Chancellor, R. D. & B.-U. Meyburg eds. 2004
Raptors Worldwide
WWGBP/MME

Science and the Conservation of the California Spotted Owl

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ABSTRACT

The California Spotted Owl *Strix occidentalis occidentalis* is not classified as threatened like other spotted owl subspecies. The conservation issues surrounding the owl are also unique because there are many owls and they are widely distributed. Thus it is difficult to estimate the status of the subspecies. I propose that the lack of threatened status designation for this subspecies is related partly to an initial scientific assessment that evaluated the owl's conservation needs. The original assessment team was the California Technical Assessment Team (CASPO), which evaluated the owl's status and proposed an interim conservation strategy in 1992. Their approach was based on strong science. Subsequent conservation plans have not displaced the CASPO strategy because they failed to follow a similarly rigorous scientific method. Following a decade of rejected alternative conservation efforts, I believe some key lessons to be learned from the CASPO approach are: 1) following accepted scientific methods establishes credibility; 2) collecting baseline information that conform to scientific standards; 3) acknowledging scientific uncertainty, while this allows criticism, is essential for progress because it helps identify areas of scientific weakness; 4) planning processes should be transparent (easily understood and observed by others) because transparency enhances the integrity of a process; 5) limiting inferences to the strength of data frames the proper interpretation of results; and 6) recognizing the limitations and needs of all interested parties helps focus scientists to work toward plans that are both scientifically defensible and acceptable to a larger public.

INTRODUCTION

The controversy over the conservation and status of the Spotted Owl *Strix occidentalis* is well known to raptor biologists (Gutiérrez *et al.* 1995). The genesis of this controversy is the result of the owl's association with old forests, which have very high commercial value. For example, the value of

unprocessed trees within a single spotted owl territory located within old growth Douglas Fir *Pseudotsuga menziesii* forest is approximately $8 million (Biles & Noon 1990). Protection under the U.S. Endangered Species Act affords protection for both the animal and its habitat. Consequently, there is a desire on the part of environmental interests to have the California Spotted Owl listed as an endangered species in order to protect its habitat. On the other hand, there is a desire on the part of economic interests not to have the owl listed as an endangered species because it could restrict logging or development. Wildlife managers are often caught in the middle of these competing interests when trying to develop conservation strategies to protect the owl. Forest managers often rely on scientists to provide information on the habitat requirements and population status of the owl. Thus the findings of spotted owl researchers are subjected to great scrutiny, perhaps more so than any other group of scientists working on an endangered species (Murphy & Noon 1991). As a consequence of this scrutiny, scientists studying spotted owls have been challenged to produce scientifically defensible conservation plans for the owl (Thomas *et al.* 1990, Verner *et al.* 1992a, USFWS 1995).

There are three subspecies of spotted owl: Northern (*S. o. caurina*), California (*S. o. occidentalis*) and Mexican (*S. o. lucida*) (AOU 1957; Barrowclough *et al.* 1999). Both the Northern and Mexican subspecies have been listed as threatened under the US Endangered Species Act (USFWS 1990, 1993). The California Spotted Owl has been denied listing by the US Fish and Wildlife Service (USFWS 2003) because of uncertainty about the population status of this subspecies and a proposed conservation plan developed by the US Forest Service which, presumably, would protect the owl's primary habitats. The California Spotted Owl is found in the Sierra Nevada of California, central coastal California, southern California, and Baja California, Mexico (Gutiérrez *et al.* 1995). The main range of the California Spotted Owl is the Sierra Nevada, which is a large mountain range of approximately 63,000km^2 (Davis *et al.* 1998). It has large areas of old growth forest, high biological diversity and impressive geologic features, making it one of the most important mountain ranges in the United States (SNEP 1996). In this paper, I briefly outline the history of owl conservation, particularly the California Spotted Owl, discuss a California Spotted Owl conservation plan with which I am familiar, and summarize some of my personal observations that might aid raptor biologists developing scientifically defensible conservation strategies.

SCIENCE AND SPOTTED OWL CONSERVATION

Northern Spotted Owl

The Northern Spotted Owl was listed as a threatened species because of declining populations and loss of habitat (USFWS 1990). Concurrent with the listing decision, an Interagency Scientific Team developed a comprehensive, scientifically defensible owl conservation strategy (Thomas *et al.* 1990). This conservation strategy formed the basis for both a spotted owl recovery plan and a comprehensive Pacific Northwest forest protection plan (USDI 1992; Thomas *et al.* 1993). Science provided the framework for Northern Spotted Owl

conservation planning (Thomas *et al.* 1990; Gutiérrez *et al.* 1996). Despite the rigour of these plans, they were strongly criticized by commercial and special interest groups (Murphy & Noon 1991). Nevertheless, the scientific bases for the plans were appropriate and defensible (e.g., see Beissinger & Westphal 1998). Thus they have withstood numerous political and legal challenges, and their effectiveness is probably being realized by the stabilization of previously declining populations in some areas (Franklin *et al.* 1999).

Mexican Spotted Owl

The Mexican Spotted Owl was listed as a threatened subspecies in 1993 because of past and potential future loss of habitat (USFWS 1993). Thus the listing was predicated more on the failure of U. S. federal land management agencies to conserve the species rather than on extensive scientific information as was the Northern Spotted Owl. Following the listing of the Mexican Spotted Owl, a recovery plan was developed which drew heavily upon an owl conservation strategy developed for the California subspecies (USFWS 1995, see also California Spotted Owl below). Some of the plan's tenets were to protect known owl sites, reverse the proposed trend toward even-aged tree management, and establish criteria for recovery. This plan did not receive the intense legal and political scrutiny of the Northern Spotted Owl plans, probably because the value of timber and the amount of privately held commercial forest were much less than in the range of the Northern Spotted Owl.

California Spotted Owl

California Spotted Owl technical assessment team.

Coincident with the listing of the Northern Spotted Owl, a team of scientists (the California Spotted Owl Technical Assessment Team; hereafter referred to as CASPO) was assembled at the request of federal and state authorities to evaluate the status of the California Spotted Owl (Verner *et al.* 1992a; Table 1). The goals of CASPO were to critically evaluate the status of the owl, characterize owl habitat, evaluate current land management, identify potential threats to the owl, evaluate a range of options for conservation strategies, and identify research needs (Verner *et al.* 1992b: 3). The desired outcomes of this process were to develop a plan that protected the owl and prevented its legal designation as an endangered species by fostering the development of a scientifically defensible conservation plan. In the following sections I briefly describe the approach used by this team, why the plan met the criteria of being scientifically defensible, why subsequent attempts to modify it failed, and why the plan has withstood the test of time, even though it was only designed as an interim plan (U. S. Forest Service 1993). The history, success, and failures of California Spotted Owl conservation planning provide an opportunity for a retrospective assessment of the issues that have application to planning for raptor conservation.

The status of the California Spotted Owl and its habitat.

CASPO addressed three fundamental questions: "is the owl declining?", "is the owl a habitat specialist?", and, if the owl is a habitat specialist, "is its habitat declining?" (Verner *et al.* 1992b). In all questions evaluated by

CASPO, they were framed as scientific hypotheses, with analysis of empirical data forming the basis for challenging these hypotheses. Moreover, the hypotheses, analytical methods and data supporting the analysis were explicitly stated. CASPO evaluated the first question by estimating the finite rate of population change (λ) using a Leslie Projection Matrix of the vital rates for three spotted owl populations (Noon *et al.* 1992). They found that while λ was less than one in the Sierra Nevada populations, the test did not have sufficient power to be certain that owls in some populations were declining. However, owls were declining in the San Bernardino Mountains, which was part of a hypothesized owl metapopulation in southern California. In addition, owl densities in the Sierra Nevada were lower than densities of Northern Spotted Owls in California, and the overall number of California Spotted Owls was substantially less than that of Northern Spotted Owls (Gutiérrez 1994).

Analysis of nesting and roosting habitats suggested that the owls were habitat specialists because they selected certain habitats disproportionately to their availability (Gutiérrez *et al.* 1992). Owls nested in forest types that contained the largest trees and highest canopy closure relative to other forest types, and they placed their nests in very large trees. However, it was unknown if this selection reflected a true requirement or optimal habitat. Timber harvest projections by the US Forest Service suggested that 74% of remaining owl habitat would be destroyed or altered appreciably (i.e. harvest of the largest trees which are usually associated with owl habitat) in the next 100 years (Verner *et al.* 1992b). These two findings, that owls were habitat specialists and that their habitat was projected to decline dramatically in the next 100 years, prompted the evaluation of conservation strategies. Of interest was the fact that owls were relatively widespread in the Sierra Nevada and were often found in habitats that had been partially logged in the past. These additional findings suggested that there was uncertainty about the effect of timber harvest on owl distribution and population dynamics.

Conservation strategies considered.

CASPO considered three conservation strategies; a spotted owl habitat area design (SOHA), a large reserve design, and an interim strategy that acknowledged the uncertainty of the data and analysis. The SOHA design was originally proposed for Northern Spotted Owls and consisted of 408ha habitat areas widely spaced throughout the landscape (US Forest Service 1988). CASPO rejected this strategy because it would isolate owl habitat and result in only a small proportion of the owl population and owl habitat receiving protection. The large reserve design strategy considered was the same as that implemented to protect the Northern Spotted Owl (Thomas *et al.* 1990). However, this strategy also was rejected because it was not evident that the current owl distribution reflected the suitable/unsuitable habitat dichotomy or distributional gaps observed in the Northern Spotted Owl range (Verner *et al.* 1992b). Thus, CASPO proposed an interim strategy that reflected both knowledge and uncertainty about the status of the owl. In addition, since the owls were widely distributed, the situation appeared to be different from that of the Northern Spotted Owl. Central recommendations of the plan included the

protection of core areas surrounding known owl sites, protection of specific habitat elements associated with owls (e.g., large trees, coarse woody debris), and application of a unique set of logging guidelines. The application of these logging guidelines allowed economic activity and reduced fire risk, while protecting key habitat features without creating large gaps in forest cover. This strategy was proposed as an interim (i.e., short-term) strategy until such time as new scientific information became available that allowed changes in the strategy. Since it was a short-term strategy, it allowed change only in habitat features that could recover quickly if the logging guidelines were inappropriate (e.g., trees in the Sierra Nevada can achieve a diameter of 76cm at breast height within approximately 50-150 years depending on site quality).

Table 1. Chronology of important recent events that potentially affect Spotted Owls and their conservation (not all events are discussed in the text).

Year	*Event*[1]
1990	Northern Spotted Owl listed as threatened species
1991	California Spotted Owl steering committee formed
1992	California Spotted Owl technical assessment report completed
1994	California Spotted Owl policy report completed
1995	First Spotted Owl US Forest Service environmental impact statement completed
1995	Mexican Spotted Owl recovery plan completed
1996	Revised Spotted Owl US Forest Service environmental impact statement completed
1996	Sierra Nevada Ecosystem Plan completed
1997	Spotted Owl Federal Advisory Committee report completed
1998	Quincy Library Group Act approved by US Government[2]
1998	Synthesis of new scientific information by US Forest Service
1998	Identification of current management direction by US Forest Service
2001	Sierra Nevada Framework conservation strategy completed
2001	US Forest Service issues Record of Decision on Framework
2001	California Spotted Owl petitioned to be listed as threatened
2001	USFWS sued to force listing evaluation
2001	Meta-analysis completed on California Spotted Owl population data
2003	California Spotted Owl listing decision denied by USFWS
2003	US Forest Service proposes significant changes to Sierra Nevada Framework

[1] Emphasis is on events that are important for the Conservation of the California Spotted Owl but two key events for the Northern and Mexican Spotted Owls are also listed.

[2] Quincy library group was an attempted political solution for the northern Sierra Nevada area that was affected by CASPO guidelines. It was not based on relevant science about spotted owls.

Post CASPO.

Following the publication of CASPO (Verner *et al.* 1992a) and its sister Policy Report (Ruth & Standiford 1994, Table 1), the US Forest Service implemented the interim strategy. Yet despite the scientific basis for the CASPO strategy, there was some resistance by local Forest Service managers to implementing the plan. Complaints about the guidelines included that they were too difficult to implement, did not allow sufficient local "flexibility" for forest management, did not allow enough harvest to make the sale of timber lucrative to private contractors, and did not allow sufficient timber harvest to reduce fire risk and the risk of tree pathogens. There also was criticism that the science was flawed because either the analytical procedures were not appropriate or no cause and effect relationships were established. Finally, environmental groups were critical of the plan because it did not advocate establishing large old growth forest reserves or eliminate logging.

Almost immediately following CASPO, the US Forest Service commenced work on a general environmental impact statement (EIS) to introduce a new owl conservation strategy (US Forest Service 1995, Table 1). The first EIS was severely criticized because there was no scientific basis to support a new management strategy. Thus this plan was discarded and a revision of the EIS commenced. The revised EIS (US Forest Service 1996) was also strongly criticized by a Federal Advisory Committee formed to evaluate the new management strategy (Federal Advisory Committee 1997). For example, the second EIS team did not estimate uncertainty associated with projections of future forest harvest or forest growth from models, and they included no new scientific information about the owl that warranted a radical departure from CASPO guidelines. Unlike CASPO, the methods used to derive forest growth and timber harvest projections were not entirely clear and the process was not transparent. The strength of the negative evaluation by the Federal Advisory Committee (1997), among other things, motivated the US Forest Service to synthesize new scientific information and to summarize existing management direction for the Sierra Nevada (US Forest Service 1998a, b). This information led to development of a comprehensive conservation and management strategy for the Sierra Nevada referred to as the Sierra Nevada Framework (US Forest Service 2001a, Table 1). The Framework developed a comprehensive plan that considered not only the owl but also other species and habitats throughout the Sierra Nevada. The comprehensive nature of this plan was viewed as both visionary regarding its attention to biodiversity conservation and destructive to local timber economies depending on one's perspective. Nevertheless, this plan was accepted in a "Record of Decision" (ROD) by the California Regional Forester of the US Forest Service (US Forest Service 2001b, Table 1). The year before the ROD was issued, a petition to list the California Spotted Owl as threatened was presented to the US Fish and Wildlife Service (USFWS), the federal agency charged with making such evaluations. When the USFWS did not respond to the petition within the legally mandated time period, it was sued by environmental groups. This suit forced the USFWS to engage in a status review of the California Spotted Owl (USFWS 2003). The USFWS deemed that the California Spotted Owl listing was not warranted, primarily because of

uncertainty about population trends and the management strategy approved by the ROD (USFWS 2003). On the same day that the USFWS announced this decision, the US Forest Service requested an *ad hoc* evaluation by owl scientists of a substantial revision of the ROD and Sierra Nevada Framework. Whether such a revision of the ROD will undermine the integrity of the USFWS decision is unknown at this time.

DISCUSSION

Throughout the past decade, the California Spotted Owl has been the focus of intense research and conservation planning. The original conservation strategy (CASPO) conceived for the owl was based on empirical data, sound scientific methods, and reasoned application of results and inferences to management guidelines. It withstood substantial criticism and challenge because the inferences were not extended beyond the support of data. In contrast, two major plans that followed failed because they did not exhibit the same degree of rigour and explicit exposition of methods and results as CASPO. In retrospect, some general ideas emerge which may help to guide other raptor biologists working to create scientifically defensible conservation plans.

Follow accepted scientific methods. Although this idea seems obvious, there is frequently inadequate exposition in raptor conservation work about hypotheses, methods, data and resulting inferences. CASPO was successful because it was explicit throughout the process. The types of questions we ask in raptor research are often not appropriate for gaining reliable knowledge about processes that govern population dynamics or habitat selection (Romesburg 1981, 1991). However, because the scale of experiments needed to answer many important conservation questions are beyond the logistical capabilities of many raptor biologists, new paradigms in analysis are emerging that allow more insight into processes and patterns of interest to raptor biologists (Anderson *et al.* 2000). Many standard statistical procedures that were acceptable twenty years ago are obsolete or inappropriate for many relevant questions (Johnson 1999, 2002). Often we are limited in the types of analyses we can perform or the questions we can ask because of the paucity of data, yet that should not constrain our attempts to be rigorous. For example, many spotted owl plans have been criticized for their weak elements, which was possible because the scientists were clear about their approach and limitations (i.e., they were honest and forthright about the limitations of their data). Such honesty often has been used by opponents of owl conservation plans to find the "weakest link" in information supporting a conservation plan. However, Murphy and Noon (1991:776) eloquently noted that a good conservation plan is not as weak as its weakest link but rather is as strong as its strongest link.

Establish baseline information. Raptor biologists excel at collecting field data. However, the utility of data is suspect if it lacks randomization (e.g., either study areas or animals are not selected at random), if it lacks replication (e.g. small sample size, one study area), if there is pseudoreplication (Hurlbert 1984), if methods cannot be reproduced (i.e. *ad hoc* and undocumented field

procedures), if it has unrecognized sampling bias (e.g. use of uncorrected index values, see also Anderson 2001), or if there is uncritical acceptance of supporting information (e.g. unverified vegetation maps used for habitat analyses). In other words, raptor biologists must refocus attention on study design as a primary element of their work. Johnson *et al.* (2001:1056) observe that bad analysis of good data can be corrected, but the reverse is not true.

Acknowledge and quantify scientific uncertainty. CASPO acknowledged uncertainty in several ways. First, the power analysis of the significance test for λ showed uncertainty that λ was less than one. An uncritical acceptance of the point estimates of λ would have logically led to a more restrictive plan, but it would not have been defensible. Second, heuristic assessments of the owl's distribution suggested protected conservation reserves may have imposed an artificial landscape on the bird and other wildlife. Third, data or analytical uncertainty were estimated using standard statistical procedures (e.g. coefficient of variation and estimates of variance). Analytical procedures, new software, new analyses and more powerful computers have become available since CASPO such that the CASPO team probably would not approach the problem in the same way today. Nevertheless, CASPO has not been supplanted by alternative plans because most alternative plans have failed to acknowledge uncertainty. For example, forest growth dynamics under a variety of competing scenarios have been projected in other plans to well over 100 years into the future but no estimate of uncertainty has ever been presented with the estimates! Without such estimates of uncertainty an inference that one management scenario is better than another is not appropriate (see also Federal Advisory Committee 1997).

Maintain a transparent process. By nature, scientists often work alone or in closely knit groups. This facilitates progress by allowing researchers to focus on goals. However, when raptor biologists are requested to work on controversial issues or issues of broad public interest, it would be worthwhile to consider inviting special interest groups to observe their work. Such invitations enhance transparency in the process and hence reduce the possibility of future allegations of unfair or unscientific processes.

Both CASPO and a newly formed California Spotted Owl meta-analysis team (Franklin *et al.* 2004; Table 1) invited observers from the primary federal land management agency, timber industry and an environmental group to observe and comment on the process. In some cases these individuals did not extensively participate in analysis or writing of reports, but they asked questions and voiced their concern over particular issues. Thus they were able to witness the thought process and deliberations of these teams. Indeed, some of their suggestions were quite insightful and led to fruitful avenues of investigation. Further, Anderson *et al.* (1999) advocated a formal, rigorous format for engaging in analysis of complex data or problems which would facilitate interaction among diverse parties.

Limit Inferences to Data. Again, this is an obvious suggestion. However, it is common practice to extend inferences beyond the ability of the data to support them. This may occur because we are so familiar with our study species that patterns emerge in our minds that unsuspectingly influence our

inferences. In the CASPO report, all point estimates of λ were less than 1. Rather than concluding that the populations were declining, however, a power analysis was done on the test of $\lambda \leq 1$ with the result that the power was too low to detect a difference. Furthermore, the inference was that it was unknown if the Sierra Nevada owl populations were declining (not that the populations were not declining). Despite our interest in the outcome of research, particularly that involving endangered or rare species, we must focus on the logical inferences that can be derived from the data. Extending inferences beyond the strength of evidence will ultimately lead to a loss of credibility for our research.

Recognize needs of public interest. Both special interests and the general public often have substantial interest in the outcome of raptor research because they are concerned either for the welfare of the species or for possible economic impacts of conservation actions. This is particularly true in developed countries. Nevertheless, developing countries also are increasingly facing challenges of sustainable use in the context of obtaining international support from various organizations (e.g. the World Bank and international aid departments of government agencies). Because raptors usually have low population densities, are visible and often charismatic fauna, they are frequently viewed as focal species of concern.

Developing conservation plans without considering the public interest is theoretically easier than considering public interests because one has only to determine those factors that are negatively affecting a species (e.g. habitat loss) and then correct them (e.g. create habitat reserves). Taking into account the public interest requires raptor biologists to consider plans that incorporate continued use of natural resources in a way that allows for either recovery or maintenance of the population. Devising plans that allow for continued, but perhaps more limited, use of natural resources while still realizing conservation objectives is often possible. In the CASPO plan, scientists devised a plan that allowed significant timber harvest while maintaining the primary elements of the Spotted Owl's habitat because they felt it was important to maintain some sustainable use of forest resources.

In summary, the original conservation strategy for the California Spotted Owl has set a standard against which all subsequent California Spotted Owl plans have been compared. The technical assessment upon which the strategy was founded followed accepted scientific methods and the process was transparent to the public. The strategy was criticized, but it withstood challenges because of its scientific soundness. What is important is not that the plan itself survives into the future, but that it sets a quality benchmark against which future plans will be judged.

ACKNOWLEDGEMENTS

Donald Mitchell read drafts of this paper. Funding was provided by the U.S. Forest Service (contract #FS/53-91S8-00-EC14) and the University of Minnesota. I thank the CASPO team, J. Verner, K. S. McKelvey, B. R. Noon, G. I. Gould Jr., and T. W. Beck, for their conservation work on the spotted owl.

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