (Austin 1993) and two in Alaska each covered more than 600 km^2 (Iverson et al. 1996). Breeding pair density varies by an order of magnitude (Squires and Reynolds 1997).

Breeding pair density may depend on the amount of habitat where suitable prey is more abundant than some threshold and is accessible enough (forest structure) that the chance of prey capture in the habitat is worth the time and energy expended. This hypothesis is based on evidence from studies of habitat selection and home range sizes (Kenward 1982, Widen 1989, Falk 1990, Austin 1993, Bosakowski and Speiser 1994, Bright-Smith and Mannan 1994, Hargis et al. 1994, Iverson et al. 1996, Beier and Drennan 1997), as well as deductive logic. Goshawk home ranges would be smaller if goshawks were able to benefit from the total biomass of all the prey species within most habitats. The time for hunting is likely inadequate for goshawks to directly assess prey abundance and accessibility in every hectare of their large home ranges, so goshawks need search images for habitats that are likely to be useful. Furthermore, selection harvesting 10–39% of the area within home ranges had no apparent effect on reproduction in half the cases, while in the other half goshawk nesting seemed to be eliminated (Crocker-Bedford 1995), and I suspect this difference was due to whether harvesting occurred in important foraging habitats. Finally, even selection harvesting has the potential to degrade habitat below some threshold of usefulness, and it can reduce forest prey populations (Crocker-Bedford 1990).

I hypothesize that most forest structures and most area within the typical home range provide little or no benefit to goshawks. Consequently, timber operations that miss important habitats may have little or no effect on home range size or breeding density. However, timber harvests in important foraging habitat likely have effects disproportionate to their sizes.

CONCLUSIONS

Goshawk demographic trend studies typically require decades of data collection to be useful for population status assessment (Widen 1997). Even then, anyone who wishes to doubt the long-term results could assert that any trends found were really due to weather, prey cycles, inconsistent techniques, or inadequate sampling. Rates of population change (λ) for goshawks are also open to question owing to wide confidence intervals, inherently biased field techniques, and data representing few years and a small number of nonrandom study sites. Environmental degradation could continue for many years or decades while demographic data are collected, and habitat degradation might continue as litigants and their consultants debate whether the trend data or λ statistic are meaningful.

Studies comparing goshawk parameters in relation to forest management practices are unlikely to ever achieve all criteria of ideal experimental designs for hypothesis testing. No landowner will ever dedicate to goshawk research multiple large tracts of forest (>1000 km^2), nor is there likely to be adequate financing and enough time to locate most goshawks before the experimental treatment, gather pretreatment data, perform manipulations in randomly selected home ranges, wait for the manipulations to have their habitat effects, and then gather the comparison data. Still, comparison studies that fall short of the perfect experimental design will typically have fewer problems with confounding factors than will long-term trend studies of forest management effects.

Goshawk research that is funded to gather information for management purposes should compare goshawk parameters (e.g., demographic data, home range sizes, spacing of territories, habitat selection, diets) between replicates of similar landscapes under different management treatments. Whenever possible, data should be collected before treatment to demonstrate the pretreatment similarity of the landscapes with respect to the parameters studied. Retrospective studies allow more rapid insights into management questions at lower costs, and aerial photos can suggest pretreatment similarity (Ward et al 1992).

Because replicates of management treatments and controls are unlikely to ever be randomly assigned to areas large enough to fully encompass home ranges, scientists should explicitly recognize that goshawk field studies are correlative, and should not interpret their results as absolute proofs. Nevertheless, they should not be dissuaded from providing logical deductions based on data and literature, although they should also explicitly state their assumptions.

Goshawk experts from different regions, including proponents of divergent theories, should be brought together to consider landscape-level habitat requirements. After gathering information from forest inventory experts on forest-landscape changes, the team could assess whether goshawks in portions of the U.S. deserve protection under the ESA, which does not require habitat threats to be range-wide before listing a species or population segment. I hypothesize that goshawks are supported by only a portion of the habitats present, and that typically most of a home range (especially where trees are small or sparse) provides little or no sustenance to individuals.

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EVALUATING NORTHERN GOSHAWK (*ACCIPITER GENTILIS ATRICAPILLUS*) POPULATION STATUS: A REPLY TO SMALLWOOD AND CROCKER-BEDFORD

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Shawn Smallwood and Cole Crocker-Bedford present thought-provoking reviews of my recent paper on Northern Goshawk (*Accipiter gentilis atricapillus*) population trends (Kennedy 1997). In addition, Crocker-Bedford provides a detailed review of his controversial 1990 paper on forest management and its impact on goshawk reproduction (Crocker-Bedford 1990). Finally, both authors present their ideas on alternative approaches that might be used to evaluate the status of the goshawk. Here is my reply to their comments.

OBJECTIVE OF KENNEDY (1997)

Smallwood and Crocker-Bedford find fault with my paper because I did not include habitat analyses. They rightly claim that evaluating habitat loss is a key listing criterion of the Endangered Species Act (ESA). I do not disagree with them and think a thorough analysis of goshawk habitat data is an important component of a status review. But the aim of my paper was not to conduct a status evaluation for the listing proposal, which was clearly misunderstood by the two authors. A status review is the purview of the U.S. Fish & Wildlife Service (USFWS) and they just finished such an evaluation (Clark 1998). I merely evaluated the petitioners' claim "that goshawk populations have suffered significant declines." I wanted to see if the statements presented by the petitioners as fact indeed had empirical basis. I treated their statement as an hypothesis, proceeded to test this hypothesis, and found no support for their statements.

The goal of my paper was to conduct the first step in a status assessment and determine, in a scientifically thorough manner, if there is evidence of a population decline. I did not continue to the next step, that of determining reasons for a decline, because, as I stated in my paper, "Diagnosing a cause of decline is irrelevant if there is no evidence that a decline has occurred." Once some evidence of a decline has been documented then the cause(s) of the decline can be determined and appropriate conservation plans developed and implemented (Caughley and Gunn 1995). If there is no evidence of a demographic decline, how can we justify spending taxpayer dollars to develop and implement expensive recovery programs? Without demographic data, how does the recovery team establish achievable, quantifiable recovery goals as delisting criteria (see Pagel et al. 1996, Cade et al. 1997, and Pagel and Bell 1997 on the debate about recovery goals for American Peregrine Falcons [*Falco peregrinus anatum*])? The USFWS used a similar approach in their recent status evaluation where they examined evidence that goshawk populations were declining and then proceeded to evaluate the potential loss of goshawk habitat. They concluded that listing the goshawk as Endangered or Threatened west of the 100th meridian is not warranted (Clark 1998).

WHAT RESPONSE VARIABLES ARE APPROPRIATE TO EVALUATE GOSHAWK POPULATION TRENDS?

Evaluating Goshawk Trends Using Demographic Variables. There are two general approaches that can be used