CASE STUDY 3

Management of the Spotted Owl: The Interaction of Science, Policy, Politics, and Litigation

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Knowledge of scientific methods is not always enough in conservation management. Political pressures, legal proceedings, and policy decisions often dictate success or failure in a management scheme. The Spotted Owl epitomizes the high-visibility struggle that sometimes ensues when protec tive legislation restricts use of a resource. Success or failure in management often is determined by skills other than ecological knowledge.

The requisite skills for effective conservation planning, reserve design, or species management entail more than knowledge of the theoretical and applied principles of population and community ecology. These principles, plus an understanding of relevant species' ecologies, life histories, and habitat relationships, are essential components of any effective conservation strategy, but by themselves are insufficient to conserve most of the species about which we are concerned.

The process of developing a scientifically sound conservation strategy defensible to political attacks, likely to be adopted by society, and subsequently implemented, is often the most difficult and least discussed aspect of conservation biology. Many strategies, even those built on a firm foundation of defensible science, will fail if the biologists involved are inept at defending their plan against inevitable criticisms, or are unable to convince decision makers of the true costs to society of failing to implement the conservation actions.

Drawing on our experiences in conservation planning for both the Northern (*Strix occidentalis caurina*) and the California (*S. o. occidentalis*) Spotted Owls, our goals in this case study are to (1) briefly review the logic and methods used to produce scientifically credible plans; (2) focus on the tactics necessary to make a conservation plan resilient to attack; (3) contrast the Northern and California Spotted Owl plans; (4) discuss ways to explicitly address scientific uncertainty and incomplete information; and (5) provide suggestions to decrease the adversarial nature of conservation planning, and increase the influence of scientists and managers in the formulation of natural resource policy.

The Northern Spotted Owl

Perhaps more than any threatened or endangered species, the Northern Spotted Owl (Figure 13.11) epitomizes the struggle between groups representing disparate value systems in a land of limited resources and unlimited demands. The debate has been oversimplified as a choice between employment and economic vitality on one hand, versus species survival and rich, functioning ecosystems on the other. This dichotomy has provoked lawsuits and intense public and scientific disagreement; with rapidly diminishing options, it led the U.S. Congress and President Clinton to judge the Spotted Owl/timber harvest situation a conflict to be resolved at the highest political levels.

One effort at resolution arose from a 1989 amendment to an appropriations bill, in which Congress directed the U.S. Fish and Wildlife Service, U.S. Forest Service, National Park Service, and Bureau of Land Management to convene an Interagency Spotted Owl Scientific Committee (ISC) to "develop a scientifically credible conservation strategy for the Northern Spotted Owl." As members of the ISC, we struggled to develop a scientific protocol, using the rigor of strong inference (i.e., hypothesis testing, discussed below), that would allow consideration of both biological and nonbiological factors in development of a habitat conservation plan. The strategy developed by the ISC and presented to Congress (Thomas et al. 1990) is not the most recent proposal for resolution of the Northern Spotted Owl conservation crisis (Thomas and Verner 1992). However, the process, logic, and rationale employed has formed the foundation for all subsequent reserve design proposals for the subspecies.

Conservation planning for the Northern Spotted Owl has a long and complex history that reads like the plot of a political novel. Protagonists, antagonists, confrontations, disputes, secret memos, political pressure, litigation, media distortion, and personal attacks have been everyday players and events. Set against this background of political and legal turmoil, our challenge was to bring to the forefront all information pertinent to the preservation of the species and to provide a defensible conservation plan that appropriately considered scientific uncertainty and competing value systems.

Figure 13.11 The Northern Spotted Owl (*Strix occidentalis caurina*), a focal point of conflicts between endangered species preservation and short-term economic interests. (Photograph by David Johnson.)

The California Spotted Owl

Concern with, and studies of, the California Spotted Owl are more recent than for the northern subspecies. Consequently, its ecological associations are less well known, and it has not yet accumulated the contentious history of legal, political, and scientific debate that characterizes its northern counterpart.

Scientific and management interest in the California Spotted Owl was largely stimulated by release of the ISC report (Thomas et al. 1990), and by concern that some environmental groups were about to petition the Fish and Wildlife Service to list the California subspecies as threatened. In response, the Forest Service, California Department of Forestry, and other state and federal agencies established a scientific team to evaluate the status of the California subspecies and, if needed, to recommend changes in land management practices. The expectation was that a proactive management response would preclude the need to list this subspecies at a later date.

Hypotheses Tested and Reserve Design Principles Invoked

To determine whether the Northern and California Spotted Owls were threatened subspecies and in jeopardy due to logging practices, we tested the following null hypotheses:

1. The finite rate of population change (λ) of owls is ≥ 1.0 (i.e., the population is growing).
2. Spotted Owls do not differentiate among habitats on the basis of forest age or structure.
3. No decline has occurred in the areal extent of habitat types selected by Spotted Owls for foraging, roosting, or nesting.

The Northern Spotted Owl. For the Northern Spotted Owl, the first null hypothesis was rejected based on the observation that λ was significantly less than 1.0 at two long-term study sites (Thomas et al. 1990). Subsequent tests of this hypothesis, based on additional study sites and additional years of data (USDI 1992), indicate that populations of resident, territorial females declined significantly, at an estimated rate of 7.5% per year, during the 1985-1991 period. No studies have found areas of stable or increasing populations.

The majority of Northern Spotted Owl habitat studies supported rejection of the second null hypothesis and provided evidence in favor of selection of old-growth forests, or forests that retained the characteristics of old forests (Thomas et al. 1990). The exception to this pattern was in coastal redwood forests of northern California (< 7% of the owl's range) where owls are also found in younger forests that retain some residual old-growth components. Since the ISC report, numerous studies have confirmed that Northern and California Spotted Owls prefer old-growth habitat, providing additional falsification of hypothesis 2 (Solis and Gutierrez 1990; Buchanan 1991; Ripple et al. 1991; Bart and Forsman 1992; Blakesley et al. 1992; Carey et al. 1992; Lehmkuhl and Raphael 1993).

The rejection of hypothesis 2 led to the test of hypothesis 3. Based on data from National Forest lands in Oregon and Washington, the ISC found significant declines in the extent of owl habitat, a trend that was projected to continue into the future (Figure 13.12). Additional analyses since the ISC report provide evidence of significant habitat declines in California (McKelvey and Johnston 1992); regionally specific estimates of habitat loss are provided in the Draft Recovery Plan (USDI 1992).

Subsequent development of the conservation strategy was based, in large part, on the results of map-based tests of five basic principles of reserve design (Wilcove and Murphy 1992), stated as falsifiable hypotheses:

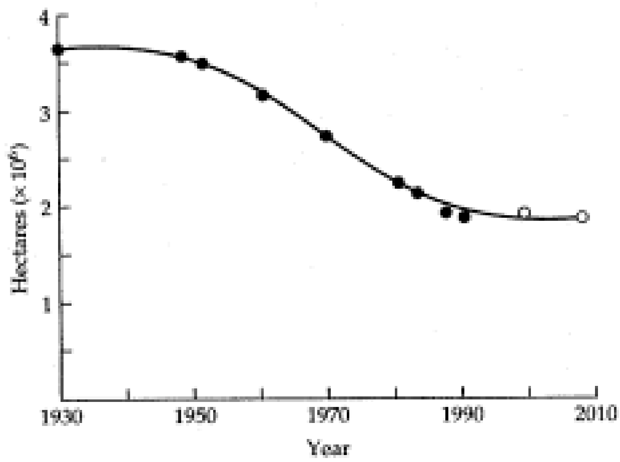

Figure 13.12 Estimated trend in the areal extent of suitable Northern Spotted Owl habitat in National Forest lands in Oregon and Washington for 1930 to 2010. Estimates beyond 1990 are projections based on National Forest plans.

1. Species that are well distributed across their ranges are less prone to extinction than species confined to small portions of their ranges.
2. Large blocks of habitat containing many individuals of a given species are more likely to sustain that species than are small blocks of habitat with only a few individuals.
3. Habitat patches (blocks) in close proximity are preferable to widely dispersed habitat patches.
4. Contiguous, unfragmented blocks of habitat are superior to highly fragmented blocks of habitat.
5. Habitat between protected areas is more easily traversed by dispersing individuals the more closely it resembles suitable habitat for the species in question.

Particularly relevant to a territorial species with obligate juvenile dispersal, such as the Spotted Owl, was the prediction from theoretical models of sharp thresholds for species extinction (Lande 1987; Thomas et al. 1990; Lamberson et al. 1992; Lamberson et al., in press; see also Chapter 7). One threat arises when the amount of suitable habitat is reduced to such a small fraction of the landscape that the difficulty of finding a territory becomes an insurmountable barrier to the population's persistence. Another occurs if population density is so low that the probability of finding a mate drops below that required to maintain a stable population.

One area of scientific uncertainty relevant to Spotted Owl reserve design was the size and spacing of reserve areas. Existing biogeographic principles were helpful, but too broad for specific application to the Spotted Owl problem. To address this uncertainty, we used computer simulation models, premised on Lande (1987), structured and parameterized in terms of the life history of the Northern Spotted Owl. The ISC determined the goal for conservation to be a 95% certainty of range-wide persistence for 100 years. Given estimates of the current amount of habitat, and its ability to regrow within 100 years, model results suggested that a minimum habitat size for locally stable populations would be a network of blocks, each capable of supporting at least 20 pairs of birds (Figure 13.13; Thomas et al. 1990; Lamberson et al. 1992; Lamberson et al., in press).

The California Spotted Owl. Demographic studies have been conducted for long enough to compute estimates of λ for two study populations in the northern Sierra Nevada of California. Estimates of λ for the Sierra Nevada populations were not significantly less than 1.0 (Noon et al. 1992). Even

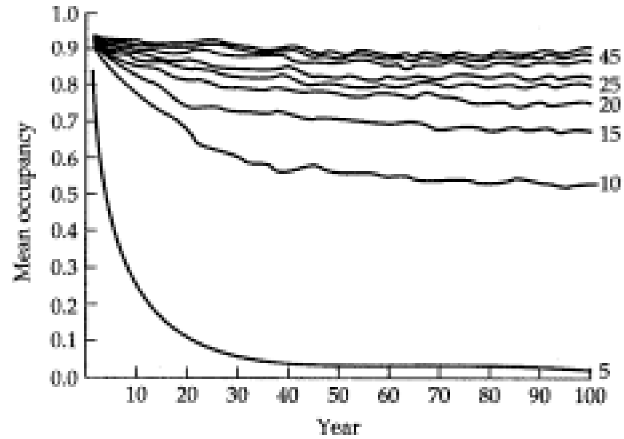

Figure 13.13 Some of the predictions for Spotted Owl persistence upon which management is based come from computer modeling. Shown here are predictions of mean occupancy rates of suitable sites by pairs of Spotted Owls over time for various sizes of cluster (blocks of suitable habitat sites), assuming 60% of the sites within a cluster are suitable. Numbers on the right are total sites per cluster. These results predict that clusters with more individual sites will support more owls.

though hypothesis 1 was not rejected for these study populations, Verner et al. (1992) proceeded to test hypothesis 2 because the tests for hypothesis 1 had low power, and the point estimates of λ were less than 1.0 (Noon et al. 1992). Hypothesis 2 was rejected at both the landscape and home-range scale for both Sierra Nevada populations (Gutierrez et al. 1992). At both spatial scales, owls selected stands of large, old trees with closed canopies. This pattern was particularly pronounced in nest and roost stands.

Consistent rejection of hypothesis 2 led to tests of hypothesis 3. Forests in the Sierra Nevada have been markedly affected by human activities within the last 150 years (McKelvey and Johnston 1992). A combination of logging and natural attrition of old-growth forest has led to a decline in the number of large, old trees (particularly pines), broken up the patchy mosaic of the natural forest, and encouraged development of dense understory conifer regeneration. The result has been rather uniform, landscape-wide loss of old-growth forest elements (e.g., large, standing live and dead trees, and large downed logs) strongly associated with the habitat use patterns of Spotted Owls.

Based on current Forest Service land management plans, loss of old-growth forest elements was projected to continue, resulting in forests susceptible to fire disturbance and nearly devoid of large, old trees. Given these projections, Verner et al. (1992) proposed interim (5-10 year) guidelines that both reduced allowable harvest levels and restricted silvicultural activities in habitats selected by Spotted Owls. These restrictions, invoked at a landscape scale, would serve to retain the large tree components in harvested stands in order to greatly accelerate the rate at which these degraded stands would become suitable habitat in the future. The locations of suitable blocks of habitat would shift dynamically across the landscape, but with reduced harvest levels, an adequate amount and distribution of suitable habitat would always be available.

Why Two Different Conservation Strategies?

At both landscape and home-range scales, the Northern and California Spotted Owls select habitats that retain old-growth forest characteristics. Consequently, timber harvest of old-growth forests, or their components, is responsible for concern over both subspecies' long-term persistence. Given the wide acceptance by the scientific community of the ISC reserve design for the northern subspecies, why was a similar strategy not adopted for the California Spotted Owl? There are several reasons (Verner et al. 1992).

First, during the past 50 years the number and distribution of Northern Spotted Owls may have been reduced by as much as 50% from pre-20th century levels (Thomas et al. 1990). No evidence of similar declines in number or distribution exists for California Spotted Owls, despite the fact that forests in the Sierra Nevada have been logged for the past 100 years. Currently, Spotted Owls in the Sierra Nevada are widely distributed throughout the conifer zone.

Second, the primary silvicultural method in the Pacific Northwest, west of the Cascade crest, was clear-cutting. Because clear-cutting practices have dominated in the Pacific Northwest, particularly over the last 50 years, habitat within the range of the Northern Spotted Owl is either undisturbed and suitable, or cut within the last 50 years and unsuitable. The result has been an island-like distribution of suitable habitat. The ISC opted for a Northern Spotted Owl strategy that clearly differentiated habitat reserves from areas where logging could occur. In contrast, selective tree harvest has been the predominant harvest method over most of the range of the California Spotted Owl (Figure 13.14). Current data indicate that some level of selective harvest does not render habitat unsuitable for owls, at least over the long term. As a result, the current distribution of Spotted Owls in the Sierra Nevada is comparatively uniform in both the conifer zone and adjacent foothill riparian/ hardwood forest. Imposing a static reserve design here would leave many owls outside of reserves and vulnerable to habitat loss.

Third, fire is not a major threat to forests west of the Cascade crest in Washington or Oregon (Agee and Edmonds 1992). Despite the fact that fire spreads contagiously, even large contiguous blocks of old-growth forest within this region would face little risk of catastrophic loss. On the other hand, the Sierran mixed conifer forests, where most California Spotted Owls occur, are drier, and given a history of fire exclusion, very prone to catastrophic fires. A habitat reserve strategy there could deal with the uncertainties of logging, but not fire.

Collectively, the above considerations led Verner et al. (1992) to propose an interim landscape-level conservation strategy that would retain the oldgrowth forest components apparently needed by owls for roosting and nesting. Based on continuing research and adaptive modifications to the interim plan, such a strategy would preserve future options for Spotted Owl management.

Figure 13.14 Photos of two forest management types: (A) clear-cutting and (B) selective harvesting. In the latter, an 80-year-old stand of Douglas fir was thinned (selectively harvested) to 50 trees/acre at age 40, and planted with hemlock in the understory. (Photographs by Barry R. Noon and John Tappeiner.)

(A)

(B)

Issues that Arise after the Conservation Plan Is Put Forward

Confronting Scientific Uncertainty. Contentious debate surrounding the value of threatened and endangered species like the Spotted Owl inevitably arises if their conservation is accompanied by significant economic costs. As a result, conservation biologists and their colleagues in forestry, range sciences, and wildlife biology have been swept into public debates that take them from the status of sequestered experts to that of key players in development of public policy. Scientists have been drawn into the land use decision-making process, have been required to defend the merits of their field studies in public forums, and are finding themselves defending their science against often savage criticism.

Scientists are trained to treat facts with doubt and to question their validity, a circumstance that lawyers use to advantage. Uncertainty is inherent in the scientific process because the goal of science is to incrementally reduce levels of uncertainty by subjecting alternative hypotheses to rigorous tests. Thus, scientists do not construct conclusions from data; rather, they construct hypotheses that are tested with further data. They cannot prove the truth of an assertion; rather, they fail to disprove that assertion, and thus support it.

Special interest groups employ lawyers and consultants to seek flaws and weaknesses in scientific analyses and data. And in those cases in which no obvious flaws exist, critics will note how little scientists actually know. They exaggerate and misconstrue the inherent, inevitable uncertainty that accompanies the best scientific efforts.

In the courtroom, the tactic used most frequently is to exploit the areas of uncertainty inherent in the scientific process-or worse, to use disinformation and distortion in an attempt to discredit the scientist. Also, critical data that could significantly contribute to problem definition and resolution may be purposely excluded as lawyers manipulate the litigation process so that the critical issues are never put on the table.

A disproportionate amount of criticism of the ISC strategy, both in Industry press releases and during litigation, was directed toward the computer simulation models and the inferences drawn from them. Models are ready candidates for commentary because any model simple enough to be operational is necessarily too simple to be completely realistic. Like all simulation models, those used in the conservation assessments of both owl subspecies were characterized by abstractions and simplifying assumptions. And, like all models, they were open to criticism if one demands (unrealistically) that a model be a complete representation of the real world. Because of these perceived weaknesses, the scientists responsible for the models were frequent targets during litigation.

The motivation to discredit both conservation strategies rested on the simple fact that owl protection meant reducing allowable tree harvest. From the timber industry's perspective, access to large-diameter, economically valuable trees on public lands would simply be too restricted. This stipulation, however, was not a consequence of the model results, but was dictated by the habitat associations of the Spotted Owl.

Burden of Proof in Conservation Debates. The allocation of burden of proof can often determine the results of decision making. Some entity must assume the responsibility for providing sufficient information to compel a decision maker to adopt a solution. In the Northern Spotted Owl litigation, the strategy of the timber industry, and to some extent the federal agency lawyers, was to put the burden on the scientists to prove an adverse effect of timber harvest on Spotted Owl persistence. In the absence of compelling information and arguments, the lawyers argued, the status quo (high levels of harvest in late seral stage forests) should continue. Failure to make a decision to change management practices for Spotted Owls was a de facto decision to continue current practices.

Federal environmental laws do not require judges to be scientific experts. Rather, the law requires public agencies to fully disclose all pertinent information, and to openly consider competing interpretations of this information. Despite attacks on the credibility and objectivity of the Spotted Owl scientists, these courtroom tactics failed because the judges ruled that existing environmental laws require a full disclosure and analysis of existing data. The analyses provided by the ISC and other scientists provided convincing evidence of risk to the species, thus mandating conservation action. Defensible science and open debate prevailed in the courtroom, and eventually led to more responsible decision making.

Ethics and Science. Most people involved in conservation science are motivated by a strong sense of responsibility to the biota and to future generations. Lawyers attempt to label such scientists as "advocates" who are therefore biased, and refuse to recognize that one can support a position in the absence of bias; bias does not necessarily follow from advocacy. Science is not value-free, nor should it be. Environmental science and environmental law have a clear ethical foundation, which is appropriate. "Resource stewardship" is not a buzz phrase but a meaningful expression of responsibility to future generations. Conservation scientists recognize that meeting this responsibility will often come at the expense of maximizing short-term economic gain.

Some scientists involved in the Spotted Owl debates chose not to participate in the normative process to render data scientifically credible (e.g., peer review and publication). Instead, they exploited the uncertainty inherent in the scientific process to justify maintaining the status quo or to obscure reasonable hypotheses. They were often able to stir up doubt, not because a hypothesis was unreasonable, but simply because irrefutable proof was a standard that could not be met.

Improving the Role of Science in Conservation Policy

The courts have assumed an increasing role in rendering land management decisions based on procedural aspects of law, as well as deciding substantive issues that should be discussed and resolved in other arenas. Because of society's continuing failure to acknowledge that hard choices must be made, and then to move forward and make them, we have lacked an adequate forum and process for environmental problem resolution.

We need to develop alternative strategies for problem resolution, and scientists should be key contributors to this process. The forum for decision making must be expanded to include all affected parties, representing a diversity of perspectives. Given such a forum, behavior must be governed by a set of rigidly enforced ground rules, including: (1) participating parties must treat one another with professional respect; (2) the strength of any argument put on the table should be a function of the information content of the argument; (3) no pertinent data may be withheld or suppressed; and (4) the reliability of the data should be judged by the degree to which they have been exposed to the scientific process of peer criticism and repeated attempts at falsification.

Such a forum for problem resolution would be a significant step toward solving emerging crises in land use and natural resource management. Once solutions were offered, the final responsibility would be to conduct risk assessments to accompany each of the alternative management plans.

Thus, the decision makers would be the final arbiters of which conservation plans were implemented and would be obligated to make known the risks, to both present and future generations, associated with the decisions they made.

Ultimately, the decisions we make as a society regarding management of declining resources come back to a fundamental question: "Does the value gained from the continued existence of a species equal the cost incurred to assure its persistence?" How we respond to this question will determine the fate of many species, including the Spotted Owl.

CASE STUDY 4

Management of a Multiple-Function Reserve: The La Selva Biological Station

David B. Clark, La Selva Biological Station

The La Selva Biological Station is one of the largest and most productive field research centers in the tropics. The author, formerly a co-director of the station, describes a stepwise approach for analyzing the mission and resources of a conservation area, and managing for that mission.

Multiple-Function Reserves

Anyone interested in conservation biology quickly becomes involved with areas set aside for various forms of protection. Much of the research on which conservation biology is based is done in protected areas that contain the last remnants of once-extensive communities. Much of the teaching of conservation biology also occurs in these areas. As a teacher, researcher, or interested visitor, you will encounter protected areas throughout your life, and much of this book concerns biological aspects of such areas. This case study addresses how the biological and conservation goals of a reserve are made possible through effective administration and management.

Conservation biologists are frequently called upon to participate in reserve management. Citizens interested in conservation biology also have multiple occasions to affect the management of protected areas. Whatever your eventual career, this study will provide you with insight into how to analyze a given reserve's operations. In the end, the scientific principles of conservation biology have to be put into practice, against a background of economic, political, and other human constraints. Here, we will see ways of analyzing reserve management in its real-world context.

There are thousands of areas around the world set aside for special management for various reasons: public education, protection of flora and fauna, research, professional training, and watershed management are typical rationales. The purposes of some reserves are so narrowly defined that they may serve only a very limited set of objectives. In many others, however, the area is intended to fulfill a variety of functions, which inevitably involve trade-offs. Managing these trade-offs among different functions is an inexact science. Political, economic, and sociological factors all play a role, sometimes in ways never dreamed of by the reserve's founders. Conservation biology emphasizes interrelations among a diversity of disciplines, and management of multiple-function reserves is an excellent example of what this means in practice.

Principles of Conservation Biology

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