

## BOOK REVIEWS

Marcy F. Lawton, Editor

**Editor's Note**—*The Spotted Owl* and *The Final Supplement* raise issues in which the scientific aspects of species conservation have run hard up against the economics of land use. Such collisions are often accompanied by a willful distortion of the scientific process. Because these issues are so important, this issue's space is entirely occupied by one long review. I urge you to read it.—M.F.L.

**The Spotted Owl and wise forest use.**—George A. Craig. 1986. Western Timber Association, Sacramento, CA. 69 p.

**Final supplement to the environmental impact statement for an amendment to the Pacific Northwest Regional Guide. Vol. I: Spotted Owl guidelines, Vol. II: Appendices.** U.S.D.A. Forest Service, Pacific Northwest Region, 1988. U.S.D.A. Forest Service, Portland, OR. 338 + 600 p.

The Northern Spotted Owl (*Strix occidentalis caurina*) is the bird of the hour. As everyone but the timber industry knows, the owl is an obligate inhabitant of old-growth forest in the Pacific Northwest. More than two-thirds of the original 15 million acres of old growth have already been destroyed, and almost all remaining suitable habitat is federally owned. At least three-fourths of this is in national forests. The problem is that owl home ranges average 2,000 to 7,000 acres (depending on region) and encompass, on average, between 2,000 and 4,200 acres of old growth. Old growth timber is worth ca. \$4,000/acre (Crain 1985). The conflict between the owl's needs and the industry's desires has generated an immense legal wrangle, innumerable newspaper articles, *Ecology's* first "Special Feature" (*Ecology* 1987), and a popular bumper sticker in Oregon that says, "Save a Logger's Job—Eat an Owl." The National Audubon Society (with the advice of the American Ornithologists' Union and the Cooper Ornithological Society) convened an advisory panel on the owl; its report was reprinted in *The Condor* (Dawson et al. 1987). This secretive bird's fate has come to symbolize the United States' struggle to maintain a modicum of pristine habitat in the face of its burgeoning population, a true dilemma for a nation with a strong entrepreneurial spirit and roots in the Judeo-Christian ethic of human exploitation of nature (White 1967).

The Forest Service (USFS) has recently released its long-awaited *Final Supplement*, detailing its views on the owl's biology and the effects of preserving the owl on logging, as well as the management plan it recommends to allow logging of old growth while preserving the owl. It addresses the Audubon advisory panel report, and defends those substantial aspects of the USFS management plan that differ from the advisory panel recommendations. Craig's *The Spotted Owl and wise forest use*, a manifesto for the timber industry, is a

counterpoint to the Audubon advisory panel report, and Craig's recommendations also differ from those of the *Final Supplement*. Both the *Supplement* and Craig's book deserve careful consideration, not only for their assertions about the biology of the owl but for their explicit and implicit views of what constitutes scientific research.

If the owl were a federally listed Endangered Species, the Forest Service could not sell timber leases in owl habitat. However, according to Craig (p. 36), who cites an unpublished "industry white paper" of 1981, "The Northern Spotted Owl is in no danger of being listed as threatened or endangered, let alone becoming extinct. *The species is in no danger.*" He is wrong on both counts; the species certainly is in danger, and it is also in "danger" of being listed as endangered. It probably should have been so listed a long time ago, but tremendous political pressure has delayed this designation. Forces opposed to the designation are so powerful that this issue has generated a split among conservationists. Some individuals assumed that a subspecies comprising only 5,000 individuals and occupying a rapidly declining habitat is *ipso facto* endangered. Taking the Endangered Species Act at its face value—a means to protect endangered species—they wished to petition the U.S. Fish and Wildlife Service (USFWS) to list the bird. Other conservationists feared the entire act might then be endangered, because listing would allow the industry and its congressional allies to pillory the bird as a "snail darter of the North Woods whose 'insignificant' existence stands in the way of thousands of jobs and billions of dollars in public and private revenue" (Kelly 1986). This fear led to the odd situation that representatives of several "mainline" conservation organizations tried to dissuade less conservative conservationists from petitioning USFWS. In the end, Green World, a small environmental organization in Cambridge, Massachusetts, submitted a petition. After this, a mainline coalition, notably lacking the National Wildlife Federation, submitted a second, more fully documented petition.

Industry representatives exulted in the USFWS decision of 18 December 1987, in concert with an inter-agency agreement with the USFS, not to grant endangered status. *Timber!* (2(1), p. 11, 1988) hailed the USFWS reference to owls outside old growth, one of Craig's recurring themes (p. 2, 5, 8, 36). For example, Craig cites two unpublished letters by J. O'Donnell, a representative of the Northwest Pine Association, noting several reports of the owl nesting in cliff caves, hardwood trees, and one hollow log. However, such evidence did not impress Federal District Judge Thomas S. Zilly, who ruled last November 17 that the Government action was "arbitrary" and "capricious," that the USFWS had acted illegally in not listing the Spotted Owl as endangered in spite of warnings by the Government's own scientists that the bird was disappearing

because of old-growth harvesting, and that the USFWS had failed to cite any scientific evidence to support its decision (Egan 1988b). I do not know whether the USFWS assessed the evidence in Craig's book. Judge Zilly gave the Government 90 days to cite further evidence; in January, the USFWS asked for a 90-day extension, which has since been granted; the USFWS has until May 1 to respond. The General Accounting Office, the investigative and auditing arm of Congress, suggests that political considerations rather than scientific ones motivated the USFWS decision: "... the Fish and Wildlife Service needs to be able to demonstrate that its review process and ultimate decisions have been thorough, independent and as objective as possible. There is evidence the Spotted Owl process did not meet such standards. . . . Management officials substantially changed the body of scientific evidence" in the original report prepared by the agency's scientists (Anonymous 1989a). However, the USFS remains adamant that there is no urgent threat. H. Salwasser, USFS Deputy Director of Wildlife and Fisheries, says of the 2,500 remaining pairs, "It's not a population on the edge of extinction, but they aren't as numerous as robins" (Anonymous 1989b).

Though the owl remains unlisted, the USFS must maintain viable populations under the National Forest Management Act of 1976 because the Pacific Northwest Region designated the owl a "management indicator species"—it represents other species that depend on old growth. Nevertheless, the USFS 1981 Draft Regional Plan and its 1984 Final Regional Guide and Final Environmental Impact Statement for the Pacific Northwest Region proposed deliberately reducing the National Forest population in Oregon and Washington to 375 pairs with 1,000 acres per pair, probably a unique decision in the history of management for a threatened, nonpest species (Dawson et al. 1987). A consortium of conservation organizations appealed the Guide on the grounds that it threatened the owl, and the Department of Agriculture, reversing the decision of the Chief of the USFS, required a supplement treating the Spotted Owl.

The USFS issued a draft supplement in the summer of 1986, solicited comments, and issued the *Final Supplement* in mid-1988 (USFS 1988). The *Final Supplement* recommends "Alternative F," which envisions 550 Spotted Owl management areas (SOMAs) containing 1,000–2,700 acres each of suitable habitat. These SOMAs would be designated on lands suitable for timber harvest only after the distribution of habitat on lands unsuitable for timber harvest are assessed. Robertson (1988) confirms that Alternative F will be the planning direction of the USFS, with some slight modification in the Olympic National Forest. Timber groups like the Northwest Forest Association denounced the preferred alternative as "completely irresponsible" (Egan 1988a), a response adumbrated by Craig (p. 27–32), who foresaw 551 areas of 1,000 acres each as leading to "adverse genetic consequences for trees and increased problems in forest protection from insects and disease. More wildlife species will have less favorable habitat than they would under different management. The costs over the long term to all levels of government, local economies, and consumers of wood products can be measured in billions of dollars."

To support the notion of a genetic threat from conserving too much old growth, Craig cites an unpublished memorandum (J. J. Kitzmiller 1982) to the USFS office in San Francisco. I contacted this office but they were unable to locate the memorandum. So I must quote from Craig's quote (p. 26): "Implementation of the Six Rivers Spotted Owl Management Area (SOMA) prescriptions would have serious dysgenic impacts on local Douglas-fir populations." He says there will be loss of diversity leading to reduced yield and adaptability. What these dysgenic impacts will be, exactly, and why they will occur are not stated. I can only express skepticism that a lineage whose genetic diversity sufficed to adapt it to a series of climatic changes beginning in the early Miocene (Waring and Franklin 1979) should suffer evolutionary failure over the next few millennia if we just leave it alone. Nor is it apparent how leaving alone some Douglas fir stands will adversely affect yield in areas managed for timber production. If Craig and Kitzmiller ever publish the bases for their concerns, the scientific community will be able to assess them.

Kitzmiller's memorandum and another unpublished 1982 memorandum to the USFS, this one by B. Roettgering, raise the sinister spectre of increase in insect and disease problems. Again, the USFS cannot locate the memorandum for me, so I must rely on Craig's citations (p. 26). Roettgering states, with respect to management for Spotted Owls (I presume this means not harvesting some old growth), "Maintenance of such fully-stocked hardwood-conifer stands will result in losses of conifers during frequent periods of moisture deficit. Moisture stress makes the conifers susceptible to attack by bark beetles and disease. Further, Armillaria root disease can spread from oaks to conifers unless precautions are taken." Kitzmiller adds (p. 26), "The attempt to maintain decadent stands would tend to produce young trees more susceptible to diseases and pests." Again, without publication of the basis for these concerns, it is impossible for a scientist to do more than marvel at the ability of these old-growth forests to have persisted since the Miocene unaided by humans in the face of the threats of insect and disease that Craig perceives. However, Waring and Franklin (1979) find that the regional climate, with high evaporative demand during the warm dry summer, puts deciduous hardwoods at a disadvantage to the conifers. And old-growth forests are typically stable despite high levels of disease and decay-producing insects (Juday 1988); in fact, they are characteristically adapted to such a regime. The *Final Supplement* states, "Insects and disease are seldom a primary factor in the loss of habitat in western Washington and Oregon" (p. B1-25). It is difficult to believe that leaving old-growth forests alone will produce a threat from this quarter.

Craig (p. 26) says that the greatest number of species and largest biomass of wildlife per acre are not maintained in old growth. Thus he characterizes old growth as "less hospitable" and Spotted Owl management as costly to other wildlife. He cites no authorities for these claims. The *Final Supplement* tells a completely different story, arguing that management for the owl will aid many species with similar habitat requirements. It finds that 206 of 414 wildlife species in the region use old growth for feeding and breeding, a higher number than for any other habitat tabulated. The *Final Sup-*

plement also notes that protecting Spotted Owl habitat will protect riparian areas containing 359 wildlife species, and will benefit many fish species. More than 100 wildlife species in this region use snags, a characteristic feature of old growth. Finally, "designation of areas as spotted owl habitat will provide added measures of protection to watershed and soil resources" (p. III-151).

Species adapted to old growth are not only numerous but often threatened, not only because their habitat is so scarce but because many are highly specialized—cavity-nesting birds are good examples. It is noteworthy that Craig cites no particular species as harmed by preservation of Spotted Owl habitat; that is because none he could name would be viewed as needing protection. This argument is generic—typically old growth is not the best habitat for deer, for example. In fact, in Wisconsin forests increased deer populations in harvested, open areas so thoroughly devastate the interiors of small, uncut patches that they destroy developing old-growth forests (Alverson et al. 1988, Luoma 1988). Deer, however, are not threatened in either Wisconsin or the Northwest.

The economic costs of the preferred alternative would be high, though probably not as high as Craig asserts. Industry estimates of the cost are typically about twice as high as those of the USFS (Simberloff 1987), while even the USFS estimates may be greatly exaggerated (Dixon and Juelson 1987). But, whatever the cost to the industry, Craig improperly blames it on the owl alone, thus concluding, for example, that each owl is worth more than 500 times as much as gold, ounce for ounce. However, the reason the bird is an indicator species is that other species, including those whose biology is poorly known, require its habitat. And, of course, the trees themselves have value even if they are not cut and exported to Asia. Thus, whatever the economic cost of not cutting old growth, one must apportion it among the entire old-growth community, not assign it solely to the owl. Craig's failure to recognize the indicator function of the owl leads him also to the conclusion that intensive management, such as providing nest boxes, can solve the owl problem. Such a course of action would contradict the entire notion of a "management indicator species." One is supposed to manage the habitat to maintain the entire community the species represents.

So Craig's alarm at consequences of the preferred alternative is unfounded scientifically, and exaggerated economically. This is not to say that the preferred alternative is acceptable biologically. It is far from certain that the proposed number of birds is sufficient. Although the *Final Supplement* is agnostic on this matter (p. G1-27), the number recommended by this report probably arose from the discredited "50-500 law" (Simberloff 1988), which states that depauperation of genetic variation in populations with effective population size less than 500 will prevent a species from evolving. However, the number 500 is at best only a ballpark estimate for only some kinds of variation (Lande and Barrowclough 1987) and, in any event, failure to evolve is not the major threat to this bird. In the Preferred Alternative, each habitat area will have 1,000 to 2,700 acres within circles of radii 1.5 miles (Oregon) or 2.1 miles (Washington). These circles will

thus contain either 4,500 or 8,900 acres, so the old growth will not even predominate. Not only that, but the old growth can be very dispersed—the only requirement is that at least one 300-acre stand, including the nest site, be contiguous. This is certainly not what the primary workers in the field meant when they determined old-growth acreages of home ranges (e.g., Gutiérrez and Carey 1985). Assuming that the habitat areas can actually support the owl, the Preferred Alternative envisions—for northwest California, the Sierra Nevada, and the Pacific Northwest—a current *capability* of support for 2,720 pairs, to be reduced to 2,180 pairs by 15 years and 1,550 by a century. By the end of a century, under the Preferred Alternative, half the owl habitat in USFS lands of the Pacific Northwest would have been destroyed.

The report of the Audubon advisory panel (Dawson et al. 1987), by contrast, recommended habitat areas between 2,500 and 4,500 acres and an absolute minimum of 1,500 pairs if there is to be any hope for survival. Thus, it appears that the Preferred Alternative aims to have sites with half as much habitat as the advisory panel recommended, and to have the *capability*, if all sites were occupied, of maintaining the bare minimum number of birds. The *Final Supplement* attempts to impugn the report of the advisory panel on this point: "The 'Report . . .' was not scientific research. It was a panel review of available research" (p. G1-64). The *Final Supplement* does not give its definition of scientific research, but the statement just noted indicates that it construes scientific research as requiring empirical data-gathering. Such a requirement would disqualify as science many papers published in, i.e., *Science* or *The Proceedings of the National Academy of Sciences*. Exactly what makes an endeavor "scientific" is, of course, a matter of so much dispute among philosophers that an adequate review of that literature would completely transcend this review. However, both philosophers and scientists have generally not demanded empirical content of each piece of work labelled as "science," and have viewed modelling as a worthy scientific activity. The advisory panel report constituted as much research (or as little) as the *Final Supplement*. In both instances, the major scientific component consisted of a review of available research and construction of a set of verbal and/or quantitative models. Both are scientific documents, but with limited empirical content.

Craig's book, on the other hand, betrays such ignorance both of how science works and what a scientific statement is that I was amazed to read that he is a "Registered Professional Forester." Half his references are unpublished letters, memos, and other inaccessible documents. I would have thought that anyone presuming to publish a book on scientific issues would understand this practice to be unacceptable. Science generally advances by placing ideas in the open literature and assessing the critical response, then using this dialogue to generate new hypotheses. It is a continuing process; generally many questions are unanswered, and these unanswered questions in no way indicate that a field is not scientific. Instead they spur the very activity that constitutes science (Kuhn 1970). Thus Craig's "Appendix A—Authoritative Evidence of Ignorance," which consists of four pages of quotes from leading

Spotted Owl researchers, misses the mark that Craig intends. Far from invalidating the nearly unanimous conclusions of these researchers that the owl requires old growth and is threatened by habitat destruction, the admissions of partial ignorance are hallmarks of honest science. That not everything is known about a phenomenon does not mean that nothing is known about it. In particular, one can conclude with assurance that the owl requires old growth without knowing exactly why it requires old growth, just as medical scientists (and now the courts) have determined that smoking causes cancer without knowing exactly how it does this. Anecdotal sightings of the owl in odd habitats do not invalidate this conclusion any more than the fact that some smokers don't get cancer invalidates the causal nexus between smoking and cancer. Given its astounding misuse of a "scientific" cachet, it is all the more remarkable that *The Spotted Owl and wise forest use* should be entered into the administrative record for state timber harvest plans (e.g., California Division of Forestry 1-88-391 Hum and 1-88-520 Hum/Men), summarized by the author for use by the California Board of Forestry, and adduced as evidence in judicial proceedings on timber harvest plans (e.g., Humboldt County Superior Court #79879 [1987] and #81790 [1988]).

The *Supplement* is a far better work than Craig's book, primarily because it is a superb compendium of facts on the Spotted Owl. A high point is a thorough literature review by Eric Forsman. This and other sections offer ample documentation of the strong association of the owl with old growth, though old-growth and "mature" forests (those in which annual net rate of growth has culminated) are often lumped in presentation of data and projections. The *Supplement* argues cogently that some though not all mature forests are suitable for Spotted Owls, and that the atypical habitats, like caves that so intrigue Craig, are not. In many places the *Supplement* is admirably modest: there is a major section on assumptions and uncertainties. Further, the uncertainties are properly viewed: they motivate a section on research and information needs.

There are some problems, however. A glaring one, with important implications for the choice of management alternatives, concerns a model of demographic stochasticity. Observed juvenile (first year) survival, for a small sample, was 0.11. The model, when run with this value as a mean, predicted a precipitous decline. However, from a sample of sites, Forsman found a mean yearly population decline of only 1.1% between 1972 and 1978. Thus, juvenile survival was arbitrarily raised to 0.38 because the model, when run with this value, produced the desired 1.1% annual decline! Certainly this procedure would never have gotten past a normal journal review, but the results of this exercise were used in assessing population viability under the various alternatives. An anonymous comment criticizing this "recalibration" elicited the remarkable response that, "the juvenile mortality rate was tempered [sic]. This allowed model results to more accurately reflect many researchers' perceptions of the current situation" (p. B-26).

Another example of evasiveness arises in the *Supplement's* treatment of endangered status for the owl. An anonymous comment proposed that further reduc-

tion of the Spotted Owl population or loss of habitat (both of which are planned in the Preferred Alternative) would cause listing, and asked for a discussion of whether the Preferred Alternative would successfully forestall listing and of what the effects of listing would be on the USFS and others. The entire response is, "A decision not to list the spotted owl was announced on December 18, 1987 by the U.S. Fish and Wildlife Service" (p. G1-73). The authors either misunderstood a related perceptive comment, deliberately sidestepped it, or were remarkably candid: "It seems that the main objective of the proposed action is to forestall listing of the spotted owl under the Endangered Species Act" (p. G1-76). The response was that, yes, that is the USFS goal, and a reiteration of the 18 December decision. In fact, the *Supplement* completely sidesteps the issue of how listing would affect both Spotted Owl management and USFS timber sales.

One also wonders about the care with which the *Supplement* authors derived the outlined research needs. The Audubon advisory panel report (p. 223) recommended against using radio transmitters on juvenile Spotted Owls because these might affect survivorship. This point is not raised in the "Assumptions and Uncertainty" of the *Supplement*. In the proposed "Monitoring and Research" program (p. D-28) is a review of transmitter technology for radio-tracking juveniles, though there is no mention of possible mortality. Now, months after the *Supplement* was issued, the USFS Deputy Director of Wildlife and Fisheries, H. Salwasser, raises the possibility that transmitter-based data may have led to faulty data that may, in turn, have misled unnamed "studies" into concluding that the Spotted Owl may be threatened or endangered (Anonymous 1989b). It is worth noting that the last 5 years of data on juvenile dispersal in the major California study rest on banding, not transmitters.

However, the main problem with the *Supplement* resembles the problem with the USFWS listing decision: the key conclusion, that the Preferred Alternative will provide a viable owl population, seems to me to be arbitrary and capricious in light of the extensive scientific findings detailed in the *Supplement*. It is as if the scientists who contributed the data and analysis did not write the conclusion. The Summary states flatly that, "There are no accepted scientific rules for evaluating the combined effects of these factors on a population over time. Therefore, a simple set of ratings was developed to help identify the likelihood that a population, given its estimated number and distribution, would be secure from threats . . . that could threaten viability. These ratings are reasoned judgements based on scientific principles" (p. S-33).

In other words, scientists familiar with the data and methods are to make a judgment call, and it is unclear what "scientific principles" are to guide them. The judgments are codified in a five-part classification of probability of continued existence running from Very High to Very Low. "Continued" means for 15, 50, 100, or 150 years. But exactly what probability corresponds to a category is unstated, and how the different threats are combined to generate these probabilities is unstated, for the reason noted above: There is no accepted way to combine them. So, although the supporting assumptions and data are admirably provided, no al-

gorithm leads to the published answers, only "reasoned judgements." An anonymous comment alluding to this problem ("There is no definition of persistence") elicits a spectacular bit of verbal legerdemain: "The term 'persistence' is not used in the Final Supplement. This concept is now expressed by the phrase 'continued existence'" (p. G1-28). However, in response to the comment that "it is impossible to quantify a viable population or the population threshold (the point at which extinction will occur)," the *Supplement* concedes the impossibility of determining a threshold and says that the rating system "expresses probability of persistence of a well-distributed population" (p. G1-55).

It is a pity that a document so candid about methodological and data limitations should be at best evasive and at worst misleading about the scientific support for its key conclusion. The *Supplement* and *The Spotted Owl and wise forest use* appear to share this defect: they use whatever scientific evidence they can muster, and especially the cachet of "science," to support a particular course of action. Thus they select those data and arguments that seem to favor their views, and ignore or distort contradictory data and arguments. Further, they make much of the fact that they are "scientific" and claim scientific support for their arguments while betraying ignorance of scientific procedures and even what a science is. Craig's book is far more egregious on all these counts than the *Supplement* is. In fact, his misuse of scientific method remarkably parallels that by the "scientific creationists," down to the emphasis on and misunderstanding of unexplained observations (cf. Raup 1983). But the impact of the *Supplement* will be greater.

I concede that my view of the preferred alternative is just a reasoned judgment. Looking at virtually the same data as are presented in the *Supplement*, the Audubon advisory panel concluded that, for the Spotted Owl to have a fighting chance, the USFS would have to provide much more of its major habitat than the preferred alternative does and that it would be dangerous to lower the existing populations substantially and deliberately. Yet this is what the *Supplement* recommends, and it presents not a shred of evidence that its view is more scientifically tenable than that of the panel. "The position of the Forest Service is that the decision reached in this document is not long-term in nature" (p. G1-20), but it is difficult to view massive removal of centuries-old trees as anything other than long-term; certainly it is irrevocable in even our great-grandchildren's lifetimes. — DANIEL SIMBERLOFF, Department of Biological Science, Florida State University, Tallahassee, FL 32306.

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