Bureaucracy, Collaboration and Coproduction: A case study of the implementation of adaptive management in the U.S.D.A. Forest Service[1]

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Abstract:

This paper examines the role of collaborative & coproductive processes in management of US national forests, utilizing a case study of the implementation of the policy of adaptive management by the U.S.D.A. Forest Service in the Pacific Northwest region of the U.S. Adaptive management is widely prescribed by ecologists and conservation theorists as a means of improving natural resource management by using designed experiments to test management hypotheses and improve management practice. Adaptive management was introduced by the US Government on public lands in the Pacific Northwest in the early 1990s in the aftermath of major controversy over the management of old-growth forest for spotted owl habitat. The Forest Service designated 10 areas as adaptive management areas, where experiments would be tried out, and further prescribed that the entire agency adopt adaptive management as a core part of management practice. Implementation of this goal has been poor: only two adaptive management projects have actually gotten off the ground, one in and one outside of a designated adaptive management area. This paper shows that the Forest Service's vision of adaptive management as a process that could occur without the collaboration of agents outside of the bureaucracy contributed to the implementation failure. When adaptive management succeeded, it was the result of co-production between the bureaucracy, the scientific community, and other policy actors. While many recent authors have focused on the role of formally organized, place and consensus based collaboratives in improving policy outcomes, this paper illustrates the role of more complex informal collaborative and adversarial processes.

Key Words:
USDA Forest Service; Collective Action; Adaptive Management; Coproduction; Collaboration; Policy Implementation.

[1] The original, less focused, title of this paper was: *Collaborative Management of government-owned forests in the USA: a literature review & methodological proposal*.

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1. Introduction

The purpose of this paper is to examine the role of collaboration and collective governance in the management of publicly owned forests in the US. Unlike many contexts in which collective governance of forests have been well studied, most publicly owned forests in the US remain under the direct control of centralized bureaucratic agencies, the largest of which, the USDA Forest Service (referred to henceforth as the FS), is the focus of this paper. Nonetheless, even a cursory examination of the field reveals that actors outside of the central agency play many important roles in forest management. Existing literature on the role of these actors is heavily tilted towards the examination of place-based collaborative groups, which in some locations have been highly successful at resolving seemingly intractable conflicts over natural resource use (Bryan & Wondolleck, 2003; Conley & Moote, 2003; Davenport, Leahy, Anderson, & Jakes, 2007; Koontz & Thomas, 2006; Marston, 2000; McKinney, 2001; Mortimer, Scardina, & Jenkins, 2004; Scardina, Mortimer, & Dudley, 2007; Schuett & Selin, 2002; Selin, Schuett, & Carr, 2000; Wondolleck & Yaffee, 2000). Although these studies have made important progress in understanding how such collaborative groups emerge, these groups are not present in most forested areas of the U.S., and the resultant studies have left aside the question of how collective action works in the context of everyday FS affairs in the majority of areas managed by the FS, where explicit place-based collaboratives are not present. I have chosen to focus my investigation on the role of collective action in the implementation of a specific policy: adaptive management.

1.1 Why Adaptive Management

Social and ecological scientists have understood for many years that static systems of ecosystem management are prone to failure. For this reason there has been a growing interest in the concept and practice of adaptive management. According to the Resilience Alliance (2008),

> *"Adaptive management seeks to aggressively use management intervention as a tool to strategically probe the functioning of an ecosystem. Interventions are designed to test key hypotheses about the functioning of the ecosystem. This approach is very different from a typical management approach of 'informed trial-and-error' which uses the best available knowledge to generate a risk-averse, 'best guess' management strategy, which is then changed as new information modifies the 'best guess'."*

The concept was introduced in natural resource management by the work of Holling et al. (1978) and Walters (1986), and has been proposed for a large number of natural resource management problems. The US government scientific committee responsible for creating an adaptive management process for management of mature forests owned by the national government in the Pacific Northwest (FEMAT, 1993, p. IX-1) defined adaptive management as

> *"The process of implementing policy decisions as scientifically driven management experiments that test predictions and assumptions in management plans, and using the resulting information to improve the plans."*

Other natural resource agencies and research groups have used slightly different definitions, but all share the key steps of designing experiments which will inform future management decisions, and altering management based on information from these designed experiments (Stankey, Clark, & Bormann, 2005). Adaptive management is meant to provide an approach to the management of complex natural systems that uses the basic thought process of science, hypothesis testing, to evaluate management strategies, thereby building an informational base that leads both to learning and improvements in management based on learning. Conceptually, adaptive management is similar to Campbell's (1969) concept of treating new policies as opportunities to design randomized or natural experiments to evaluate the efficacy of competing policies. Adaptive management is frequently contrasted with ad-hoc learning styles such as trial and error, where learning is not a structured activity. As conceived of by Holling and Walters, adaptive management involves intentional design for the provision of information. Adaptive management can also be contrasted with what Holling and Meffe (1996) describe as "the pathology of natural resource management." In the pathology, managers set production goals which are achieved in the short-term, but which compromise long-term system resilience. Buoyed by short-term success, managers become entrenched in their ways, and fail to anticipate crises. Adaptive management is supposed by many authors to be a method to avoid such entrenchment.

Although adaptive management has been widely discussed, and has been officially adopted by diverse natural resource management agencies, evaluation of the implementation of adaptive management has been limited. Google Scholar lists 1229 citing references for Holling (1978). A careful review indicates that the vast majority of these articles either recommend adaptive management, or provide conceptual models of how adaptive management could be used. In spite of 30 years of theory and policy recommendations, there is almost no literature evaluating the actual implementation of adaptive management in the field. To the extent that an implementation literature exists, it primarily consists of anecdotal accounts by scientist practitioners, primarily ecologists, of their own struggles to implement adaptive management policies. In the most widely cited of these accounts, Walters (1997), reviewing his own experience with the implementation of the policy model he helped pioneer, notes that there have been few successes:

> *Experimental policies have been seen as too costly or risky, particularly in relation to monitoring costs and risk to sensitive species. Research and management stakeholders have shown deplorable self-interest, seeing adaptive-policy development as a threat to existing research programs and management regimes, rather than as an opportunity for improvement. Proposals for experimental management regimes have exposed and highlighted some really fundamental conflicts in ecological values.*

The vast majority of literature on adaptive management – both the prescriptive and evaluative - assumes that it is a technocratic policy. The implementer of adaptive management is nearly always a natural resource bureaucracy, and the item managed is nearly always an ecosystem. Social and political actors and institutions are inevitably described as barriers to implementation, rather than as core components of the management system or as pieces of a linked socio-ecological system that need to be understood in their own right. In an attempt to overcome this barrier, some more recent literature uses the term adaptive *governance* (Dietz, Ostrom, & Stern, 2003; Folke, Hahn, Olsson, & Norberg, 2005) rather than management

> *Because the idea of governance conveys the difficulty of control, the need to proceed in the face of substantial uncertainty, and the importance of dealing with diversity and reconciling conflict among people and groups who differ in values, interests, perspectives, power, and the kinds of information they bring to situations. (Dietz et al., 2003, note 27)*

In this reconceptualization, adaptive governance is viewed as a collective action problem that involves diverse actors with divergent interests, and the system which must be understood is conceived of as including these actors, along with the ecosystem. I will use a case study of the U.S.D.A. Forest Service's adaptive management program to examine the role of collective action in the implementation of adaptive management programs.

1.2 Why study the U.S.D.A. Forest Service

The FS is one of the largest land management agencies in the world, managing 193 million acres, and has traditionally been a pace-setter among US natural resource agencies, and by extension, many resource agencies in other countries. The FS' roots in Germanic Scientific Forestry and Progressive era ideas about the role of government in society are shared by forestry and natural resource agencies around the world (Balogh, 2002; Gadgil & Guha, 2000; Marshall, 2005; Miller, 2001; Wilkinson & Anderson, 1985).

In 1991, as a result of extended controversies over land management policy, the FS officially adopted a new philosophy of "Ecosystem Management" (FEMAT, 1993). Although various definitions of ecosystem management have been used both within the FS and in the broader scientific community, all have included adaptive management as a crucial component of ecosystem management (Butler & Koontz, 2005; Christensen et al., 1996; FEMAT, 1993; Grumbine, 1994; Kohm & Franklin, 1997). The FEMAT definition of Adaptive Management is quoted in section 1.1. Specific FS management plans implementing the new philosophy of ecosystem management have been in effect since 1994 in the Pacific Northwest, where the philosophy was first integrated into management direction, and since the mid 1990s in most other FS regions. In the Pacific Northwest, adaptive management was not only written into overarching management plans, but ten areas, ranging in size from approximately 100,000 to 500,000 acres, were specifically designated as adaptive management areas (AMAs), where using adaptive management would be a focus. Since these policies have now been in effect for more than 10 years, it is possible to make reasonable evaluations of their success.

If adaptive management can succeed as a technocratic –i.e. bureaucratic and scientific – process, there are reasons to view the FS as unusually well situated for success. The FS has a historical reputation as a bureaucracy which can effectively translate top-down management direction into field implementation (Kaufman, 1960), although more recent evaluations indicate that the FS has lost this edge (Dialogos, 2007; O'Toole, 1988). The FS has enormous scientific resources - the research branch of the FS is one of the largest and most productive research organizations in the world in relevant fields, including forestry, ecology, and wildlife biology, and the FS also has close relationships with leading researchers at top US research universities. If the FS, with its enormous capacity, fails at this task, we may learn important lessons about the implementation possibilities for adaptive management in other, less favorable contexts, which if technical capacity is a key variable, might include nearly every other natural resource management agency.

As discussed at the outset of this paper, much recent literature on the challenges facing the Forest Service has focused on the potential of collaborative approaches for alleviating perennial conflicts and improving management outcomes, reflecting a broader trend of interest in collaborative natural resource management globally. These scholars have focused on the appearance of place & consensus based collaborative groups among stakeholders who had previously held polarized views. Many of these scholars view collaboration as a key component of adaptive management, as discussed below. Critics of collaborative approaches (Peterson, Peterson, & Peterson, 2005, 2006; Stahl, 2001) worry that collaborative approaches will be biased in favor of extractive uses, or in favor of local rather than national interests, and that consensus-based approaches obstruct the use of argument which is essential to the construction of scientific truth. In spite of all the attention given to collaborative management of public lands in the US, there have not been systematic efforts to compare cases and understand how the collaborative cases studied differ from the counterfactual, presumably non-collaborative cases, in terms of the process and outcomes of decision-making. The absence of a counterfactual condition makes it difficult to understand how collaboration may alter the dynamics of decision-making. This paper explicitly examines the role that collaboration plays in the production of adaptive management.

1.3 Competing conceptions of adaptive management

One significant subsector of the adaptive management literature assumes that bureaucratic land management agencies can independently choose adaptive management as a strategy. This assumption is common to all of the proposals, progress reports, and evaluations of adaptive management produced by the FS (Bormann, Haynes, & Martin, 2007; FEMAT, 1993; Gray, 2000; Haynes, Bormann, Lee, & Martin, 2006; Pipkin, 1998; Stankey et al., 2003; Stankey et al., 2005; Stankey & Shindler, 1997). In this conception, the FS designs management interventions, monitors their success to gather new information, learns from the new intervention, and then implements improved interventions. I call this model the “bureaucratic model,” as it specifies that adaptive management occurs within the bureaucracy. It is worth noting that in the FS conceptualization of adaptive management, the social, political, and economic aspects of forest management are rarely considered worthy of the kind of organized experimental probing that ecosystems are subject to.

A contrasting conception can be found in work on what is frequently described as adaptive collaborative management (Colfer, 2005a, 2005b; Folke et al., 2005; Ruitenbeek & Cartier, 2001). In this conception of adaptive management, stakeholders from a community work together to plan management actions and learn from those actions. The emphasis on community is problematic, as it can be very difficult to define the relevant extent of community in any situation(Agrawal & Gibson, 1999), particularly for lands owned by the US federal government, as the number of people actually living in immediate proximity to a given parcel may be very small, while powerful interests assert the importance of regional and national claims to any locale. Many so called community-based collaborative groups in US National Forests include significant representation from these regional and national interests, while those that do not face significant hurdles in enacting their preferred policies (Bryan & Wondolleck, 2003; Marston, 2000). Nonetheless, this tradition has clearly influenced the work of many scholars in the US, who see strong parallels between conditions in developing countries and the rural US (McCarthy, 2002), and who view collaborative processes as a potential way forward (Koontz et al., 2004; Wondolleck & Yaffee, 2000). I call this the "collaborative model," as it specifies the community-based collaborative group as the key unit of analysis.

Given the many problems inherent in delineating community, Agrawal and Gibson (1999) argue that a more useful analytic focus for studying natural resource management is on actors, interests, and institutions. In light of this critique I suggest a third model for adaptive management, which assumes that no single entity is capable of implementing adaptive management alone. Instead, interactions between actors lead to adaptive or maladaptive outcomes, depending on institutional structures and situational conditions. In the FS context, we would expect part of the process of designing, monitoring and learning to occur outside of the agency – among interest groups, community based collaboratives, or academic scientists, which then use collaborative or adversarial processes to change FS policies. I call this model the "coproduction model," relying on Ostrom's (1996) definition: "Coproduction is a process through which inputs from individuals who are not 'in' the same organization are transformed into goods and services." Although the collaborative model described above is a form of coproduction, I use the coproductive model to broaden the focus away from place & consensus-based collaboratives, which have been the focus of most of the literature in the US, to include policy processes driven by diverse networks of actors who do not necessarily share physical locations, and who do not necessarily collaborate all of the time. The existence of adversarial politics – the presumable counterfactual to a collaborative group and one of the most widely discussed reasons for the failure of the bureaucratic model – is not viewed in this model as a definitive sign of failure. In fact, as I will discuss, organized adversarial politics can play a role both in hindering and aiding the process of adaptation.

1.4 What should adaptive management look like?

In order to evaluate the implementation of adaptive management, we must know what qualifies. As discussed in section 1.1, adaptive management has been defined by numerous sources as the process of designing management interventions as experiments, and then using the information gleaned from those experiments to change

and improve policies. A few authors have suggested that there may be "weak" forms of adaptive management, which include trial and error learning (Stankey et al., 2005), and it appears that adaptive management is widely understood among managers and administrators as including informal "learning by doing" accompanied by models & systematic monitoring.[3] This understanding contrasts directly with the widely cited theoretical papers which established adaptive management of natural resources as a policy goal (Gunderson, 1999; Holling, 1978; Lee, 1993, 1999; Walters, 1986, 1997), and also contrasts directly with the FS policy documents that established adaptive management as a policy, including notably, the FEMAT report (1993) quoted at the beginning of this paper. All of these documents specifically define adaptive management as a management strategy involving designed experiments that *contrasts* with trial and error and informal learning by doing. While these differing conceptions are the subject of some analysis later in this paper, I take as my starting point the definition provided by the classic literature, and enshrined in FS policy. At a minimum, then, an adaptive management policy should lead to experiments that are designed to answer questions about management outcomes. The results of those experiments should then be used to improve management outcomes.

1.5 Hypotheses about adaptive management and the FS

In this paper I focus on the region in the Pacific Northwest where adaptive management has been around for the longest time – the National Forests and neighboring public lands of western Washington, Oregon, and Northwest California. I pose three interrelated questions:

1. Has the FS been successful at achieving adaptive management?
2. If the FS has been successful in its adaptive management program, which model has contributed to its success?
3. If the FS has failed in its adaptive management program, which model contributed to its failure?

I find support for the following hypothesis: The FS conceives of adaptive management as a process of a bureaucracy acting on an ecosystem. In addition to internal difficulties in reorganizing priorities, the FS has had difficulty finding ways to work productively with external actors, whom it has not systematically attempted to understand. This has resulted in a general failure to implement adaptive management. Where the FS has succeeded in creating adaptive management, it has done so through coproduction with scientists and policy actors who otherwise frequently take adversarial roles. The importance of these groups in helping the FS overcome its institutional constraints implies that attempts to build adaptive management into the processes of bureaucracies may rely as much on the strengths of civil society actors and non-agency scientists as it does on the strengths of the bureaucracy itself, and thus lends support to the coproductive model of adaptive management.

[3] I owe this observation to Professor Burnell Fischer, who was Indiana State Forester for much of the time in question (i.e. 1990-2005).

2. The Forest Service Context: Institutional Constraints and the emergence of the Ecosystem Management Paradigm

2.1 Institutional Constraints

In his landmark study of the FS' organizational behavior, Kaufman (1960) described an agency with an unusual ability to implement policy from the Washington headquarters down to remote district offices. The pre-1960 FS had a high level of ethnic and cultural homogeneity – the FS employed almost exclusively white males with forestry degrees from a relatively small number of forestry colleges – which meant that individual goals were closely aligned with the goals of the agency as a whole. The FS was extremely powerful in the remote and sparsely populated regions where it was the primary landowner, and was given an unusual level of administrative discretion (Wilkinson & Anderson, 1985), with few Congressional directives or limitations on agency priorities. Both the organizational philosophy and the congressionally created incentive structure rewarded timber management at the expense of other legally mandated uses such as grazing, wildlife, recreation, and watershed protection, and many local communities were broadly sympathetic with the resulting management outcomes (Clary, 1986; Hirt, 1994; O'Toole, 1988).

The 1960s and 1970s saw the emergence of strong environmental laws which limited the actions of the FS. The most important laws were: The Wilderness Act, which set aside land for nonconsumptive uses; the National Environmental Policy Act (NEPA), which required that any major federal action be preceded by an environmental impact statement, prepared by an interdisciplinary team; the Endangered Species Act (ESA), which required that the Forest Service and other federal land management agencies protect listed species; and the National Forest Management Act (NFMA), which formalized planning procedures. All of these laws were passed with large legislative majorities, and were perceived to represent a national consensus on the importance of conservation. It is apparent that many the supporters of these laws did not understand their full implications (Petersen, 1999), and some senior legislators who supported these laws initially have recently called for their repeal or substantial reform. Recent attempts to rewrite NEPA and the ESA have not made progress in Congress even when opponents of these laws chaired all relevant committees, and with the current ascendance of a democratic Congress, changes in these laws do not seem likely in the foreseeable future.

2.2 The Emergence of Ecosystem & Adaptive Management as FS governing paradigms

The new environmental laws created a new institutional structure that ultimately led to the birth of the ecosystem management paradigm; however the impact of these laws was not felt immediately. Forest Service policies, at least with regards to timber harvest, did not change significantly in the 1970s and 1980s. The new forest plans written under the NFMA contained elaborate computer models which purported to show that existing levels of timber harvest were sustainable & profitable, even when conventional accounting methods showed that they were neither (O'Toole, 1988), and warning signs that some species were approaching endangerment were largely ignored

(Yaffee, 1994). The agency continued to be aligned closely with resource extraction interests.

But the times were changing, even if FS policies and actions were not. Affirmative action led to a social diversification of the workforce, while the new NEPA process required the FS to hire large numbers of experts trained in disciplines outside of the forestry mainstream – wildlife and fisheries biologists, hydrologists, botanists, and social scientists. The new hires, who did not share the agency's rural patrician roots, often had very different ideas about how forest should be managed than conventionally trained foresters (Halvorsen, 2001). The migration of large numbers of young urbanites into rural areas in the late 1960s and 1970s, along with the increased mobility of urban dwellers, bought increasing numbers of people in contact with national forest lands. These people were often disturbed by what they perceived to be excessive timber harvests. Small, locally based environmental advocacy groups began appearing in the rural west, calling for increased wilderness protection and decreased logging. At the same time, the larger environmental groups, which had traditionally focused on issues such as pollution control or the designation of National Parks, began to grow interested in the management of National Forests.

All of these groups found that the new environmental laws, and in particular, NEPA, provided legal hooks which they could use to halt projects which they did not agree with. Although NEPA technically only required disclosure of environmental harm, and not avoidance or mitigation, environmental groups found that they could frequently halt a project by finding shortcomings in its environmental impact statement. The story of the northern spotted owl has been extensively analyzed elsewhere (see in particular Yaffee, 1994). Although the Forest Service had been aware that spotted owls were in decline, and were dependent on old-growth forests that were being rapidly eliminated by the timber-focused management, they had not shifted their management strategy to accommodate species protection. In 1989 Environmental groups used NEPA and ESA litigation based on declining numbers of spotted owls to halt timber sales in the FS' most productive timber-producing region, the moist temperate forests of the Pacific Northwest.

Attempts to resolve the crisis varied through the years. In 1992, FS chief Dale Robertson announced that the FS was adopting an "ecosystem approach" for the management of the National Forests. The following year, newly-elected president Bill Clinton convened a conference to mediate and resolve the controversy, and formally endorsed the approach of ecosystem management. The FS and cooperating agencies authored a major report entitled: Forest Ecosystem Management: An Ecological, Economic, and Social Assessment (FEMAT, 1993), and this in turn was used as the basis for developing a new set of management options. The approach adopted in the FEMAT report represented a major departure from planning strategies used by the FS in the past, as the plan was conceived of and written by senior scientists from the research branch of the FS, rather than by field personnel. The Northwest Forest Plan, the compromise result of Clinton's conference and the FEMAT report, was released and adopted in 1994 – and called for dramatic reductions in timber harvest, combined with an increased emphasis on ecosystem management. As described in section 1.2,

adaptive management was considered to be a crucial component of ecosystem management throughout the Forest Service, and particularly in the Pacific Northwest, where ten "adaptive management areas" where set aside to be managed with a specifically adaptive approach. The FEMAT report emphasized the role of adaptive management in resolving the substantial uncertainties that existed in terms of habitat restoration.

3. Evaluation of Adaptive Management in the FS

Initial results from evaluations of adaptive management have not been encouraging. The FS appears to have fallen short of its goals, both in the creation of specific AMAs, and in the creation of programmatic adaptive management. Only two adaptive management experiments have been documented, one taking place on an AMA, the second taking place outside. Since one of these experiments was only implemented in 2004, and since the processes being manipulated, the development of forest stand structure, take place over time scales of 20-100 years, it may be too soon to evaluate whether information generated in these experiments is being used to alter management plans.

3.1 Evaluation of AMAs

The Northwest Forest Plan was adopted by President Clinton in 1994 for the management of approximately 25 million acres of federal land within the range of the northern spotted owl, primarily managed by the FS, but also by the Bureau of Land Management, National Park Service, and other agencies. The plan made three different land management designations. A large portion of the land was designated "Late-Successional Reserve." These lands were to be managed as habitat for the spotted owl and other species dependent on older forest types. A second portion of land was designated matrix – i.e. areas in between reserves – that would be managed under a more traditional conception of the FS' multiple-use mandate. A final portion, consisting of 10 areas, ranging in size from a little less than 100,000 acres to 500,000 acres, were designated as "adaptive management areas." According to FS documents prepared in 1993 (FEMAT, 1993, p. III-24),

> *Adaptive Management Areas are landscape units designated to encourage the development and testing of technical and social approaches to achieving desired ecological, economic, and other social objectives… The overarching objective for Adaptive Management Areas is to learn how to do ecosystem management in terms of both technical and social challenges, and in a manner consistent with applicable laws. It is hoped that localized, idiosyncratic approaches that may achieve the conservation objectives of this plan can be pursued. These approaches rely on the experience and ingenuity of resource managers and communities rather than traditionally derived and tightly prescriptive approaches that are generally applied in management of forests… Establishment of the Adaptive Management Areas is not intended to discourage the development of innovative social and technical approaches to forest resource issues in other locales. These are intended to provide a*

> *geographic focus for innovation and experimentation, with the intent that such experience will be widely shared.*

Further details of the FS' approach to adaptive management were published in an implementation plan (Bormann, Cunningham, Brookes, Manning, & Collopy, 1994). Initial evaluations of the implementation of AMAs were mixed. A 1998 review by the Department of the Interior's Office of Policy Analysis[4] stated,

> *For some managers, there is only limited understanding of how the adaptive management areas "relate to the wider scheme of forest management and especially to the implementation of ecosystem management."*
> *Plans for adaptive management areas lag behind expectations. However, plans for seven areas have been submitted and reviewed by a work group that was chartered to review such plans and to assist the regional federal executives in interpreting relevant policy issues that arise from the plans.*

FS researchers (Stankey & Shindler, 1997) described "a disquieting feeling among some observers, both within and outside the agencies, that the ideals expressed in FEMAT about the AMAs have been compromised or lost altogether," although they also noted that the AMAs represented a new policy. Academics outside of the agency were even less impressed. Lee (1999), referring to the FEMAT report (1993) wrote, "The Forest Service's definition of adaptive management does not emphasize experimentation but rather rational planning coupled with trial and error learning. Here "adaptive" management has become a buzzword, a fashionable label that means less than it seems to promise." It is not clear if Lee was entirely fair – after all, the FS definition cited at the beginning of this paper is from the same document that Lee cites, and is not conceptually distinguishable from the Resilience Alliance's 2008 definition. Nonetheless, it is clear that informed observers in the late 1990s were already concerned that AMAs were not living up to their potential.

In 2000, a FS Pacific Northwest Research Station scientist who had been designated lead scientist for the North Coast AMA in northwest Oregon published reflections on his experience (Gray, 2000). Although some progress was made in terms of thinking about uncertainty in management issues in the AMA, there was little interest in implementing experimental treatments on the part of the public or agency officials. The dispersed nature of the land holdings, and the fact that the area combined equal parts FS, BLM, State, and private lands made coordination difficult. Furthermore, the relatively large percent of AMA lands that were already administratively reserved for various habitat requirements made experimental design difficult. It appears that some of the ideas generated by Gray and his colleagues were eventually implemented on the nearby Five Rivers project, outside of the AMA, discussed in the next section (Bormann & Kiester, 2004).

[4] The FS is a part of the Department of Agriculture, however the Department of Interior, through the Bureau of Land Management, also administers areas governed by the Northwest Forest Plan, including parts of AMAs, while the Fish & Wildlife Service, also part of Interior, is responsible for endangered species management under the ESA, hence the Department of Interior review.

By 2003, more evidence had accumulated on the implementation of the AMAs. Stankey et al. (2003) conducted interviews with 50 individuals who were involved in the implementation of AMAs. The 50 individuals were primarily agency employees who had a direct role in the AMAs, although they also interviewed agency scientists who had been involved in authoring the adaptive management section of the FEMAT (1993) report, along with six non-agency academics and citizens. This selection of evaluation method reflects the FS' bureaucratic interpretation of the process of adaptive management. The authors of the paper were themselves FS scientists who had been integrally involved in the AMA process, dating back to the FEMAT report. In spite of the interest we might expect in their portraying the project as a success, they report that, "despite its appealing and apparently straightforward objectives, examples of successful implementation remain elusive."

Stankey et al. (2003) identified several important barriers to implementation within the framework of the bureaucracy. They found that interviewees did not have a shared conception of what adaptive management meant, or how it ought to be implemented. Some argued that the agency had always behaved adaptively, and that no change was therefore needed. Declining budgets had negatively impacted the AMAs. Although coordinators for each area were identified, and some were initially given a full-time role, most were now spending 25% or less of their time on managing the AMAs. The coordinators had not received any special training, and although they perceived that they did not have sufficient time to implement the AMA mandate, others in the agency resented what they perceived to be priority treatment to AMAs, making collaboration difficult. Furthermore, they perceived that their supervisors and the agency as a whole were not interested in making the AMAs a priority. Researchers were involved in some of the AMAs, however after 1998, the FS' Pacific Northwest Research Station had cut its funding specifically for researchers to engage with the AMAs. The one AMA which had implemented a large scale experimental treatment that differed from the standard Northwest Forest Plan approach, the Central Cascades AMA, included and was closely associated with the H.J. Andrews Long-Term Ecological Research group, a major scientific research institution with a long history and several sources of stable funding.

Finally Stankey et al. (2003) found that bureaucrats felt hampered in their attempts to implement adaptive management in the AMAs by legal mandates and organizational cultures that favored precaution. It was not merely that their supervisors did not make AMAs a priority. Plans that deviated from standard direction were halted by the U.S. Fish & Wildlife Service, the agency responsible for protecting Endangered Species Act, for concern that they might jeopardize listed species. Although Stankey et al. believed that there was not enough information available to support this conclusion, they found that the regulatory agencies preferred the familiar action with uncertain consequences to the unfamiliar action with uncertain consequences but the possibility for learning. This attitude was not confined to the agencies, but was reinforced by litigious external agents, including environmental advocacy groups and the timber industry.

An additional unpublished survey by the Regional Ecosystem Office, an interagency coordinating committee created under the Northwest Forest Plan, conducted in 2004 (Badgley, Mohoric, Gravenmier, Mohoric, & Pietrzak, 2004) contained results that

largely supported the findings of Stankey et al. (2003). Badgley et al. sent questionnaires to the line officers responsible for the management of each AMA. Line officers agreed that the most serious barrier to implementation of the AMAs was funding, but they also mentioned many of the same issues discussed by Stankey et al., which is not surprising, given that the two samples undoubtedly overlapped. In particular, they mentioned a desire for more flexibility in implementing the binding portions of the Northwest Forest Plan in AMAs, a request which corresponded with an emphasis of the FS under the Bush administration of attempting to increase its administrative discretion. Badgley et al. also surveyed research projects. They found that while the Pacific Northwest Research Station had funded 31 research projects in the Northwest Forest Plan area, only 7 of these were taking place in AMAs.

In 2006 a series of reports evaluating the first ten years of implementation of the Northwest Forest Plan were published as a Forest Service General Technical Report (Haynes et al., 2006), and as a special issue of the scholarly journal *Conservation Biology* (Dellasala & Williams, 2006). One chapter of the General Technical Report (Bormann et al., 2006) was devoted to adaptive management, as was a subsequent journal article (Bormann et al., 2007). In examining the effectiveness of the AMAs, these reports did not conduct substantial new research, however they repeated the theme emerging from the literature – that there was little evidence that adaptive management had actually occurred in the AMAs. The one major success, the research in the Central Cascades AMA, could not be reasonably credited to the AMA designation, as the research was begun before the AMA was designated, and was in fact the reason the area was designated as an AMA in the first place. The authors identified four barriers to implementation in the AMAs:

1. The Scientists who conceived of the AMAs believed that they would have substantial latitude to deviate from the programs practiced on the rest of the National Forests, however, when the plans were written, the AMAs did not actually have increased discretion.
2. Many people thought of the AMAs as areas where collaborative approaches would dominate, and while the AMAs did help support some collaborative approaches, it proved very difficult to reach consensus.
3. Precaution was emphasized more than adaptation.
4. Funding was inadequate.

3.2 Evaluation of adaptive management across the region

Although the evaluation literature has emphasized the AMAs, the Northwest Forest Plan made adaptive management a programmatic priority, and adaptive management as a management paradigm across the FS. Bormann et al. (2007) noted that, “Allocating land with specific adaptive management mandates is not enough to ensure that goals are met… AMAs largely failed in their primary mission to test alternative strategies, eventually becoming noncompetitive in budget allocations.” Did the agency as a whole fail the adaptive management test as much as the AMAs did?

Several experiments designed specifically to test uncertain management outcomes have been implemented in the Pacific Northwest. As mentioned previously, the Blue River experiment associated with the H.J. Andrews Long-Term Ecological Research

group (Cissel, Swanson, & Weisberg, 1999), which later became part of the Cascades Adaptive Management Area, fit the paradigm of adaptive management. While these experiments have received added support as a result of the Northwest Forest Plan, they appear to owe their existence as much to the long history of high quality ecological research conducted at the H.J. Andrews Experimental Forest by researchers from the FS and Oregon State University, some of which played a key role in creating the controversy over old-growth management in the Pacific Northwest in the first place (Yaffee, 1994).

An experiment with a very different history is the Five Rivers project on the Siuslaw National Forest. The project was originally proposed for the North Coast AMA discussed by Gray (2000), but was apparently halted there due to "gridlock" (Bormann et al., 2006). It was moved to an area of "Matrix" forest, and was then again halted by litigation related to endangered fish species on a regional scale ("Pacific Coast Federation of Fishermen's Associations v. NMFS," 1999). When the plaintiffs learned the details of the project, they asked the judge to make an exception for the experiment. The exception was granted, and the project was begun in 2003 (Bormann & Kiester, 2004). The project's goal was to recreate structural characteristics of old-growth forests out of planted forest plantations. Instead of applying a uniform approach, the project replicates three different treatments: passive management, where the forest is allowed to change without human interference; continuous access management, where a permanent road network enables frequent, low level logging to improve stand structure; and pulsed access management, where roads would be built, relatively heavy logging performed, and then the roads would be closed for 30 years, potentially to be followed by an additional heavy treatment.

The Blue River and Five Rivers projects share two characteristics, which may be viewed as possible necessary conditions for the implementation of adaptive management projects in the context of the Pacific Northwest. First the projects involved close collaboration between scientists at the Oregon State University College of Forestry and Forest Service managers. The College of Forestry has strong historical relationships with the management of both areas – the headquarters of the Siuslaw National Forest are located in Corvallis, only a couple of miles from the College of Forestry, and College of Forestry researchers have a long history of working in the H.J. Andrews Experimental Forest. Fieldwork is needed to clarify the extent of these relationships, and whether they differ substantively from relationships between other research groups and FS units. Similar adaptive management experiments have not emerged out of the Humboldt State University or University of Washington forestry programs, in spite of the high caliber of both of these programs and their proximity to FS management units.

A second condition shared by the Five Rivers and Blue River projects are a relatively high level of trust between FS management and stakeholder groups. In this case the history of the locations differs substantially. In the case of the H.J. Andrews Experimental Forest, there is a long history of collaboration and friendship between scientists conducting research on old-growth forests, local forest managers, and advocacy groups working for the protection of old-growth forests. Environmental advocacy groups that have the capability, through lawsuits, of slowing or halting

management interventions, may be more favorably inclined to projects which are part of the research program of scientists who they consider their allies. It appears that this relationship may be in decline, however, as recent years have seen a spate of lawsuits and tree-sits targeted against logging projects connected to the Blue River experiment. The Blue River project involved logging some existing old-growth stands, an activity which is seen as unacceptable among prominent members of the advocacy community in the area.

The Siuslaw National Forest did not historically share any close linkages with advocacy groups, however in the wake of the Spotted Owl decision, the Siuslaw engaged in an innovative retooling of its operations to focus on thinning in plantations and decommissioning roads. These activities are approved of by logging interests, who are happy to see opportunities for logging. They are also approved of by environmental interests who approve of road decommissioning (old roads are a major source of erosion, which is implicated in the decline of salmon populations), and who think that thinning plantations is at worst harmless, and may in fact accelerate a return to mature forests. As a result, a consensus has emerged in favor of current management practices on the Siuslaw. One Siuslaw official told me that the Siuslaw spent substantially less than other forests in the region on its environmental analyses, because while other forests had to make sure that they did not make any mistakes that would make them vulnerable to lawsuits by environmental or timber industry interests that opposed the project, the Siuslaw could be reasonably certain that their projects would not have to undergo judicial review. The Five Rivers project fit well into this paradigm, explaining the environmental groups' willingness to release it from a regional injunction. The success in building consensus in the Siuslaw may not be reproducible in other parts of the region. The Siuslaw is unusual in that it contains a large percentage of low-elevation coastal forests, which grow extremely rapidly, allowing logging in younger stands, and that it contains very little old-growth forest.[5] These two conditions currently make consensus building easier on the Siuslaw than on other forests in the region.

The history of these projects suggest that collaboration between FS managers, scientists inside and outside of the agency, and advocacy groups is a necessary condition for the success of adaptive management, although obviously the small number of cases limits the strength of this generalization. Does this fit the collaborative model I drew from the literature and described in section 1.3? In fact, it differs substantially from the model of collaboration described by, for example Wondolleck & Yaffee (2000), which emphasizes formal collaborative processes, which typically follow variants of formal consensus and involve place-based actors. In these case collaboration occurs on an ad-hoc, informal basis that does not involve formal consensus and involves buy-in both from local actors and from organizations and individuals not typically considered as parts of place-based programs. Scientists in this

[5] The Siuslaw National Forest was one of the few areas in the Oregon Coast Range not claimed by private logging companies in the late 19th century, because it had burned in a large fire in the 1850s, and did not contain much mature timber. As a result, the Siuslaw contains few forests older than 150 years, which is relatively young in the context of forestry in the region. In addition, the forest was logged very heavily between 1950 and 1990.

case appear to play an important role, as do advocacy groups that are more typically engaged in adversarial politics. Although these entities ultimately work together to co-produce collaborative outcomes, they appear to fit better into the broader co-productive model than the narrow collaborative model.

Both the Blue River and Five Rivers projects are examples of management interventions designed "as a tool to strategically probe the functioning of an ecosystem (Resilience Alliance, 2008)." There is no evidence, so far, that the FS has used the resulting information to improve management plans, as called for in the FEMAT (1993) report. It is possible that it is premature to evaluate this second step of adaptive management. The hypothesis posed in both experiments relate to the restoration of functional old-growth forest in a landscape where it may take more than one hundred years for a forest to be considered old growth, and it may take a very long time for any lessons to be learned from the management experiments that are robust enough to be applied to management.

On a broader level, the ten year assessments of the Northwest Forest Plan (Bormann et al., 2007; Bormann et al., 2006; Haynes et al., 2006) suggest that information from a heavily funded monitoring program is being incorporated into management direction. For example, monitoring of spotted owl populations indicates that they are declining more rapidly than expected in the northern part of their range, perhaps due to competition with invading barred owls, while in the southern part of their range, they seem to be better able to take advantage of young forests than previously believed (Noon & Blakesley, 2006). The ten year assessment does not actually detail how this new information is being incorporated into management direction. Assuming that it is, this incorporation is more likely to reflect the reactive or what Walters (1997) calls the "passively adaptive use of improved monitoring information." As Campbell (1969) pointed out long ago, the results of monitoring that is not part of a clearly specified experimental or quasi-experimental design is subject to numerous threats to validity. There is no evidence to suggest that new information on spotted owl habitat requirements is the result of a consciously experimental approach to management planning. The spotted owl protections written into the Northwest Forest Plan were uniform across the region, and any variation that existed was as much the result of political compromise or legal necessity as it was an attempt to design replicated experiments. The threat of differing history (Shadish, Cook, & Campbell, 2002) is particularly relevant to this monitoring information, as it now appears that effects of forest management practices on spotted owl populations are interacting with a major invasion of a competitor species, the barred owl (Noon & Blakesley, 2006).

3.3 Information processing and change: the next step in adaptive management

Analysis of how the contemporary FS makes decisions – and changes its mind – is quite limited. There have been a few limited attempts at model building (Martin & Bender, 1999), and extensive analyses of collaborative processes (Conley & Moote, 2003; Koontz et al., 2004; Moore & Koontz, 2003; Wondolleck & Yaffee, 2000), however none of these have adequately described the interaction, largely mediated through the NEPA process, that goes on within the agency, between agencies, and between agencies & the public, in the process of FS planning. In fact, the FS itself seems quite

confused by its own processes (Richards et al., 2007). This paper cannot fill this gap. I do wish to briefly draw on my own experience to illustrate the highly interactive nature of this process, and the difficulties the FS may face in trying to apply information from adaptive management experiments to alter its management practices.

From 2004-2006, I served as policy advocate for a watchdog group, Forest Service Employees for Environmental Ethics.[6] In this capacity, I worked with numerous agency employees, including whistleblowers, along with members of local, regional, and national environmental advocacy groups and other members of the public to help them incorporate new scientific information into projects and plans. Although I worked in areas all around the country, I was based in Eugene, OR, at the center of the region discussed in this paper. At times, I was impressed with the ability of FS managers to incorporate new scientific information. For example, in the wake of the Toolbox Fire on the Fremont National Forest, FS managers worked with scientists from the Rocky Mountain Research Station and Montana State University to implement a series of treatments that enabled the scientists to develop habitat models for birds dependent on post-fire environments, and would lead to improved management in the future (Russell, Saab, & Dudley, 2007).

In many other cases, however, FS managers were not aware of current research findings, even findings generated within the agency. The NEPA process, which includes several periods of public comment, was an opportunity for the science and advocacy communities to inform the FS regarding the latest scientific information. In at least some cases I was involved in, the FS chose to ignore new information. For example, in the case of the Sims Fire ("FSEEE v. USFS," 2006), which burned legally designated spotted owl critical habitat, the local office of the FS decided it did not need to initiate consultation under the ESA prior to engage in salvage logging because it believed that once spotted owl habitat was burnt, it would no longer be suitable as habitat. I had recently read a progress review of a radio telemetry study funded by the FS that showed that spotted owls continue to utilize certain kinds of forests after fires. The local FS office ignored this information, and my organization joined several others in a lawsuit that halted the project.

This personal example is meant to illustrate a fairly simple point that was illustrated on a grand scale during the original spotted owl controversy (Yaffee, 1994). There has frequently been a large gap between the overall knowledge that exists about forest management and the management decisions made by the FS. This gap exists both because the field of knowledge about how forests should be managed is sufficiently large that no individual can master it all, and because the FS has been slow to adapt to new circumstances and implement plans based on new knowledge. Outside groups, including scientists and advocacy groups from diverse parts of the political spectrum have played critical roles both in providing new information to the FS, and advocating for changes in agency management. In many situations, such as the original spotted owl controversy, FS managers have strong incentives not to change their behavior – the changes ultimately forced on the FS resulted in dramatic declines in logging, which led

[6] http://www.fseee.org

to many forest budgets to be cut in half or more. Pressure for change can take the form of lawsuits – as in the Sims fire or the larger spotted owl controversy, but it can also occur in a less confrontational manner, as scientists or advocates of various policies interact and collaborate with FS managers, who in my experience are nearly all highly intelligent individuals interested in improving their management practices.

In spite of the successes that have been achieved through collaborative processes (Wondolleck & Yaffee, 2000), it is apparent that only certain kinds of change are likely to occur without adversarial confrontation, and that these changes are simply not possible within the context of a bureaucratic model of adaptive management. The story of the spotted owl indicates that the FS would have driven the owl, and several other species, to extinction, if environmental advocacy groups had not intervened with a highly confrontational approach. In this case, the changes necessary to preserve the spotted owl were actively resisted by the FS in spite of increasing evidence (Yaffee, 1994). The changes necessary to preserve the spotted owl were not mere changes in management strategy, but involved a shift in power within the agency - from managers to scientists and from foresters to wildlife biologists and ecologists – and a shift in the power structure controlling the agency, from an agency that had been largely captured by the timber industry, to an agency that had to balance the interests of industry with those of environmental advocacy groups. These changes were not in the interest of those in positions of power prior to the controversy. The new policies introduced in the early 1990s, including adaptive management (FEMAT, 1993), were not merely the result of bureaucratic or collaborative processes. The FS eventually adapted to the new conditions, but only after court orders effectively shut down its operations for several years.

Should adaptive management experiments show a need for such radical change in the future, there is no reason to expect that the FS would react any differently than it did in the 1980s, and thus, the potential for strong adversarial action from outside the existing power structure must be viewed as an essential aspect of any adaptive management program. In fact, following the arguments of Campbell (1969), it may be generally against the interests of FS scientists and managers to design experiments that test the hypothesis that current management is incorrect. If this is the case, it may help explain why the only documented cases of adaptive management in the Pacific Northwest have occurred as a result of the intervention of external scientists, and not primarily by design from within the agency.

4. Discussion and Suggestions for Further Research

4.1 What do we know about the success and failure of adaptive management?

Examination of existing literature on the implementation of adaptive management by the USDA Forest Service in the Pacific Northwest offers a few key lessons, however it also raises many interesting questions that cannot be answered with existing data. All of the literature indicates that the designation of areas devoted to adaptive management was not a successful strategy for promoting adaptive management. It appears that only one adaptive management area actually implemented anything that could be called adaptive management, and in that one case, the administrative designation does not appear to

have been an important causal factor – instead, it appears that the designation occurred because of innovative research that was already occurring at the site. The literature further indicates that in spite of a large amount of rhetoric, only a few adaptive management experiments are actually in progress in the region as a whole. FS documents clearly indicate intent to use adaptive management, and demonstrate real understanding of what adaptive management means. It is clear that the FS envisioned adaptive management as a bureaucratic process. Both in the AMAs and in the region as a whole, this intent has not been translated into action.

Unfortunately, data to evaluate this shortcoming are very limited. The only study that attempts to probe the failure of AMAs conducted 50 interviews with agency employees involved in AMAs (Stankey et al., 2003). It did not look at the wider context of adaptive management in the region, nor did it interview the large number of non-agency players, and it was conducted by a team of scientists who were themselves involved in the implementation process, and whose biases and preconceptions may have been reflected in the results. Due to the lack of interviews with members of the larger community, it is difficult to evaluate their role. Interviewed bureaucrats and scientists identified a lack of funding as the most important reason for failure, along with administrative constraints, a bias towards precaution, and a lack of clarity on the concept. Neither Stankey et al., nor the several more recent evaluations (Badgley et al., 2004; Bormann et al., 2007; Bormann & Kiester, 2004; Bormann et al., 2006; Haynes et al., 2006; Stankey et al., 2005) have attempted to examine precisely how these barriers prevented implementation, nor have they looked into the important question of why a few locations were able to overcome these barriers. Examining the conditions shared by the two successful adaptive management projects indicates that long-term relationships with university researchers, and the trust of environmental advocacy groups, may be necessary conditions for overcoming the barriers to implementation, including not only the barriers listed above, but also the substantial incentives FS managers may face to not design experiments that could prove their current policies unwise or incorrect. Obviously, with only two cases, it is difficult to draw broad generalizations. It is possible that the FS or other agencies are engaged in adaptive experiments that have not been reported in the literature. Locating additional cases would greatly contribute to the validity of these very preliminary hypotheses.

The evidence from the two successful experiments appears to lend support to the effectiveness of collaborative approaches, although in a different context than it is commonly understood in the literature on community forest management internationally (Colfer, 2005a, 2005b; Ruitenbeek & Cartier, 2001), or domestically (Koontz et al., 2004; Lyman, 2007). Instead of the collaboration occurring in a locale, the collaboration occurs between the management agency, scientists, and interest groups which may or may not have strong place-based connections. More traditional place-based collaborative groups were incorporated into the original adaptive management strategy – notably in the Applegate & Hayfork AMAs. The Applegate area featured a well-documented collaborative group that was highlighted by President Clinton as an example for the rest of the region in 1993. In spite of impressive progress made by the group in terms of consensus building, fire planning, and watershed restoration (Rolle, 2002; Sturtevant & Lange, 1996), the Applegate AMA does not appear to have ever

engaged in adaptive management. The Hayfork AMA was the site of innovation in rural employment in timber dependent communities during the mid to late 1990s (Danks, 2000), but again, there is no evidence that adaptive management occurred in the Hayfork AMA. Furthermore, it appears that the importance of these collaborative groups has faded as the trauma of the major conflict of the early 1990s has been left behind.

What differentiates the community groups in the Applegate and Hayfork AMAs from the collaborative efforts that led to the implementation of adaptive management in the Blue River and Five Rivers project? The first difference is in engagement of university scientists interested in engaging in adaptive management. Although the scientific capacity marshaled in the efforts of the Applegate and Hayfork groups was impressive (Danks, 2000; Rolle, 2002; Sturtevant & Lange, 1996), it was targeted towards the particular issues of concern to residents – jobs, watershed restoration, and fire danger, and did not lead to the sort of structured experimentation called for by adaptive management advocates. Only in the context of a major forestry research program, such as that present at Oregon State University, does the practice of adaptive management appear to have gained prominence. The second difference lies in access to power. The environmental interest groups and prominent scientists involved in the Blue River and Five Rivers project are powerful figures – they include many of the individuals who organized the successful spotted owl lawsuits and legal campaigns, along with many of the scientists who provided supporting documentation and authored the Northwest Forest Plan. As Walters (1997) has argued, bureaucrats face strong disincentives towards engaging in adaptive management projects. It may be that in the two successful projects, the power of scientists and sympathetic environmental advocacy groups was enough to overcome these obstacles. Rogers (1998) suggests that one reason adaptive management collaborations between scientists and managers rarely take off is that neither fully understands the needs of the other. As I discussed earlier, the administration of both Blue River and Five Rivers projects has a long history of close contact with academics, and this may have further contributed to the success of these adaptive management projects.

In the introduction, I suggested that adaptive management could be seen as a bureaucratic, collaborative, or co-productive endeavor. The evidence I have reviewed strongly suggests that strictly bureaucratic approaches to adaptive management are likely to fail. The difference between the collaborative and co-productive models lies in the role of adversarial politics. In the co-productive model, adversarial politics may also play an important role. In most evaluations, including those discussed in this paper performed by the Forest Service, adversarial politics are viewed as a negative element in adaptive management programs. Is this warranted? In the case of the Five Rivers project, it appears that environmental advocacy groups were interested in making an exception to a regional lawsuit to allow the adaptive management approach to move forward, indicating that adversarial politics are not the death knell of adaptive approaches. As noted in section 3.3, adversarial politics play a key role in forcing bureaucracies to adjust their policies when necessary innovations are against the interest of the bureaucracy. If adaptive management is against the interests of bureaucrats, it may be that the failure of adaptive management is the result of too little

rather than too much confrontation. In a sense, advocacy groups can be thought of as playing the role of monitors of the bureaucracy. Several large-n studies have shown that effective monitoring systems are essential to successful forest conservation whether the forest is owned by government, local communities, or private citizens (Banana & Gombya-Ssembajjwe, 2000; Gibson, McKean, & Ostrom, 2000; Gibson, Williams, & Ostrom, 2005; Hayes, 2006).

Given that adaptive management is not happening as prescribed under the Northwest Forest Plan, it is worth asking whether adaptive management is needed. The concept of adaptive management was introduced to the practice of natural resource management by academic ecologists, to whom the concept of policy experiments seems rather intuitive (Rogers, 1998). If it has not been embraced by managers, it may be because it is of limited utility, or because, as Campbell (1969) suggests, policy actors may have an interest in representing their policy choices as the best, and may thus be wary of experiments that could prove them incorrect. There is evidence that managers have a very different conception of the term adaptive management than scientists, and it is possible that this differing interpretation is the result of managers trying to reinterpret science-based policy direction to answer their own needs.

It is difficult to evaluate the utility of adaptive management. Although its proponents cite many potential benefits (Holling, 1978; Lee, 1993, 1999; Resilience Alliance, 2008; Rogers, 1998; Walters, 1986, 1997), they do not cite many examples where those benefits have been realized. Certainly forest management in the US is plagued by substantial uncertainty, and additional information could help resolve these uncertainties. Acquiring such information on systems such as the temperate rainforests of the Pacific Northwest may require very long-term investments – it may take hundreds of years, for example, before we know the consequences of the different management practices being tested on the Blue River and Five Rivers experiments for the restoration and maintenance of a forest type where one of the primary early successional species has an average lifespan of over 400 years. Even if we adopt a very low discount rate, the payout for gaining such information far in the future would have to be enormous to justify investment today. Furthermore, the most intractable conflicts over public land management are frequently about differing values, and additional information may not help resolve these controversies. In fact, it is possible, as I have suggested above, that agreement between conflicting agendas may be a precondition for adaptive management, rather than a means of resolving them. Given the pervasive conflicts that still surround public forest management in the Pacific Northwest, it may be that a wider and more open public discussion of values is more important than generating additional scientific information.

4.2 Can the lessons of the adaptive management program in the Pacific Northwest be applied elsewhere?

In the introduction, I implied that because the FS is similar in certain ways to many other natural resource bureaucracies, lessons learned from the FS may be applicable to other natural resource agencies in the US and in other countries. One key lesson is that adoption of formal adaptive management policies – even ones that devote substantial resources and land area to pursue adaptive management – is not enough to actually

create adaptive management. Even in a bureaucratic agency with large scientific resources, adaptive management is likely to depend on relationships between bureaucratic agencies and independent scientists. Explorations of how such collaborations can be fostered would greatly contribute to the literature on adaptive management. Furthermore, it appears that buy in from key interest groups may be an essential prerequisite for adaptive management. In the case I examined, environmental interest groups appear to have been the important groups – most likely because US environmental laws, including NEPA, the ESA, and the NFMA, allow these groups to halt or at least slow the implementation of projects they do not approve of. In other contexts, other groups may play similar roles. For example, in many developing countries, the cooperation of local people may be essential for the implementation of forest policies, and thus, the place-based collaborative approach emphasized in the developing country literature may be essential. Without scientific input, however, it may not be enough to create the sorts of experiments called for by proponents of adaptive management. Broad agreement about goals may be a necessary precondition for implementation. Again, given the lack of successful implementation, it is not clear whether adaptive management is a worthwhile goal in these societies.

4.3 Suggestions for further research

This paper leaves more questions than it answers. More information is clearly needed to understand the shortcomings and successes of adaptive management in the Pacific Northwest forests. I suggest that the most useful approach will be to study those situations in which adaptive management has occurred. This will enable identification of necessary conditions – i.e. those conditions which are shared across all instances of adaptive management (Ragin, 2000), and which might be replicable in other contexts. In this paper, I have only been able to identify two instances, and it would be helpful to identify additional instances. As mentioned in section 4.1, there may be additional areas in the Pacific Northwest where the sorts of policy experiments called for in the FEMAT (1993) report are occurring. A comparative approach to identifying necessary conditions need not be regionally confined. A cross Forest Service survey – or an even broader survey, might usefully identify experiments that have been successfully implemented. Once several examples are identified, useful comparative work can begin.

In addition, I would argue that there is a need for additional theoretical developments. Adaptive management was proposed thirty years ago (Holling, 1978) as a theoretical way of improving environmental management outcomes, enabling environmental managers to improve their understanding and adapt to changing circumstances. While the literature indicates that success has been limited at best, there are numerous examples of successful environmental management, including places where those responsible for managing ecological systems have gathered new information and changed management as a result, or have reacted in innovative and productive ways to changes in the external environment. Rather than reflexively prescribing an adaptive management blueprint, scientists should focus on empirical study of how successful management regimes incorporate new information and adapt to changing social and ecological environments. Although experimental methods appear to trained scientists to be the best method of evaluating policy choice, there may be other tools which are more

widely applicable. Myopic forest management policies are not necessarily the result of the failure of learning-by-doing and trial-and-error approaches to organizational change – they may be the result of the strong institutional incentives that FS managers face to behave in certain ways regardless of their levels of knowledge. If this is the case, no amount of additional knowledge will force a change in policy direction. An explorative study of change in long-enduring socio-ecological systems over time would enable new theory-building about how systems may be designed to incorporate these desirable elements. As I have suggested in this paper, important agents of change are frequently located outside of the natural resource bureaucracies that have been the primary locus of most adaptive management analyses, and adversarial and collaborative relationships between actors can both play crucial roles in gathering information and contributing to change in practices.

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