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Roles of Scientists in Forestry Policy and Management: Views from the Pacific Northwest

Frederick J. Swanson

The Pacific Northwest (PNW) of the United States has been a hotbed of forest policy conflict. Old-growth forests and northern spotted owls (*Strix occidentalis caurina*) have become icons in a struggle to decide the future of federally managed forest lands. Science and scientists have played many roles on behalf of the many interests involved in the fray, so this is a rich environment to examine general perspectives on roles of scientists in natural resource issues. In this chapter, I examine many of the venues for science engagement with policy and management; review the spectrum of roles of scientists in decision making and how those roles are perceived by different groups; and consider the different worldviews that scientists bring to policy-relevant issues. While this account is largely descriptive, I close with personal concerns about progress in formulating viable forest policy.

These representations and interpretations are based on my experience as a scientist participating in the Pacific Northwest events, and not as a scholar with experience in the sociology and history of science. This contributes to a narrowness of view, especially the focus on scientists and not the many other important players in forest policy and management. My view is shaped by

the good fortune of working three decades in the research-management partnership centered on the H. J. Andrews Experimental Forest in the Oregon Cascades, involving the Pacific Northwest Research Station and Willamette National Forest of the United States Department of Agriculture (USDA) Forest Service and Oregon State University. Work within this partnership spans basic science sponsored by the National Science Foundation to applied studies to forestry and watershed management applications. Such partnerships are rare, despite periodic encouragement and applause from the leadership of partner institutions. Participants in the partnership centered on the H. J. Andrews Forest have been involved to some degree in nearly all of the roles discussed in this chapter.

Despite this chapter's focus on the Pacific Northwest, the issue of scientists' roles in natural resource issues generally is significant (Lubchenco 1998) and thoughtfully considered elsewhere (see Jasanoff 1990, Mills and Clark 2001). Dramatic changes in natural resource management are occurring around the globe and, in a longer-term perspective, Holling (1995) has argued that natural resource management and policy may undergo cycles of abrupt overthrow of dominant management paradigms. Gunderson et al. (1995) argue that the nature of science in service to natural resource policy and management must undergo fundamental change from experimental, deterministic approaches to more holistic science. Furthermore, they argue that science should be part of institutions with good learning capability through adaptive management to reduce social convulsions and improve management.

Realms of Science Input to Forestry Policy and Management

The course of forest management and policy in the Pacific Northwest seems to match well the pattern of periodic convulsions outlined by Holling (1995), in which decades of extractive management of a natural resource, such as fisheries and forests, lead up to a crisis triggered by natural or social forces. We can trace scientists' roles in relation to a period of crisis schematically through figure 7.1, in which the shaded central line from left to right represents resource management and policy over time, passing from a period of relative stability through a period of crisis and ultimately to a new period of stability. This depiction of Pacific Northwest federal forestry issues stretches from the post–World War II inception of the extraction forestry period, through the intense old-growth and spotted owl conflicts of the 1990s, to the last decade's efforts to implement the Northwest Forest Plan (NWFP), which was intended to guide the postcrisis period of forest management.

Underpinning and influencing gradual and convulsive change in natural resource policy and management are the general context of governance, developments in basic science, and sustained research-management partnerships (bottom of figure 7.1). *Governance* in the federal case, which is central to Pacific Northwest issues, involves consideration of the political party in control of Congress and the White House, and the role of the judiciary and legislative branches of government. For example, in

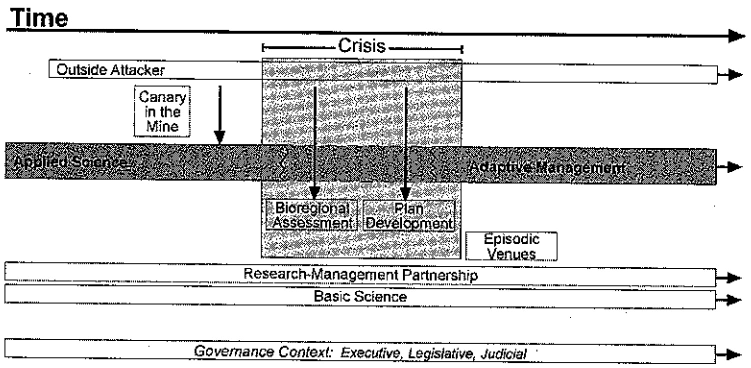

Figure 7.1. Nine Venues of Direct Science Engagement to Policy and Management. Schematic representation over time of venues of direct science engagement to policy and management, shown in the context of one approach to engaging science (applied science) leading to crisis followed by another approach (adaptive management). Note that the nine venues of engagement are set within a broader governance context that includes executive, legislative, and judicial subcontexts.

the case of the NWFP, the judiciary played a significant role early in the period of change; litigation filled the void created by an absence of legislative solutions to political and social gridlock, as court injunctions stopped logging. These circumstances may have frozen the central issue somewhat on the initial species focus rather than let it broaden to give more balanced treatment of the broad spectrum of relevant social and ecological issues. Congress did convene several venues for science input on relevant issues through use of expert panels (Franklin 1995). This set the stage for involvement by President Clinton (see Thomas, this volume).

Scientists are important, though perhaps indirect players in policy matters through continued conduct of *basic science* (figure 7.1) in fields such as ecology and fisheries sciences. These fields contribute to change in general public perception, language, and technical knowledge about the ecosystems from which natural resources are extracted. The governance context of this science may be important in that support of basic environmental sciences can wax and wane as various political interests see advantage in the types and intensity of science conducted. Interestingly, basic science of old-growth forests in the Pacific Northwest was supported at the H. J. Andrews Forest in the 1970s by the National Science Foundation with no expectation or motivation of its relevance. As ecosystem science has developed over time, forests have come to be viewed more as ecosystems than as tree farms.

Research-management partnerships, such as that centered on the H. J. Andrews Forest, may also be sustained over many decades and through major changes in management and policy (figure 7.1). Work in such partnerships can be distinguished from *basic science*, which lacks near-term expectation of relevance, and *applied science*, which focuses on near-term relevance and minor modification of existing management paradigms, rather than aggressive attention to testing new, more radical, science-based approaches to management that may have relevance in the future. Given the common multidecade lags between inception of ideas and general adoption of new practices, these partnership activities necessarily persist through periodic changes in policy. Examples include the research at the H. J. Andrews Forest on old growth and management of wood in streams beginning in the

1970s. Current work on landscape management based in part on historic wildfire regimes (Cissel et al. 1999) may find broader application in coming decades if policy shifts from a species focus to better balance with an ecosystem focus.

In the period between management and policy crises a large cadre of scientists conduct *applied science* with the intent to improve efficiency of the management paradigm of the day. In the case of development of intensive plantation forestry, this work included improving seedling culture and planting technology, tree genetics, and methods for suppression of competing vegetation, all with the objective of enhancing wood production. Scientist-to-manager communications in this context has been referred to as "technology transfer," which reflects the role of science in supporting current policy. Scientists who draw research support from this work, managers whose work is resource extraction, and local communities supported by the work are all tightly linked to continuation of the existing policy and management approach. However, as ecosystems or social systems (e.g., communities) become stressed, scientists may take on the role of giving warning of impending problems, acting as the "canary in the mine" (figure 7.1). This role may take the form initially of dissent internal to management and research organizations involved in executing established policy. Scientists outside these management and research organizations may take on the role of *outside attackers* of the management paradigm of the day through public statements, participation in lawsuits, and other means (figure 7.1). Some scientists are always attacking from the inside or outside, but their numbers may increase as conflict builds.

When policies and management paradigms collapse in crises or "train wrecks" (Holling 1995), groups of scientists, such as blue ribbon panels, may help define the current situation by participating in development of a *bioregional assessment* (Johnson et al. 1999a). Bioregional assessments commonly provide objective information about the state and capability of the natural resource and social systems to provide goods and services expected by society. In the past two decades these assessments have covered vast tracts of the United States, from south Florida to the Northern Forest Lands of Maine to the Columbia River Basin (Johnson et al. 1999a). Building

from information provided by a bioregional assessment, scientists involved in the assessments or other scientists may help chart the future course of policy and management set forth in a *management plan*. Scientists' tasks in preparation of management plans may include formulation of alternative plans and evaluation of their consequences. In figure 7.1 bioregional assessments and subsequent development of management plans occur during the crisis and influence the path of management after the crisis.

In the Pacific Northwest these steps culminated in the Forest Ecosystem Management Assessment Team report (FEMAT) and the NWFP (FEMAT 1993, USDA/USDI 1994a, Franklin 1995, Johnson et al. 1999b). The roles of science and scientists in these efforts have been thoroughly critiqued (see Johnson and Shannon 1994, Johnson et al. 1999b). While the NWFP is criticized by some as overemphasizing environmental protection, others point out that strong emphasis on species protection reflects the context set by the spotted owl litigation. Other scientists played the role of outside attackers of the assessment and the NWFP, charging that important science views and management alternatives were granted meager attention or ignored altogether. A high level of controversy seems to come with operating in the realm of high-profile political issues, even for scientists.

As with other natural resource crises (Gunderson et al. 1995), the NWFP was intended to conclude a policy crisis with a new action plan and the future use of *adaptive management* to test assumptions in the plan and develop new management approaches. Since adaptive management involves designing and conducting management actions to test hypotheses about the functioning of large, natural resource systems, scientists must play central roles in this continuing learning process. To encourage the adaptive management process, the NWFP designated Adaptive Management Areas (AMA), where scientists and land managers work together to develop and test new approaches to management. While in the precrisis period in the Northwest (1950s–1980s), and generally across the Forest Service, the phrase "technology transfer" connoted support of the current management paradigm, the currently vogue "adaptive management" language implies a sustained commitment to learning that may lead to profound change in the management approach. Surprisingly, scientists now have potentially deeper involvement in management through the adaptive management process, for adaptive management is intended to guide *incremental* change in management and prevent the *convulsive* change hypothesized by Holling (1995) and earlier experienced by the Pacific Northwest in the spotted owl and old-growth wars.

Scientists also take part in *episodic venues* that involve them in policy and management issues for periods of months to years. This contrasts with the multidecade time scale of adaptive management programs dealing with long-term processes, such as forest landscape management. Examples of episodic venues include serving on blue ribbon panels to advise policy makers, conducting research studies of effects of alternative management approaches (see Spies et al. 2002b), and consulting on technical matters related to lawsuits concerning development and implementation of management plans. These sorts of activities may occur at any time, but may be more common during and near crisis periods.

Scientists may play several of these roles simultaneously or in sequence. The social context of issues may influence a scientist's choice of roles. In an area with sparse science talent, for example, scientists may be more inclined to move to the role of canary in the mine than in an environment such as the Pacific Northwest, where forestry issues are very mature and all major interests have strong science talent.

Roles of Scientists in Natural Resource Policy Decisions

What is the appropriate role of scientists in making decisions about policy and management? Several Oregon State University social scientists have addressed this question for Pacific Northwest federal forestlands. Steel et al. (2001) and Lach et al. (2003) sampled the views of four different categories of actors: research scientists, land managers, members of interest groups and organizations (including environmental and forest products industry),

and members of the "attentive public." In a study of fifty interviews and more than 600 written surveys, Lach et al. (2003) had respondents rank the appropriate conduct for H. J. Andrews Forest scientists in Pacific Northwest forestry issues across five stages of a gradient of engagement in decision making:

- *Report* scientific results that others use in making decisions on natural resource management issues.
- Report and *interpret* results for others who are involved in natural resource management decisions.
- Working closely with managers and others, *integrate* scientific results into management decisions.
- Actively *advocate* for specific and preferred natural resource management decisions.
- *Make decisions* about natural resource management and policy.

Steel et al. (2001) found widespread support across all groups of respondents for the "integrate" role of scientists—80 percent of respondents agreed with the "integrate" role and 63 percent the "interpret" role, the second most favored. However, some important differences were registered by the various groups. For example, some members of interest groups wanted scientists to play the "advocate" role, which raises the question of "who is the scientist?" and "whose science is it?" People with Ph.D.-level science training work for research, education, land management, environmental, and industrial organizations. Each of these organizations has distinct expectations and reward systems for their scientists. Despite diverse personal values and senses of appropriate levels of advocacy amongst scientists overall, scientists rated "make the decision" lowest of the four groups (Lach et al. 2003), in part because of concern about loss of credibility if their engagement reaches the "advocate" and "make the decision" levels. Scientists feared their research could be viewed as lacking objectivity and possibly slanted to influence decisions. Even without that potential loss of credibility, scientists were concerned that increased engagement in policy and management distracts from the science work. Another indication of scientists' tendency to stick within the science community mind-set was their emphasis on measuring individual credibility by their reputation in their field and the quality of the publications and data they generate. In contrast, nonscientists associated scientists' credibility with their ability to communicate with the public, elected officials, and media (Lach et al. 2003).

In contrast, a broader sampling of the Pacific Northwest of the United States and British Columbia using the same questions revealed greater acceptance by Canadians of scientists taking on deeper levels of engagement. Canadians recorded 49 and 20 percent agreement with the "advocate" and "make the decision" roles, respectively, compared with 32 and 14 percent for the U.S. respondents (Steel et al. 2001). In summary, these results indicate that some areas of strong agreement exist among the different groups of respondents, but some significant differences of opinion distinguish groups in the Oregon sample from other domestic and international contexts.

Alternative Worldviews of Forest Resource Management: A Challenge for Integration

Approaches to management of forest landscapes align with management objectives and the worldview of scientists. By *worldview* I mean the dominant ecosystem or resource management objective held by an individual or a group, which influences their starting point for discussion of future management and management approaches for meeting objectives (figure 7.2). An anthropocentric worldview, for example, may see forests as foremost for human consumption and would therefore support an agricultural management approach carried out through intensive plantation forestry. A biocentric view may consider species protection paramount and support management based on a conservation biology approach using reserves and matrix prescriptions to accommodate particular species. An alternative worldview emphasizing ecosystem dynamics may favor sustaining the range of historic conditions as a management approach for balancing commodity and species objectives. Thus, each of these worldviews represents

a dominant management objective and one or more associated management approaches used to achieve that objective (figure 7.2). Each worldview can say "we have science on our side": decades of research and development of intensive plantation forestry anchors the agricultural worldview; conservation biology for sustaining species rests on island biogeographic theory and species-focused science; and ecosystem dynamics perspectives are founded in disturbance ecology. The level of development varies greatly among these management approaches: plantation forestry has been half a century in development, conservation biology is a few decades old, and landscape management based on concepts of ecosystem dynamics is in its infancy.

In the Pacific Northwest we can trace proposed and actual policy and management regimes over the past several decades as

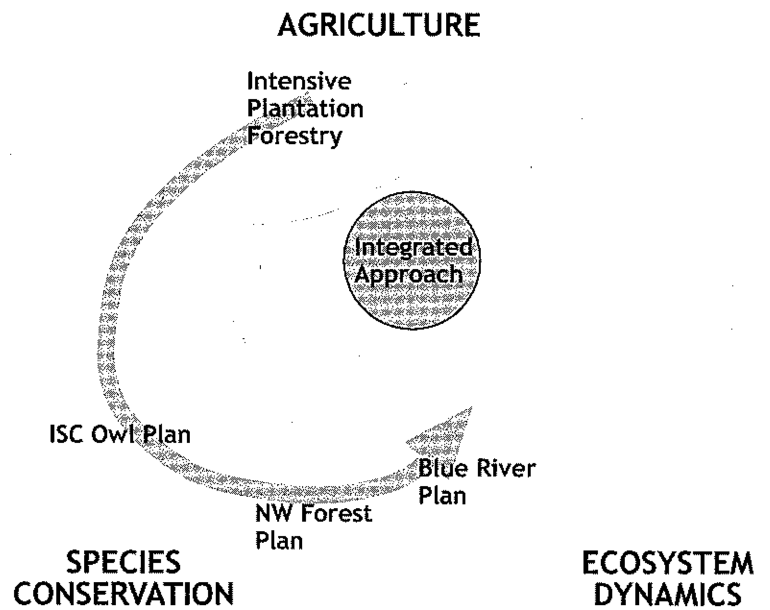

Figure 7.2. Schematic Representation of Contrasting Worldviews and Approaches to Forest Management. The arrow traces a possible path of integration from the intensive plantation forestry approach to a single-species-focused, conservation biology management system (e.g., Spotted Owl Plan of the Interagency Scientific Committee; Thomas et al. 1990) to ecosystem dynamics approaches, such as the Blue River Landscape Plan, which include consideration of historical disturbances regimes.

shifting from the agricultural approach of intensive plantation forestry to a conservation biology plan, the never-implemented spotted owl protection plan of the Interagency Scientific Committee (ISC) (Thomas et al. 1990) to the NWFP, which contains some recognition of fire and stream-flow regimes as important elements of ecosystem dynamics (figure 7.2). Over the course of events from the ISC to the NWFP there is progressive ramping up of components of the ecosystem considered—from a single species, to many species, to whole watersheds, to the bioregion as a whole. Franklin (1995) and Johnson et al. (1999b) trace this evolution of these and other science responses to policy and judicial considerations (see also Thomas, this volume). To extend the temporal perspective we may add a final point of comparison, the Blue River Landscape Plan, which strongly reflects an ecosystem dynamics component based in part on historic fire regimes (Cissel et al. 1999), is in early stages of development and testing in the Central Cascades Adaptive Management Area. This exploratory landscape plan and study considers the past 500 years of ecosystem change and uses that to plan management for the next 200 years.

This evolution of changing forest and landscape management approaches, represented schematically by the bold arrow in figure 7.2, may foreshadow a blending of the three approaches in a way that uses the best of each to meet local management objectives. Ultimately we probably need such a blending of these and other worldviews, including indigenous knowledge, to arrive at sustainable policy. The multiplicity of societal objectives—sustain species, ecosystems, ecological services (see Daily 1997)—calls for a multiplicity of approaches. We need to identify the strengths and weakness of each view and learn how to blend them to best meet local social and biophysical objectives, opportunities, and constraints. It is counterproductive to have competition among these worldviews and management approaches in either science or policy arenas.

Toward an Integrative Approach

I have briefly sketched three dimensions of involvement of scientists in natural resource policy and management—the diverse settings in which scientists play roles, their types and depths of

engagement in decision making, and the worldviews they bring to issues. It is useful to reflect on each of these in terms relevant to scientists and to users of their information, and then examine the aggregate impact of these considerations on policy.

There is striking diversity of roles for scientists in natural resource policy and management. This diversity itself gives important checks and balances to the involvement of science, and thus, is an essential aspect of arriving at effective, sustainable policy, especially given the long time scales and uncertainties in management of forests and watersheds. An individual scientist may gain appreciation of the importance of this diversity of roles as his or her own roles change as a career matures, issues develop, the governance context changes, and institutions restructure.

Appropriate engagement of scientists in decision making has been heatedly debated, commonly under the theme of "What is acceptable advocacy?" In a provocative paper title, social scientists assert, "Science Advocacy Is Inevitable: Deal with It" (Shannon et al. 1996). Even advocating the use of science in management and policy decisions can be a bold act (Swanson and Greene 1999). For the scientist it is important to recognize their intended depth of engagement, being careful to not let "role creep" occur—for example, moving to deeper levels of advocacy than intended because of passion for a particular outcome on a particular issue. For those who may call on scientists for information, a scientist's record of past conduct, even a single digression into deeper-than-intended engagement may influence their credibility and effectiveness in substantive or perceptual terms. A scientist may wish to separate her roles as scientist and as citizen, but this distinction is very difficult for both the scientist and others to maintain.

Unrecognized differences of worldview commonly underlie frustrating debates among scientists about natural resource policy and management. Institutional, language, and conceptual barriers greatly impede communication among worldviews considered here. Compartmentalization of the science community arises in part from the fundamental divisions of ecological science, such as distictions among species/population, community, and ecosystem levels. Scientists separate into groups of similar worldview—academic departments, work units within government research labs, and scientific societies. Policy issues that call for integrated approaches can become battlegrounds for supremacy of worldviews even within science circles—in FEMAT, for example, one could hear "my endangered species trumps your fuzzy ecosystem dynamics concept" by implication, and that seems to be the way court rulings are playing out (*Pacific Coast Federation of Fishermen's Association v. National Marine Fisheries Servic* 1999).

An integrated approach to natural resource policy and management is essential to meeting society's complex objectives, yet integration across disciplines and worldviews remains a major challenge. Fragmentation within the science community is paralleled by piecemeal natural resource policy, developed in part in the context of a succession of high-profile issues. In the Pacific Northwest, for example, we have shifted from emphasis on efficiency of timber extraction and silvicultural practice to species protection, followed by heightened concern for watershed issues triggered by the 1996 floods. Water issues were quickly supplanted on the front pages of newspapers by fire hazard issues in the big fire years of 2000 and 2002. The issues have progressed, yet the NWFP retains a species protection focus because it was developed in response to litigation with that emphasis, in part because federal policies then had (and still have) a strong focus on species protection.

More integrated natural resource policy can be crafted in various contexts, such as in debate concerning specific policy issues, among scientists with differing worldviews, or in the research-management partnerships. The policy arena, where integration is much needed, is often too hot politically and too focused on the ultimate decision to foster thoughtful discourse. I feel that the science community has a social responsibility to integrate across worldviews outside the contentious policy arena before testing those ideas in the heat of policy conflict—a form of social-process adaptive management. The objective would be to identify the strengths and weaknesses of different management approaches and examine how they can be best mixed and matched to achieve local management objectives. Such an effort could critique a small set of case studies and develop alternative, more integrative, longer-term methods blending diverse ap-

proaches. The work of Gunderson et al. (1995) and Johnson et al. (1999a) takes the first step, but stops short of developing more integrative alternatives to the plans adopted. The National Science Foundation–sponsored National Center for Ecological Analysis and Synthesis in Santa Barbara, California, could provide a forum to bring together the perspectives of scientists, managers, and policy makers to begin work on this matter. However, this rather academic approach to integration across worldviews has the serious drawback of lacking the reality check of implementing real policy through real management.

Long-term work within a research-management partnership can be an important venue for integrating worldviews and management approaches though real-world adaptive management. A close, sustained working relationship of land managers and scientists with continuing public scrutiny and input can lead to a blending of worldviews and give scientists a context for very effectively playing the "integrate" role in a succession of decisions by line officers in the management organization. FEMAT and the NWFP assigned the adaptive management task to ten specific land areas (AMAs) and their line officers in an effort to increase the potential for success. However, developing and sustaining support and conduct of adaptive management has proven very difficult (Stankey et al. 2003). The land allocation for AMAs remains, but support of the learning process there is now left to individual national forests, whose budgets are severely constrained by continued reductions. It is distressing to note that the institutional commitment to adaptive management has faltered significantly—the Pacific Northwest Research Station eliminated support of AMAs in 1998, and the Regional Office of the National Forest System did so in 2003, before the NWFP was a decade old. Failure to have a strong and effective commitment to adaptive management increases the potential for convulsive rather than thoughtful, incremental change in management approaches (Holling 1995). The AMA network was a critical component of the overall adaptive management approach of the NWFP; if the adaptive management scheme set out in the plan is not workable, another should be developed. In short, adaptive management is an important investment in the future: absence of adaptive management diminishes the possibility of producing well-tested management schemes with both science and management credibility (the "right stuff") ready for implementation when a policy window allowing or requiring innovation opens.

An abundance of science relevant to regional policy issues, a strong commitment to having science-based policy and management, and keen public attention to forestry issues are hallmarks of the Pacific Northwest in recent decades. However, the region has been unable to mesh this incredible human resource, including scientific knowledge, with its even more impressive natural resources to arrive at workable future policy. Current struggles, for example, concern whether or not to thin forests for fuel reduction and enhancement of old-growth forest attributes in plantations, and whether short-term environmental damage from improvement of culverts on forest roads outweighs long-term watershed restoration. Science can help inform the trade-off considerations, but competing social worldviews of cut vs. no-cut have created stalemate. While frustrating, perhaps this should come as no surprise, since it is simply an extension of conflict extending back well into the nineteenth century (Wilkinson 1992). Contemporary biological, social, and physical sciences can contribute to framing issues and defining capabilities of ecosystems and social systems, but resolution of the issue remains largely a matter of social and political leadership.

Note

This chapter is based on a talk given at the Forest Futures Conference at Willamette University in Salem, Oregon, on September 25, 2002. These views have been developed over many years of work in the H. J. Andrews Experimental Forest and the Long-Term Ecological Research Program, Cascade Center for Ecosystem Management, and Central Cascades Adaptive Management Area centered there. I thank many colleagues and friends for discussions of the science-management-policy interface and K. Arabas, J. Bowersox, J. Cissel, J. Jones, J. Laurence, B. Shindler, and T. Spies for reviews of the manuscript. The opinions expressed are my own. For more information about the Andrews Forest program, see www.fsl.orst.edu/lter.