Translating Ecosystem Science into Ecosystem Management and Policy: A Case Study of Network Formation

by

Alexios R. Antypas

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UMI
300 North Zeeb Road
Ann Arbor, MI 48103

University of Washington

Abstract

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Chairperson of the Supervisory Committee
Professor Margaret A. Shannon
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By 1991, federal timber harvesting on federal lands in the Pacific Northwest had virtually ceased. Court injunctions barred the U.S. Forest Service and the Bureau of Land Management from making new timber sales because the agencies had violated laws protecting wildlife. Specifically, the federal agencies failed to provide adequate protection to the northern spotted owl, a rare bird found primarily in the old growth forests of the Northwest. Public pressure for government to resolve the spotted owl issue was intense, and yet numerous efforts to do so had all failed.

The crisis over federal forest management gave opponents of the existing forest management regime an opportunity to try to restructure the relationships within the forest policy subsystem. The emergence of ecosystem ecology and its application to the old growth forests of the Northwest provided scientists and

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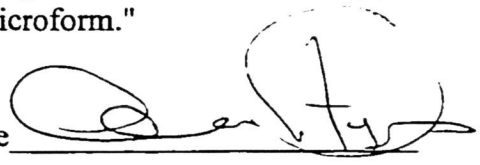
Signature 

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others with resources to construct alternative management strategies that addressed both conservation and commodity production interests. A group of scientists called the Andrews Group found itself well positioned and prepared to develop strategies to the translate ecosystem science into techniques and a philosophy for management, and into principles of policy.

This dissertation argues that ecosystem knowledge was translated through a network of multiple actors who transformed it from narrowly scientific knowledge into management and political resources with broad application and effects. In order to translate its scientific knowledge into management and policy resources, the Andrews Group formed relationships with managers and policy makers intended transformed their interests, goals, and frameworks for understanding the forest management and policy problem and turn them into advocates for ecosystem management. The purpose of this dissertation is to examine how and under what conditions these relationships were created. The general conclusion of this research is that scientific knowledge can be translated into management and policy resources when the existing advocacy coalitions structure fails to resolve a scientifically intensive policy conflict with high political stakes, and scientists with a coherent program and organizational resources become a part of a translation network seeking to broker a solution between the advocacy coalitions.

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For my Mother

Chapter One

Introduction

A. Introduction

1. Overview of the Research Problem

In 1991, federal timber harvesting on the National Forests and Bureau of Land Management lands in the Pacific Northwest had virtually ceased. Court injunctions barred the U.S. Forest Service and the Bureau of Land Management from making new timber sales because the agencies had violated laws protecting wildlife. Specifically, the federal agencies failed to provide adequate habitat protection to the northern spotted owl, a rare bird found primarily in the old growth forests west of the Cascade Range from northern Washington state to northern California. Public pressure for government to resolve the spotted owl issue was intense, and yet numerous efforts to do so had failed.

The spotted owl issue pitted environmental organizations, who were using the owl to challenge timber harvesting on the federal lands, against the forest products industry and its allies among traditional forestry organizations, who wanted to protect jobs, profits, and access to federal timber. The environmental and traditional forestry interests each attempted to frame the issue in either/or terms: either save the owl or protect jobs and save the economy. Within the policy

making arena, each side staked out irreconcilable positions. Although many bills addressing the issue had been proposed in Congress since 1989, not one had passed out of a committee. No majority position, much less a consensus, seemed likely to emerge in this most divisive of natural resource issues.

Yet, by 1991 an alternative to environmentalist and traditional forestry positions had slowly begun to form. A group of federal scientists, called the Interagency Scientific Committee (ISC), was convened by federal land management agencies in 1989 to develop a conservation strategy for the spotted owl. In 1990, the ISC issued its report (Thomas et al. 1990), in which it recommended protecting about 8.4 million acres of spotted owl habitat in the Northwest and reforming timber harvest practices on other lands. The ISC scientists estimated that their conservation strategy would result in a 30% increase in spotted owls by the end of the 21st century. The ISC strategy was owl specific—it dealt with the owl in isolation of other species that were part of the old growth ecosystem. However, foreshadowing future policy debates, the authors noted that the issue transcended spotted owls and timber supply. From their perspective, the land management agencies would have to address the broader issue of maintaining the old growth ecosystem which the spotted owl and many other species required for survival.

President George Bush and his administration did not adopt the ISC strategy, partly because the cost in reduced timber harvest seemed too high in political and economic terms. The administration thereby failed to take action necessary for the federal courts to lift the injunctions against the federal timber program. Some administration officials hoped that the ensuing political crisis would create

enough pressure to force the Congress to adopt legislation weakening the legal protections for wildlife in the Endangered Species Act and the National Forest Management Act. Instead, the Congress chose to commission its own panel of scientists, who, for the first time, were charged with developing an *ecosystem* based approach to managing the federal forests in the Northwest. The report of The Scientific Panel on Late-Successional Forest Ecosystems (Johnson et al. 1991) fundamentally reframed the policy problem. The shift in understanding and addressing the forest management issue from a single resource to an integrated ecosystem problem represented the first step in resolving the controversy and inaugurating a new era of federal forest management.

From a scientific perspective, the ecosystem approach to understanding and addressing the forest management problem had been developing for many years. The conceptual foundations of what has come to be called ecosystem management were laid in the late 1960's and early 1970's among ecologists studying the interdependencies of ecosystem structures, functions, and species composition. In the Northwest, the main scientific proponents of ecosystem management were scientists who identified themselves as the Andrews Group. In addition to their scientific research, these scientists had years of experience in designing and testing forestry techniques based on ecological knowledge. The Scientific Panel on Late Successional Forest Ecosystems represented the first opportunity to analyze the forest management issue from an ecosystem perspective in the policy making arena.

Approaching the forest management problem from an ecosystem science standpoint was a turning point in the Northwest forest management crisis. It is the formation of relationships, interests, and commitments that led to this turning point that is the subject of this dissertation. Specifically, this dissertation examines the ways in which the Andrews Group created relationships that translated ecosystem science into ecosystem management and policy.

2. The Andrews Group

The Andrews Group is a group of scientists in Corvallis, Oregon, composed of researchers from Oregon State University (OSU) and the U.S. Forest Service Pacific Northwest Research Station (PNW). The name Andrews Group refers to the H. J. Andrews Experimental Forest, where the group conducts the bulk of its research. The Andrews Group came into being as a self-referencing group in the early 1970's as a result of a National Science Foundation (NSF) grant to OSU as a part of the International Biological Program, a large-scale effort to model ecosystems around the world. After the IBP had already gotten underway in 1970, Richard Waring of OSU and Jerry Franklin of the PNW Station applied to the National Science Foundation to become a part Coniferous Forest Biome, one of six biomes being studied in the program nationwide.

Oregon State University's partner in the Coniferous Forest Biome was the University of Washington (UW). The UW researchers, who were located in the College of Forest Resources, focused the bulk of their research on the ecology of younger forests in the Pacific Northwest. This research focus was consistent with

the assumption prevalent at the time that older forests would all eventually be harvested for timber and replaced by fast growing young forests. On the other hand, a part of the Oregon Group, led by Dr. Jerry Franklin of the PNW Station, favored studying the old growth forest as well as younger forests. This fit well with hydrologic and nutrient cycling studies of old growth forests he and other researchers had already begun. It would also allow the researchers to conduct most of their field work on a single site, the old growth covered H.J. Andrews Experimental Forest near Corvallis.

The Coniferous Forest Biome part of the IBP only lasted from 1971 to 1974. When the program came to an end, the Andrews Group sought further funding to continue it's the ecological work they had initiated. Auspiciously, Jerry Franklin went to Washington, DC in 1974 to work as a program officer at the NSF. The IBP had its own line item in the NSF budget, and Franklin and others succeeded in continuing that line item under another ecosystem studies program. In time, what had been the line item for the IBP became the base budget for the ecosystem studies program, which is now the biggest program in environmental biology at the NSF. This allowed the best of the IBP programs to continue to be funded over the next several decades. The Andrews Group was among the selected sites.

The Andrews Group received funding from NSF over the next several years under the ecosystem studies program, but there was no single large institutional grant such as under the IBP around which to organize their work. Rather, the group patched its funding together from several grants. This more unstable funding structure sustained the group until the Long Term Ecological Research (LTER)

program was established by the NSF in 1979. LTER was originally part of ecosystem studies but eventually was assigned its own program officer, the same person who had been the program officer for IBP. By this time the Andrews Group-NSF connection was solid, and the group had produced an impressive array of publications and research findings. It's research agenda, focused as it was on old growth forest ecosystem, was still unique and of national importance given the high rate of timber harvest in these forests. Moreover, the Andrews Group's research program was already centered around long term ecosystem studies and fit the objectives of LTER. The first LTER funds arrived in 1980, and while members of the group still received other grants, many of them from NSF, the basic annual LTER grants provided the group with the core institutional support that would sustain it until the present.

3. The H.J. Andrews Experimental Forest

Established in 1948, the H. J. Andrews Experimental Forest was originally the Blue River Experimental Forest located on the Willamette National Forest northwest of Eugene Oregon in the Cascade Range. It was renamed the H. J. Andrews Experimental Forest a few years later after the Region 6 Regional Forester who had gone to Washington DC to become Chief of the Forest Service.[1] The experimental forest today is located on the Blue River Ranger District which has a close association with the researchers from the Pacific Northwest Research Station (PNW Station) and Oregon State through

[1] H. J. Andrews died in an automobile accident shortly after arriving in Washington, DC.

partnerships to test management approaches. The forest covers approximately 6,000 ha and consists of lower to upper elevation coniferous forests, about 80% of which was in old growth condition in 1948 (Franklin and Waring 1986). Since its designation as an experimental forest about 20% of the forest area has been clearcut, although significant logging has not taken place in number of years.

For the first decade most of the projects on the H. J. Andrews were logging projects. These included most of the original research on staggered setting clearcutting (Franklin and Waring 1986) as well as regeneration studies, salvage logging, and road building. Work on the forest also focused on developing the concept of comprehensive forest planning with attendant road build building (Franklin and Waring 1986). The second decade of research focused on watershed research that included studies of soil stability and nutrient loss after clearcutting (Franklin and Waring 1986).

Prior to the IBP period, the scientists who worked on the H. J. Andrews forest were only loosely affiliated with each other through their common work environment. They were not a group in that they shared neither a group identity nor a common and integrated research program. The Andrews Group only emerged as a result of the NSF funding under the IBP. The group is constituted by an integrated research program, common sources of funding, and a strong collective identity.

4. The Andrews Group and Forest Management Reform

During the IBP period, the Andrews Group's studies of old growth forest ecology gave rise to an awareness in the group that the old growth forest was a unique and biologically rich ecosystem that was quickly being lost due to rapid timber harvest. The Andrews Group researchers were first to identify the structures and functions of the old growth ecosystem (Franklin, et al. 1981), and gradually the group developed a set of forestry techniques intended to maintain ecological values while still providing a timber harvest (Franklin 1989).

These techniques, called New Forestry, gained currency first among managers on the Willamette National Forest and then spread throughout the Pacific Northwest region. New Forestry techniques were adopted by both public and private forestry organizations. Many of the basic New Forestry principles, discussed in Chapter Six, are now commonly practiced in the region.

Andrews Group scientists became a part of the controversy over federal forest management in the Pacific Northwest during the 1980's. This controversy was ostensibly focused on the management of the northern spotted owl, which was listed under the Endangered Species Act as a threatened species in 1989. However, the Andrews Group and others argued that the underlying issue was management of the old growth forests, on which the spotted owl and many other species depended.

The controversy over the spotted owl and management of the old growth forests gradually involved the Andrews Group in the policy debate as it became increasingly divisive in the late 1980's and early 1990's. For example, Andrews scientists appeared as witnesses before Congressional committees to give testimony on legislative attempts by Congress to address the spotted owl issue.

5. The Gang of Four

In May, 1991 the House Agriculture and Merchant Marine and Fisheries Committees commissioned a panel of scientists, The Scientific Panel on Late-Successional Forest Ecosystems, (commonly referred to as the "Gang of Four"), to examine alternative management strategies for late successional forests in the Pacific Northwest. The Congressional committees charged the panel to identify old-growth forest areas in the Northwest; develop alternatives for managing "ecologically-significant old growth and late successional ecosystems, species, and processes, including, but not confined to, spotted owls" (Johnson et al. 1991:44); prepare maps for each national forest and BLM district that show each alternative "as a graded series from most to least important for achieving protection and management objectives" (Subcommittee on Forests, Family Farms, and Energy et al. 1991:3); and develop guidelines for managing unreserved lands associated with the alternatives, and to quantify the effects of each on timber

harvest. They were also told specifically to take account of fish species as they developed management alternatives.[2]

This was the first time that a policy analysis process had been established to analyze the issue from a holistic, ecological point of view rather than for the exclusive sake of managing the spotted owl (the point being to conserve the old-growth ecosystem with its associated species, *including* the spotted owl). The Committee on Interior and Insular Affairs subsequently joined the other committees in sponsoring the panel. The panel included Jerry Franklin, then having left Corvallis and teaching at the University of Washington; Jack Ward Thomas, U.S. Forest Service biologist and author of the ISC Report; John Gordon, Dean of the Yale School of Forestry; and K. Norman Johnson of Oregon State University and the author of the Forest Service's forest inventory program, FORPLAN.

The Gang of Four delivered its report to Congress in October of 1991 (Subcommittee on Forests, Family Farms, and Energy et al. 1991). The panel graphically showed that there was "no free lunch" alternative which would accommodate both a high timber harvest and high levels of protection the old-growth ecosystem and associated species. Instead, the scientists convinced legislators that a new management regime based on an integrated ecological

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[2]The directive to anticipate the consequences for fish was given verbally by Chairman Harold Volkmer of the Subcommittee on Forests, Family Farms, and Energy of the Committee on Agriculture.

understanding of forests needed to be developed for the federal forest lands in the Northwest.

The relationships that the scientists formed with members of Congress represented the extension of the network that the Andrews Group had established with managers years earlier. These relationships, and the interests and understandings that emerged from them, provided the nexus through which ecosystem science was translated into management and policy. This dissertation examines how the Andrews Group acquired the resources to become an effective actor in reforming forest management and policy, and how the group developed a network of relationships that worked to transform its scientific knowledge of the old growth ecosystem into a political resource.

B. Overview of Chapters

Chapter Two establishes the theoretical and conceptual framework for this dissertation. Translation network theory from the sociology of science is used with the theory of advocacy coalitions from policy science to form a holistic conceptual approach that takes account of both agency and structure in this case.

Chapter Three discusses the interactionist methodological approach used in this dissertation. Interactionist methodology examines social phenomena at the actor level while accounting for structure in a historical context. This chapter lays out the design and field methods of the network analysis conducted in this research.

Chapter Four examines the development of two main advocacy coalitions within the federal forest policy subsystem. The traditional forestry and environmental advocacy coalitions are discussed within a historical context. The structure of relationships and laws within the federal forest policy subsystem are discussed to the extent that they pertain to the case of network formation examined in this study.

Chapter Five discusses the history of federal conservation issues in the Pacific Northwest. It examines briefly the history of the forest reserves that became the National Forests in the Northwest, the establishment of Olympic National Park, and the controversy over wilderness. It then discusses at length the development of the spotted owl issue, which organized the immediate political context in which the network formation that is the subject of this dissertation occurred.

Chapter Six examines the Andrews Group as an organization. The Andrews Group developed an efficient division of labor within the group and developed a high degree of group solidarity. These features of the organization provided the capacity the Andrews Group needed to garner resources to build its scientific program and make allies among managers and others outside of its scientific circles. The forest management techniques developed by the Andrews Group were successfully translated into management as a result.

Chapter Seven examines the Gang of Four process as a case of translation network formation in the context of an advocacy coalition framework. The chapter argues that key allies allowed the Gang of Four to gain access and

credibility among members of Congress. These relationships prevented the process from being politicized by the advocacy coalitions. In this context, the Gang of Four successfully redefined the policy problem for members of Congress and set itself up as a policy broker between the advocacy coalitions.

Chapter Eight discusses the findings and conclusions of this dissertation. This research demonstrates translation networks linking scientific analysis producing processes to political choices can create new policy options without jeopardizing the reputations of scientists through the politicizing attack of interest groups. The Gang of Four process showed that it is possible to create a network that positions itself as a policy broker between advocacy coalitions under conditions of intense policy conflict.

Chapter Two

Theoretical and Conceptual Framework

A. A Dual Theoretical Approach

This dissertation utilizes two theoretical approaches to develop a conceptual framework for understanding how science is translated into management and policy. The theory of "translation networks" is a micro-level approach that shows how actors struggle to construct and negotiate relationships and interdependencies that allow them to act together to meet a collectively determined goal. The theory of translation networks reveals social action in its dynamic and indeterminate flow, tracking the movements of groups and individuals whose interests and roles are an outcome of their interactive strategies. The "advocacy coalitions" framework complements translation network theory by providing a macro-level analysis of the context in which actors form translation networks. The advocacy coalitions framework describes policy "subsystems" that organize around particular policy issues, and structure interests that persist with only incremental changes for a decade or longer. The two frameworks describe phenomena that condition each other, and which complement and strengthen each other to explain the case of network development that is the subject of this dissertation.

1. Translation Network Theory

The French sociologists of science Bruno Latour and Michel Callon developed the translation-network framework[3] for understanding the role of science in society. Translation networks are associations of actors that link the scientific world with other parts of society. These networks are composed of actors who attempt to "enroll" each other as allies in their projects, and in the process of enrollment they "translate" their projects into resources that meet, define, or redefine the interests of their potential allies. In this process the roles that actors play (i.e. as scientists, political actors, etc.) may be as ambiguous at times and as negotiable as the interests that they try to stabilize.

Translation is the process whereby actors contest and negotiate the meanings and interests that define and direct their relationships with each other. Actors try to "enroll" each other in networks because they need allies in order to enhance their capacity to act in the world. When one actor succeeds in convincing a potential ally to advance his project, he has made an enrollment. However, in the process of translation, actors may reinterpret that project, and counter-enroll the enrollers. Callon describes translation as the process "during which the identity of actors, the possibility of interaction and the margins of manoeuvre are negotiated and delimited" (Callon 1986:203). Latour adds that translation is "the interpretation given by the fact-builders of their interests and that of the people they enroll"

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[3]The term "translation network" was first used by Callon; Latour has used the term "actor network" to describe the same phenomenon. I prefer the former because it emphasizes the action of *translation* that is at the core of the process this dissertation examines.

(Latour 1987:108). Both the "identity" and the "interests" of actors are outcomes of translation, and subject to modification during each instance of translation. Actors can belong to multiple translation networks, and therefore have complex identities based on multiple interests roles expressed in their memberships in multiple networks.

Latour (1987) identifies several forms of translation. In the simplest form of translation ("I want what you want") the enrolling actor tailors his project to the explicit interests of the potential ally. Here the enrolling actor attempts to convince the potential ally that reaching his (the potential ally's) goal will be facilitated by adopting the enroller's project. The project is *translated* in that it becomes a part of a wider social project. The explicit interests of the enrollers and those who are enrolled are similar so their alignment through translation can easily be accomplished. Translations of this sort are empirically verifiable by observing actors adopt an enroller's project for the purpose of meeting a pre-set goal.

Other forms of translation are more complicated, involving the "reshuffling", or redefinition of interests. One way of doing this occurs when the interests of a potential ally cannot be met because his usual way of accomplishing goals has been cut off. The enrolling actor offers his program as a "detour" leading to the potential allies goals; however, the detour may lead to an end that is not what the enrolled actor originally had in mind. His goals and interests in reaching those goals are fundamentally different than he originally had in mind. An enrolling actor can also "displace" the goals of potential allies with goals that make his

project fit as a means of achieving them. The displacement of goals can involve the redefinition of interests and the reframing of problems. For instance, reframing a public policy problem in scientific terms can redefine the interests of political actors, tying them to scientists who may offer a potential solution to the newly defined problem. Latour argues that this strategy is most successful when the enrolling actor invents new non-human "entities"—scientifically defined phenomena. Such entities gain ontological status through the mediation of science (e.g. "ecosystems" are entities derived through the interpretation of scientific data), and they can be used in translation processes to redefine the interests and goals of non-scientific actors. They become resources in translation strategies.

Translation is successful when actors enroll as allies in a project, and take action in the promotion of that project. Latour describes the process of translation and enrollment in terms of social "movement": "Translating interests means at once offering new interpretations of these interests and channeling people in different directions" (1987:117). This movement results in the tying together of smaller and larger projects and goals so that the smaller gain the strength of the larger: In the case of science, Latour argues that scientific facts and techniques alone do not have the power to change society. However, when they are tied to larger political or social goals, they gain the importance of those goals. For instance, trying to split atoms may have remained the curious pursuit of "pure" science had it not been tied to winning the Second World War, at which point nuclear physics became a multi-billion dollar government project (Latour 1987). Though military leaders first strongly objected to using scarce resources to fund what seemed to

them an unnecessary project unlikely to lead to a successful outcome, nuclear physicists convinced them that the Germans might be on the verge of developing a devastating atom bomb. The work of nuclear physicists was no longer a matter of splitting atoms or even blowing up cities, it was a matter of winning the war and saving the nation. Threats to the Manhattan Project had then to be considered threats to the security of the nation. As Latour might say, "weak" physicists became "strong" warriors. The end result of this translation of interests was that physicists became "indispensable" to policy makers, the military, and ultimately to the country. In order to achieve the goal that all of these actors wanted to achieve—winning the war—they had to "pass through" the laboratories of nuclear physicists. In this instance of translation, scientists reframed interests and made themselves essential for meeting those interests. Though they possessed nothing more than what appeared to be arcane knowledge, they gained command over the attention of presidents and vast financial and other resources.

Translation networks are heterogeneous, composed of many different kinds of actors in many different locations in society. A network that began within a scientific laboratory may extend to a grant making organization, a reporter, a member of Congress, and so forth. The linkage of actors through society shows how interdependencies are negotiated and roles defined. Latour uses the term technoscience "to describe all the elements tied to the scientific contents no matter how dirty, unexpected, or foreign they may seem..." (1987:174). By "dirty" and "foreign" Latour means those elements (e.g. political maneuvers, rhetorical strategies) that the standard understanding of science does not associate with science. Latour is making the case that while there is an "inside" to science--the

laboratory--this inside is only possible because of its connections to the outside, and cannot be understood except in the context of these reciprocal, though potentially contested and asymmetrical, linkages.

> ...the ability to work in a laboratory with dedicated colleagues depended on how successful other scientists were at collecting resources .... this success in turn depended on how many people were already convinced by scientists that the detour through the lab was necessary for furthering *their own goals* (emphasis in the original) (Latour 1987:157).

Latour argues that science is one of the most effective change agents in the modern world. Rather than being out of place in the arena of politics, science thrives on it and requires politics in order to continue its project of extending its many programs throughout society. Since networks are inherently heterogeneous, there are no stable boundaries between realms of activity such as "science" and "politics," but only shifting boundaries subject to processes of translation. In order to understand how society changes, Latour argues, one must follow the networks of translation and enrollment that lead to the formation of new interests and goals, and the resources organized to meet them.

Translation strategies aim to create new social structures and institutions. Latour uses the less conventional term "black box" to refer to an assemblage of interests, resources, and rules that keep actors "in line"—stabilize networks and routine ways of doing things. Black boxes are "automatons" in that they no longer require the effort of translation to keep them going, but rather rely on standardized practices enshrined in convention, law, and/or technology (Latour 1987:130-131).

Black boxes contain so many relationships that challenging them would require an investment of resources exceeding the resources invested in the elements holding the black box together. Knowledge itself can become a black box when the resources required to challenge it are great and difficult to assemble. In order to displace a scientific fact, for instance, it is necessary to take on the many scientists, laboratories, and publications that support it. Unless the necessary resources to do this are assembled, the fact remains uncontested.

This dissertation argues that ecosystem knowledge was translated through a translation network of multiple actors who transformed it from narrowly scientific knowledge into a management and political resource with broad application and effects. The extent to which ecosystem management lasts as a management regime can only be seen with the passage of time, however. The durability of its structures will be tied closely to the extent to which its practices become black boxes resistant to deconstruction.

2. The Advocacy Coalitions Framework

Sabatier (1988) and Sabatier and Jenkins-Smith (1993) developed advocacy coalitions framework to explain the dynamics of policy making and conflict over long periods of time. The framework is meant to show how "policy subsystems" are maintained in relative equilibrium by advocacy coalitions that form around particular issues. Advocacy coalitions, like networks, are heterogeneous, composed of

> people from a variety of positions (elected and agency officials, interest group leaders, researchers, etc.) who share a particular belief system--for example, a set of basic values, causal assumptions, and problem perceptions--and who show a nontrivial degree of coordinated activity over time. (Sabatier 1988:139).

Entire organizations may be members of an advocacy coalition, or only certain individuals within organizations. It is not uncommon to find individuals within organizations, especially government agencies, who are members of opposing coalitions. For instance, some Forest Service employees created an organization called the Association of Forest Service Employees for Environmental Ethics, which brought internal pressure on the agency to reform its forest management policy and practices. Other Forest Service employees are a part of the traditional forestry advocacy coalition.

A policy subsystem contains the advocacy coalitions that are organized around a particular issue and any other actors "who are concerned actively with the maintenance and evolution of policy in a particular domain" (Mintrom and Vergari 1996:421). These might include "journalists, analysts, researchers, and others who play important roles in the generation, dissemination, and evaluation of policy ideas as well as actors at other levels of government who play important roles in policy formation and implementation" (Sabatier 1988:138). These other actors may be a part of the advocacy coalitions (e.g. environmentally oriented journalists), but they need not be. Some actors may take on the role of policy broker, "whose principle concern is to find some reasonable compromise

[between advocacy coalitions] that will reduce intense conflict" (Sabatier and Jenkins-Smith 1993:18-19).

Sabatier and Jenkins-Smith have shown that policy subsystems tend to develop an equilibrium of power between advocacy coalitions over ten years or longer. For certain periods one coalition may enjoy a relative advantage, and then the other. Changes in policy are incremental, and often gains by one coalition are balanced with gains by the opposing coalition. More fundamental policy change in favor of either coalition occurs rarely. Moreover, when radical change does occur, it is usually initiated from outside of the traditional coalitions in a policy subsystem.

3. Linking the Two Frameworks

The translation networks framework shows how actors communicate, negotiate, and struggle with each other over the interpretation of interests and definition of goals. From the translation framework perspective, interests and goals are not preset, but must be constructed through a laborious process of stitching together alliances among actors so that concerted, collective action becomes possible. The framework suggests that organized, patterned interactions among social actors are the outcomes of pervious translation and enrollment processes that have now become institutionalized, or black boxed. The purpose of using the translation framework is to show *how* individual actors form networks in order to get work done. Because the primary emphasis is on the interaction of actors, the translation framework works on a micro level.

The advocacy coalitions framework also deals with actors, but at the macro-level of the policy subsystem, in which the movement of coalitions rather than individual actor-interactions is the main concern. At the policy subsystem level, relationships among actors are already loosely structured, and decision making routines have been established. This framework shows change within policy subsystems is gradual and incremental, coalitions tend organize around their issues with explicitly defined interests, and fundamental change is usually initiated outside of the advocacy coalitions.

One way to link micro and the macro-levels is through the relationship of agency and social structure (Giddens 1993 [1976]:3 & 7; Giddens 1984:139-144). Structure can be thought of as all of those social phenomena that confront the individual as immovable and self-reproducing social facts: formal and informal rules and patterned relationships among actors (inclusive of familial relationships, political relationships, relationships among organizations, etc.) (Giddens 1984; Turner 1978). Agency refers to the inherent action-taking capacity of individuals and groups (Turner 1978). Both concepts of agency and structure are necessary in order to understand society and social change. Given the apparent dichotomy between structure and agency, the relationship between the two is necessarily dynamic and dialectical—each shapes the other, and in the process changes the characteristics and capacities of the other (Giddens 1993 [1976]:10-17). The purpose of employing translation network theory and the advocacy coalitions framework simultaneously in this dissertation is to examine how the Andrews scientists and the other actors with whom they formed alliances were able to exercise agency within the structure of the federal forest policy subsystem.

The social theorist Anthony Giddens has developed what he calls the theory of "structuration" to describe the dynamic relationship between agency and structure (1981; 1982; 1984; 1993 [1976]). Giddens argues that structure and agency are co-determinative. Social structures provide constraints *and* opportunities for action, which in turn reproduce, produce, and transform social structure. Giddens calls this the "duality of structure" in which "the structural properties of social systems are both medium and outcome of the practices they recursively organize" (1984:25). The concept of structuration allows one to link the agency inherent in network formation to the existing structure of the policy subsystem, and examine how each organizes the other in a recursive fashion.

With the concept of structuration as an active process, network formation can be understood as both an outcome of the structural conditions under which it occurs and as a process of restructuring those conditions. The structure of a policy subsystem provides a part of the context in which networks are formed, imposing opportunities and constraints for action. Network formation is by definition a kind of social change. To the extent that networks reshape social structure, they then make new forms of action possible. Translation network theory suggests that network builders will try to "black box" their achievements in order to make networks and their directed action self-reproducing.

In science intensive translation networks, the medium of translation is knowledge itself. Actors translate knowledge in networks to redefine interests and purposes. This means that when a network develops within the context of an existing system

of advocacy coalitions, the network has the capacity to restructure the relationships between the coalitions by transforming their interests.

The following is a proposition derived from the theory of structuration applied to relationship between translation networks and advocacy coalitions: networks can lead to the formation of new coalitions that become a fixed part of the policy subsystem. However, structuration theory indicates that a network does not spring up independently of the advocacy coalitions, but rather that the coalition structure actually makes networks possible. The advocacy coalitions not only limit action, but they provide opportunities for action. The network develops the inherent, latent possibilities for action within the coalition structure. Consequently, one must account for the advocacy coalitions structure in order to understand what possibilities for action existed for the network builders: what interests, understandings, relationships and so forth gave coherence to their activities both in terms of what they could and could not do.

B. Studies of Science and Policy Making

Previous research into the dynamics of science in policy making have either implicitly or explicitly approached the issue from a perspective similar to the advocacy coalition framework—limited to political institutions and in the context of adversarial politics with heavy interest group participation(Collingridge and Reeve 1986; Nelkin 1987; Nowotny 1987). The translation network approach has not yet been applied to a policy making setting. Below, some of the key issues raised by the existing literature are reviewed.

Political Context. Research into the way policy institutions and political culture affect the role of science in policy making have shown that scientists working in the American political context face certain hazards that their colleagues in European countries normally do not. Overall, the American system is more contentious, open, and unwilling or unable to defer to experts than European political systems. This poses a challenge to scientists who want to be present their knowledge as dispassionately as possible but find themselves drawn into the political fray.

Gillespie, Eva, and Johnston (1979) found that in the United Kingdom scientists conferred with policy makers over pesticide policy outside of direct public scrutiny. This was due to both the lack of a public right to review and challenge decisions and to a political culture in which deference to expert judgment is routine (Brickman 1984). In this context, the connections between scientists and policy makers can remain both close and relatively hidden from view.

> In the UK, the scientists were much closer institutionally to government, and operated in a more personal network with the decision makers, with less process for formal review and explicit justification of scientific (and political) judgments. In other words, the decision rules for going from a scientific front, still full of various anomalies and uncertainties to policy knowledge of risks, were private to the elite scientists and policymakers (Wynne 1987:106).

Policy institutions in the United States are much less insulated from public scrutiny through the media and interest groups. This tends to raise the standard of

scientific justification that is necessary in order to make a policy decision. Administrative and judicial review of decisions is common, which further increases the pressure to support decisions with sound scientific evidence (Brickman 1984). In the case of pesticides, regulators in the United States have barred pesticides that were allowed on the market in Europe because the political system in the United States demanded a higher standard of safety (Gillespie et al. 1979). Likewise, in the United States, no licenses to construct new nuclear power stations have been issued since the mid 1970's because interests groups have successfully challenged utilities through regulatory review and the courts. Nuclear power provides less then 20% of U.S. electricity, while in France, for instance, it provides over 70%. Unlike in the U.S., the French political system does not allow interest groups to challenge the underlying science of technically intensive policy decisions (Jasper 1992; Jasper 1990; Nelkin 1981; Nelkin and Pollack 1980; Richardson 1982).

Science as a political weapon. As discussed, the openness and contentiousness of the American political system encourages interested parties to challenge the technical basis of decisions, thereby increasing the standard of technical quality required to make legitimate decisions. At the same time, this process leads to the "politicization" of science in that interest groups employ their own scientists to scrutinize and challenge decisions, studies, and the technical claims of opposing interest groups. Rather than rationalize the political process by requiring technically intensive decisions to be based on the best available science, interest group-based science can sometimes reduce science to a merely partisan variable. Some studies of science in policy have found that "scientific expertise was treated

like any other input into the political process: as a political resource to be used by both sides, negotiable, and not necessarily 'true'; in any case not endowed with higher political credibility than other inputs" (Nowotny 1987:66). The political conditions that lead to a higher level of technical scrutiny of decision making consequently also can lead to a devaluation of science because it is used as a weapon of advocacy rather then a means and standard of review.

> Although questioning the role of expertise and demanding greater participation by those affected by policy decisions, the protagonists in these debates themselves depend heavily on scientific expertise. Whatever social or political values motivate these disputes, they often focus on technical questions that call for scientific expertise....This is tactically effective, for in all disputes broad areas of uncertainty are open to conflicting scientific interpretation....[P]ower hinges on the ability to manipulate knowledge or to challenge the evidence that is presented to support particular policies. Technical expertise becomes a resource exploited by all parties to justify their views, to create legitimacy, and to control the terms of debate....Both project proponents and critics use the work of "their" experts to reflect their judgments about priorities or about acceptable levels of risk. Expertise becomes one more weapon in an arsenal of political tools. (Nelkin 1987:288-289)

The delegitimation of science. Collingridge and Reeve (1986) develop what they call the "over-critical and under-critical models" of science in policy making. The under-critical model applies to cases of routine decision making in which the political stakes are low and the scientific knowledge used in decisions is routine and uncontroversial. In such cases, science is not closely scrutinized, and decisions receive sufficient support to maintain the status quo. Science does not, in such cases, help bring about policy changes.

In the over-critical model, the political stakes are high, which brings on a high level of scrutiny of the science used for decision making. However, the great majority of scientific claims are to some degree uncertain, and therefore contestable. For instance, within science there are great debates regarding research methods and interpretation of data. Consequently, it is almost always possible to attack a scientific claim on methodological grounds or to arrive at different conclusions based on the same data. Interest groups that have a stake in undermining a scientific claim often have little difficulty doing so with scientific claims of their own. Collingridge and Reeve argue that this is especially true when decisions must be made under time constraints, that is, before non-interest group scientists have formed at least a provisional consensus regarding applicable knowledge. Time pressure is almost always a factor in policy making when the political stakes are high.

> Here is the root of the ruin of the ambition of science to influence policy. Influence calls for [science] to have a high error cost, but high error cost makes appropriate an intense scrutiny of the conjecture .... Scientists and policymakers using their results become very critical of scientific reports which threaten their case, and in turn the technical case they make out is criticized by the other side. The result is that no consensus can be reached that is of use in policymaking.(Collingridge and Reeve 1986:31)

Collingridge and Reeve conclude that the greatest cost of using science for policy is borne by science. They argue that because of the dynamic they describe in the over-critical model, high-stakes policy decisions will be determined by a political calculus, even if they are argued in technical terms. When scientific claims are contested, policy maker revert to calculations of power to arrive at decisions.

Science, however, unfairly suffers a loss of prestige and legitimacy. Only in political systems like the British or French where scientists can be isolated from interest groups, and the technical merit of decisions is not closely scrutinized by interest groups, can science both influence policy making and retain its public standing.

The two cultures. Some researchers have found that science in policy is undermined by a clash of cultures when scientists try to communicate with policy makers and the public. Wynne (1987) notes that part of this clash involves the "implicit" and "explicit" languages that scientists use. In their daily practice, scientists recognize the necessity of using tacit knowledge and flexible methods to obtain provisional and often uncertain results. In their writing and speaking, however, they use an "idealized normative language" that gives the impression (to non scientists) that scientific work is tidy, uncontroversial, and that scientific facts are certain. Wynne emphasizes that this is not a deceptive ploy by scientists but that the language is "used *descriptively* as a way of gaining *prescriptive* purchase on scientific practice, so that even though they are not fully achieved, the procedural ideals do have a real quality controlling effect" (1987:98). Traditionally, scientists were taught to write for and speak about science only to other scientists, and so misunderstandings were rare. Everyone "knew" that knowledge is not as fixed as the explicit language of science seemed to imply. This assumption cannot hold for non scientists.

> But while scientific insiders may tacitly appreciate the limitations on knowledge and process and evaluate descriptions and claims accordingly, outsiders will not, unless a deliberate effort is made to

> explicate the implicit self-knowledge of the insiders. Without this effort, the natural extension of the implicit language inevitably tends to understate uncertainties and other limitations in the knowledge. If this were only a problem of individual politicians or scientists willfully trying to obtain credibility by deception it would be relatively simple. The structural process I have tried to outline makes the situation more complex. It is not that scientists have been concealing their inside implicit knowledge, just that they have been quite naturally operating with their own style of knowledge in a different set of social relationships. (Wynne 1987:99)

Given the lack of any formal language clarifying the relationship between real and idealized science, scientists will often point out the uncertainties of their opponents' arguments in the same language of objectivity, thereby further confusing policy makers and the public (Mazur 1981). If scientific disputes were confined to science, these tactics might not be problematic, but rather constitute a normal process of review and debate. The public and policy makers are often not aware of the conventions of science, however, and scientists are not aware of or cannot adjust to the conflicting demands made upon them in the policy arena. Consequently, the fact that they "are trained to treat uncertainty as both a problem and an opportunity to advance knowledge" (Barke 1986:143) becomes highly controversial.

Scientists are faced, according to this analysis, with a dilemma: when political stakes are high, policy makers are most likely to require and demand certainty from scientists, yet under these conditions scientists are least likely to be able to provide it. Yet, scientists may present their science in a language that implies certainty to non-scientists, but which leaves them open to charges of bias or

malfeasance when their claims are challenged by other scientists (who may be employed by interest groups or in some other way be a part of an advocacy coalition). However, when scientists make uncertainty explicit, they run the risk of undermining their claim to participate in policy making as non-political actors. In other words, they lose their special epistemological status (Weiss 1991).

C. Conceptual Framework for this Research

This dissertation examines how a group of scientists who initiated and created a translation network in order to link science and policy with the object of challenging established advocacy coalitions. It elaborates the theory of translation networks by applying it to policy, and also seeks to develop a stronger model of translation network development in the policy context by integrating the advocacy coalitions framework.

The conceptual framework posits that interests and purposes of actors are not necessarily fixed, but shift according to both the latent potentialities of structure and the "reshuffling" caused by network formation. Stable structures may emerge through the interaction of actors. In the literature, most researchers tend to base their analysis on the premise that certain features of the social world are stable and certain. These feature may include the interests of actors, professional culture, the incapacity of scientists and policy makers to communicate effectively with each other, and the tendency of the political process to politicize science. The conceptual framework posits that these stabilized features are the outcome of

network formation, and therefore much less determinate than science studies researchers assume.

This research may therefore inform many of the questions raised in the literature about the role of science in policy making. These include whether science is always used as a political tool in a contentious political environment; whether science loses legitimacy in a contentious political environment because its validity is challenged; and whether inherent scientific uncertainties are necessarily hidden from policy makers, resulting in greater vulnerability of scientific claims and politicization of science.

The conceptual framework for this dissertation posits that terms and concepts used in the literature may be misleading or one dimensional in the ways they frame the issue of using science in policy making. For instance, if networks can intersect advocacy coalitions, then the politicization of science, even when the stakes are high, in a policy context is not a forgone conclusion. Rather, science translated through networks may transform the interests, purposes, and understandings of the advocacy coalitions, thus restating some of the terms of policy debate rather than being at the mercy of routine policy making dynamics. In this case, rather than being neutralized by becoming just another political weapon for interested parties, science retains its epistemological privilege and also gains the "protection" of the translation network. The conceptual framework for this dissertation also posits that scientists may be able to communicate scientific uncertainty to policy makers when uncertainty is communicated in the

context of a translation that stabilizes interests and purposes so that uncertainty is not used as a means of undermining the legitimacy of the knowledge.

D. Summary

This dissertation aims to combine micro and macro level theoretical approaches in order to develop a conceptual framework for examining the translation of science into management and policy. This framework links actors who form networks through processes of translation in which interests, purposes, and understandings emerge. This interaction level of analysis is complemented by the advocacy coalition framework, which takes account of macro-level phenomena that make agency possible and delimit its range of possible action. Networks are posited to intersect advocacy coalitions, but also to potentially reshape existing coalitions or form the basis of new coalitions through the reshuffling of interests, purposes, and understandings. When networks are based on the translation of scientific knowledge, it is that knowledge that actors use to shape or change interests, purposes, and understandings. The most successful networks will create automatons, or black boxes—sets of rules and resources that are self-reproducing. Consequently, the interactive strategies of network formation can lead ultimately to changes in social structure. Tracking this process makes it possible to understand how science can move out of the laboratory, where it interests only a few individuals and organizations and has no agency of its own, into the field of social action and being utilized as a means of making social change.

The translation network and advocacy coalitions frameworks are linked by the conceptual framework of this dissertation. The concept of structuration seeks to describe the dialectical relationship between agency and structure, and it is suggested that translation network formation in the context of a policy subsystem may provide a concrete example of structuration. The literature on the role of science in policy making raises questions about the dynamics and usefulness of using science in policy making. Researchers have tended to frame both the policy process and science as stable (that is, discrete from each other and structurally unchanging), but incompatible phenomena. The worlds of science and policy making are theorized to clash over conflicting expectations and communicative strategies. The dual-theoretic conceptual framework used in this dissertation raises questions about these formulations. Network theory shows how what appear to be discrete social worlds, such as science and policy, can be linked through translation to form a cooperative association. The outcome of such cooperation can be institutionalized in black boxes. Far from clashing, the social worlds become integrated through the individual actors who make the translations. It is suggested that the concept of structuration, which describes the dialectical interdependence of structure and agency, provides the theoretical frame that makes it possible to understand the significance of the construction of particular translation networks.

Chapter Three

"Following Actors Around": An Interactionist Approach

A. Network Formation as Interaction

The methodological framework that guides this research and that underlies translation network theory is *interactionist* in its core principles and assumptions. Interactionism seeks to document the "emergence" of society through the agency of "situated" actors—that is, interactionism posits that society is produced and reproduced through the collective effort of real persons acting in concrete situations. However, interactionism does not neglect the role of structure in interaction and the reproduction of society. Rather, in this perspective, social structure is defined, evaluated, and interpreted by acting subjects who have the potential to alter structures through processes of redefinition occurring in interactive situations (Turner 1978:332-333). Consequently, while actors "face" a pre-existing matrix of social structures, structure also emerges from interaction.

As an emergent phenomenon, structure assumes a dynamic character as expressed in Giddens' concept of structuration. In short, interactionism seeks to document the convergence of action, history, and structure (Hall 1987) in an explanation of emerging social organization. Two main methodological principles that should guide interactionist research are that one "ought to study the formative and sustaining processes" which create the social structural order and "that the social

organization of human behavior must always be studied historically" (Maines 1989:396, paraphrasing Blumer 1969). The focus on processes allows the researcher to discover structure as an emergent property of social action. The focus on history allows the researcher to take account of existing social structures that confront actors and circumscribe their capacity for agency.

The "Rules of Method" developed by Latour (1987) are specific to the tracking and unpacking of networks; however, they conform fundamentally to the methodological principles of interactionism. The most important Latourian rule of method for this dissertation is that one must be "undecided .... as to what technoscience is made of; every time an inside/outside divide is built, we should study the two sides simultaneously and make the list, no matter how long and heterogeneous, of those who do the work" (Latour 1987:258). This rule of method instructs the researcher to "follow" actors as they form associations through translation across what are normally thought of as discrete social worlds, such as science and management or policy.

The "inside/outside divide[s]" to which Latour refers are the boundaries actors construct rhetorically around categories of action and the norms which govern the latter. For instance, one would expect scientists and policy makers to draw boundaries around science and policy making as fields of action, each with its own rules and norms of conduct. One such norm might be that scientists must remain neutral and not become political advocates. Network theory suggests that in order to form translation networks scientists in fact must become political actors also. The rule of method directs the researcher to track associations of

allies, and the interaction strategies they are composed of (the work they do), regardless of where those associations lead. In this way actors are seen as playing roles according to the logic of translation strategies rather than embodying fixed statuses as one or another kind of social actor. The researcher thus must describe the processes of interaction that link actors in order to explain collective action rather than rely on some notion of the irresistible force of institutions determining action.

Complementary to the above rule of method is Latour's rule that society, or social structure, cannot be used as an explanation of why a social controversy has been settled. Rather, social structure is the outcome of the settlement of controversies. Consequently, the researcher must track the enrollments that made settlement possible.

The next Latourian rule of method that is crucial for this dissertation is that the researcher must study how actors create black boxes, and "follow the controversies that reopen them" (the black boxes) (Latour 1987:258). This means that the researcher must simultaneously account for emergent social structural phenomena and existing structures that were created in the past. The history of how black boxes were created helps the researcher understand the strategies that contemporary actors use in trying to reopen them; that is, in trying to create networks that displace certain black boxes with other black boxes.

To summarize, the interactionist approach deals with the "intersections of interaction, biography, and social structure in particular historical moments"

(Denzin 1992:20). The Latourian focus on network formation naturally orients itself toward this intersection. "By attending to politically engaged agents seeking to constitute agencies, to constitute interests, to constitute structures, the [Latourian] method seeks to map how agents actually do 'translate' phenomena into resources, and resources into networks of control, of alliance, of coalition, of antagonism, of interest, and of structure" (Clegg 1989:204). Structure is understood as both an emergent phenomenon (produced by situated actors) and an existing constraint on and context for agency. Since structure is realized and reproduced by social actors, that is to say, interactionally, it is at the level of interaction that the significance of structure is decided. Consequently, the emphasis of this study is on the actors themselves, and the ways they negotiated, cooperated, and struggled with each other to produce the common interests, purposes, and understandings that make collective action possible.

B. The Case Study

1. Overview of the Case

This research grew out of a Forest Service funded study, "Science and Advocacy in Natural Resources Policy."[4] The principal investigator was Dr. Errol Meidinger[5]. Dr. Meidinger and I chose "ecosystem management" as the focus for the study. We set out to examine what role scientists were playing in the

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[4]Cooperative Agreement Number 92-0212, supported by the People and Natural Resources Program, Pacific Northwest Research Station, U.S. Forest Service, Seattle, Washington.

[5]Professor of Law and Adjunct Professor of Sociology at the State University of New York at Buffalo, and Visiting Professor of Environmental Studies at the University of Washington.

development of ecosystem management strategies. The pursuit of this exploratory question led to the Andrews Group.

When this research began in 1992, Andrews Group scientists were not the only scientists to have worked on developing ecosystem management by 1992. The Forest Service had announced a policy of ecosystem management in June of 1992 (Robertson 1992) and named ecosystem management coordinators in regional offices. These coordinators directed funds toward projects that fell within the scope of ecosystem management. At that time ecosystem management was an emerging phenomenon still lacking conceptual clarity and the experience of extensive application. The regional ecosystem management coordinator for Region 6 (Oregon and Washington) was one of the first interview subjects for this research. He provided a great deal of information about the scope of ecosystem management related scientific research in the region, and directed me to the Andrews Group.

The Andrews Group presented itself as a well-suited case for the science and advocacy research, and later for the research of this dissertation, for several reasons. First, the group was of sufficient size and had a long enough publication record to have what could be termed a coherent "program" that distinguished it from other scientists working in the region. Second, the Andrews Group was clearly implicated in the management and policy debate over forests in the Pacific Northwest, and its history of involvement could be traced through interviews, observation, and a study of written records. And third, the Andrews Group described itself and was described by others as having obtained a unique status as

scientific advocates for an ecosystem approach to forest management in the region. By all accounts, the Andrews Group represented a case through which to explore the issue of how scientists participated in management and policy, and how they translated their knowledge into resources for management and policy.

This study was designed to trace the network of associations, and the methods of forming those associations, that allowed the Andrews Group to translate its knowledge of ecosystems into management practices and policy debate and policy making. Toward this end, I conducted field research at two principle research locations: the U.S. Congress, where the Gang of Four had taken place, and the campus of Oregon State University, where the Andrews Group was located.

In order to exemplify the process of translation and network formation, it was necessary to study the organizational context in which the Andrews Group scientists worked. This meant having to inquire into the origins and organization of the Andrews Group itself, integrating into that narrative the development of the translation networks that Andrews Group members became a part of with managers, interest groups, policy makers, or others. The Gang of Four process was chosen to exemplify the extension of the translation network into the policy making realm. Examining the Andrews Group as an organization, translation network with managers, and the extension of this translation network to policy making required extensive interviewing as well as documentary research.

In order to establish the connection between the existing forest policy subsystem and the Gang of Four, it was necessary to include a brief discussion of the

development of the policy subsystem and to place the Gang of Four in that context. It was also necessary to provide an independent context for the development of the Andrews Group out of ecosystem ecology and the U.S. government's policy of science funding and science institution building.

2. Conducting a Study of Network Formation in the Context of a Policy Subsystem

This study seeks to analyze the formation of a translation network within the context of an existing policy subsystem containing established advocacy coalitions. It furthermore seeks to provide an account of those advocacy coalitions, and the effects on them of the formation of the translation network. Consequently the study must combine an analysis of the translation network and the advocacy coalitions.

This study divided the examination of the network created by the Andrews Group with managers and extended by the Gang of Four into the Congress into two parts. The first was a study of the Andrews Group as an organization. The purpose of this part of the study was to discover the qualities that gave the Andrews Group its capacity as an enrolling agent. This part of the study is consequently an examination of the Andrews Group as an actor with particular resources and organizational characteristics that shape the way in which these scientists develop translation strategies and make allies.

A translation network is by definition composed of various actors whose relationships with each other are characterized by translations, as discussed above. Consequently, in order to study a translation network the researcher must examine how the relationships between actors were formed, and how they formulated and interpreted translation strategies. This means that the researcher should establish, as Latour would say, the direction (toward particular goals) in which actors were heading before and after the translation. To the extent that the direction has changed, the translation has had an observable effect, it has been successful.

In this study, the translation network between Andrews Group scientists, managers, and members of Congress was examined by determining (1) where, when, and how scientists interacted with managers and members of Congress and Congressional staffers; and (2) how these interactions changed what the enrolled actors did afterwards. The latter included examining what independent actions the manager and Congressional allies took on behalf of the network, whether allies cooperated with each other, and in what ways their expressed commitments changed. The strength of the network can be assessed by the ways in which enrolled actors act on behalf of the network.

Researchers who have studied advocacy coalitions with qualitative methods have designed studies using archival, interview, and observational data to reconstruct key events in the formation of policy subsystems (Sabatier and Jenkins-Smith 1992). Such studies have involved a time perspective of a decade or longer and have focused on (1) the relationships among the loosely allied actors who make up advocacy coalitions, (2) the values inherent in advocacy coalitions, and (3) the

institutionalization of values that advocacy coalitions achieve in law and policy. This study uses archival and interview data to reconstruct basic structural features of the federal forest policy subsystem as they pertain to the spotted owl/old growth issue and the translation network analyzed here: identifying the major advocacy coalitions; providing relevant legal framework; and identifying major controversies between the coalitions in a historical context. The controversies are the substantive areas of contention over which advocacy coalitions define key problems and delimit the range of possible actions that coalitions can take to implement their agendas. The definition of problems is usually a focus of controversy, because definitions greatly influence the how the range of possible action is delimited.

This study does not attempt to reconstruct the history of the federal forest policy subsystem in its entirety, or to even to describe the range of actors who are members of advocacy coalitions in the policy subsystem and their relationships with each other. Rather, this study describes the features of the federal forest policy subsystem that are relevant to understanding the context in which the Andrews Group created its network. The question of how the Andrews Group created relationships that translated ecosystem knowledge into ecosystem management thus defines the scope of the study of advocacy coalitions. Toward this end, the study uses archival data to reconstruct (1) the development of traditional forestry and the relationship between traditional forestry and science; (2) the rise of environmentalism and the environmental challenge to traditional forestry; (3) the involvement of the advocacy coalitions in the spotted owl issue, and (4) the failure of the advocacy coalitions to resolve the spotted owl conflict.

The study also incorporates interview data to reconstruct the failure of the advocacy coalitions to resolve the spotted owl conflict in the Congress. The interview data from the Congress also is used to show how the advocacy coalitions context structured the possibilities for action of the Gang of Four, and how the Gang of Four process impacted the advocacy coalitions.

3. Field Research

I conducted interviews with Andrews Group scientists in Corvallis and on the H.J. Andrews Experimental Forest. Since the core group of Andrews scientists numbers around twenty-five people, I attempted to interview them all. I also interviewed scientists who were peripheral members of the Group. As some members of the group were on sabbatical during my field research period and some others were unavailable due to scheduling conflicts, I interviewed about twenty members of the group.

In the Spring of 1994, Errol Meidinger, the principal investigator for the Science and Advocacy project, and I went to Washington DC. to conduct interviews with Forest Service and other federal agency personnel and Congressional staffers who had been involved with or observed the Gang of Four process two and a half years earlier. I was now pursuing the role of the Andrews Group in the policy controversy in the Northwest as my dissertation topic. In addition to the Gang of Four related interviews which I conducted, Dr. Meidinger and I also interviewed former and present Forest Service administrators and employees of other agencies who were involved in developing ecosystem management strategies and policies.

While in Washington I also interviewed environmentalists and industry representatives from the national organizations and trade groups. My purpose in conducting these interviews was to triangulate the Andrews Group's role in the national-level policy making process. These interviews also helped provide information about the political context within which the Gang of Four and the development of the ecosystem management policy took place. I also interviewed administrators at the National Science Foundation from which the Andrews Group received much of its funding.

I also interviewed Forest Service employees in the Pacific Northwest who had had ongoing relationships with the Andrews Group. These included employees of the Blue River Ranger District on which the Andrews Forest is located, as well as employees of the Willamette National Forest of which the Blue River District is a part. This research helped me describe the network that the Andrews Group had built in the region to test and disseminate its management ideas and practices.

Additionally, I interviewed researchers at Oregon State University and the University of Washington who considered themselves opponents of the Andrews Group. I conducted these interviews as part of a triangulation strategy and to help me better understand the social and professional context within which the group was doing its work. I also interviewed several environmentalists and timber industry representatives in the region with connections to the Andrews Group.

C. Interview Strategies

I conducted sixty-three interviews for this research project. Of these, the majority were with Andrews scientists and Congressional staffers. The rest were with Forest Service managers and administrators, environmentalists, industry representatives, Andrews Group opponents in the scientific community, and National Science Foundation administrators. I conducted open-ended interviews which loosely followed interview protocols that contained subject areas I wanted to be sure to cover. These areas differed according to the kind of person I interviewed.

With Andrews Group researchers I asked questions in six general areas:

1. Personal history: How did scientists become involved in natural resources work? How did they become members of the Andrews Group? How did they know that they had become members of the group? How did belonging to the group affect their research? Did it change the way they thought? What they believed?

2. Andrews Group organization and development: How did the Andrews Group form? Who were the original members? How did they organize the group? How was the group held together financially? How is the group organized now? Who are the group leaders? How are they chosen? Is there an inner circle? How does one become a part of it? How is the work divided among the members of the group?

3. Andrews Group culture: How do members of the group work with each other? Are there established patterns of cooperation? Are there conflicts within the group? What do group members do to integrate their work? What is the nature of the relationships between group members?

4. Development of Andrews Group research: What were the initial areas of research for the group? What were the most important questions? The most important analytical concepts? How did the research program evolve? What have been the most important findings of the research at various stages and in the aggregate? What are the key publications? How else does the group disseminate its findings?

5. Involvement with management: At what point did the group begin to deal with management questions? How did this occur? What have been/are the relationships with managers? How have managers been involved in the group's work? Who have been the key managers who have worked with the group?

6. Involvement with policy: At what point did the group (group members) get involved in policy? Who has been involved in policy and who has not? How did group members get into policy related work? How have group members been involved in policy? What have been the results of this involvement?

I asked questions of Congressional staff in seven general areas[6]:

1. Background to the Gang of Four: What was the context prior to the Gang of Four? How had the spotted owl/old growth issue evolved in the Congress? What were the prospects of a legislative solution?

2. Initiation of the process: How did the idea for the Gang of Four get developed? Who were the key initiators? Why were people interested in having a scientific panel? What were the alternatives?

3. Selection of the panel: How and by whom were the panel members chosen? Were there people who were considered but not chosen? People who were left out?

4. Expectations and goals of the members: What did members of Congress expect from the Gang of Four? How were they going to use the information? Were there non-explicit goals and expectations from this process?

5. Contemporaneous effects of the process: What were the key findings of the report? How were they presented? How did members of Congress react? What

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[6]I did not always have to ask all of these questions. In some cases I asked the respondent to tell me about the Gang of Four and the respondent proceeded with little further prodding to tell a narrative which covered all of the subject areas of my protocol. In such cases most my questions were simply follow up and clarification questions. In other cases I had to follow the protocol more closely.

effect did the report have on the work of the committees? How did the scientists interact with the members and the staffs?

6. Long term effects of the process: Are there legacies of the Gang of Four? How is the process thought of now? Are members and scientists from the Gang of Four still in contact? How does the Gang of Four compare with FEMAT?

7. Science and advocacy: How did scientists interact with members? How did they communicate their findings/ideas/opinions? Did scientists ever "go outside" of science? How does one know when that is happening? How was power divided between scientists and policy makers in this process? Were some scientists—members of the Gang of Four and other scientists involved in the Northwest issue—perceived to be advocates while others were not? Why?

My questions to Forest Service administrators and managers depended on where they were located and what I knew of their involvement with the Andrews Group and with ecosystem management policy to have been. With managers in the region I focused on their involvement with the Andrews Group:

1. Contact with Andrews Group: In what ways had managers been in contact with the Andrews Group? Had they visited the Andrews Forest? If they worked on the district, did they regularly work with the Andrews Group? What did they do with the scientists? How had their own work been affected by their contact with the Andrews Group? Did the scientists work directly with the district/forest on management projects? Had forest management changed as a consequence of

having the Andrews Group working on the forest? How did the Andrews Group disseminate its information and management prescriptions?

2. Participation in Andrews network: Did managers help disseminate information from the Andrews Group? Did they adopt management practices developed by the Andrews Group? Did they advocate the use of these practices to other managers? What did they think of the Andrews Group's program (New Forestry/ecosystem management) as a new way of managing the forest? Did they think it represented a fundamental change?

3. Observations of the Andrews Group's role in the region: How did managers perceive the role of the Andrews Group within the forestry community? Was it unique? Were there groups or individuals positioned against the Andrews Group? Why? What did they do?

With administrators at the Washington Office I pursued a more general line of questioning. I was mostly interested in their helping provide the national context for the Northwest issue, the Andrews Group, and the development of ecosystem management:

1. Development of the ecosystem management policy: How did the Forest Service come to adopt ecosystem management as a management "paradigm"? How is ecosystem management different from the usual way of doing things? What actual effect has it had on management? How is it related to New

Perspectives? Is ecosystem management more a "philosophy" or is it a set or management prescriptions or is it something else?

2. Role of the Northwest in that development: How is ecosystem management at the national level connected to the ecosystem management of the President's Plan? Was the Northwest policy the first real example of ecosystem management? Will it serve as a model for the future?

3. Role of the Andrews Group: Has the Andrews Group been instrumental in the development of ecosystem management at the national level? Have Andrews Group members had contact with the Chief or other top administrators in relation to forest policy?

With environmentalists and industry representatives I generally sought to first have them describe their view of the evolution of the Northwest issue, their role in the issue, and then their involvement with the Andrews Group and the views of the development of ecosystem management:

1. Evolution of the issue: How did the interest groups think of the causes and evolution of the Northwest issue? What was their role in shaping the issue? How did they define the main policy questions?

2. Role of science in issue development: Did the interest groups define the issue in scientific terms? What kind of scientific terms? Did the interest groups employ scientists? Did they rely on academic scientists? How did they respond

to scientific evidence and arguments? Did they think some scientific voices were more credible than others? Why? How did they deal with conflicting science?

3. Role of Andrews Group in issue development: How did the interest groups think of the role of the Andrews Group in shaping the policy debate? Whose side did they think the Andrews Group was on? What was their position vis-a-vis ecosystem management? Had their positions been affected by the Andrews Group in any way?

I used my interviews with opponents of the Andrews Group to help me understand the social and professional position of the group in the region. Scientists who were open critics of the Andrews Group were people closely associated with traditional forestry, usually silviculturalists, forest engineers, and foresters.

1. Personal history: What were the scientists' professional training? How had their careers progressed? What did they think of as their professional mission?

2. The forest issue: Had they taken part in the Northwest issue in some fashion? What did they think the issue was really about? How did they view the challenge to traditional forest management? How did they view the rise of "new" disciplines in forest management over the past two or more decades (i.e. biology, ecology, etc.)? How had they related their work to these disciplines?

3. Role of the Andrews Group: Had they had contact with the Andrews Group? What did they know of the group's work? What did they think of it? How did they assess the role of the group in the context of the forest?

D. Triangulation and Checking the Validity of Data

Threats to the validity of a qualitative study include bias in the data as well as outright misinformation and gross oversight. Qualitative researchers must take precautions against bias and blunders that undermine the validity of the research. In this study I utilized two strategies to guard against imposing my own biases (finding what I expect to find) and mistakes (being misled by respondents).

Triangulation. Where possible, I used variable methods to gain a fuller understanding of phenomena under study. These included interviews, as discussed above, observation, and archival research. It was possible to make observations of Andrews Group scientists during their regular monthly meetings in Corvallis, and on field-trips on the H.J. Andrews Forest. In all, I undertook about a half-dozen observational sessions lasting from two hours (meetings) to two days. During these sessions I witnessed interactions among the scientists and between scientists and others that exemplified the cultural phenomena I identified in the interviews. I triangulated around enrollment strategies used by the Andrews Group through archival research that included scientific and mass-market publications by the scientists themselves, and articles written about them. I also gained diverse perspectives of the group by interviewing outside observers

of the group. These included interest group representatives, colleagues, managers, and faculty opponents.

It was not possible to observe the Gang of Four process because it took place prior to the research project. However, there was ample documentary evidence, consisting mainly of hearing transcripts, to which I referred to check and enrich the interview data. In addition, because the process involved both scientists and policy makers, responses from each group could be compared with the other. In matters of fact, I found no significant discrepancy between the accounts given by scientists and Congressional staffers.

Saturation Interviewing. Triangulation is not always possible, in which case the strategy of saturation interviewing is another method of insuring the validity of data. Saturation interviewing consists of interviewing as many subjects as necessary until the stories they tell have repeated themselves so often that no new information emerges. For instance, during my first several interviews with Andrews Group scientists, individuals gave me their own viewpoints on certain group dynamics that seemed important in understanding how the group developed resources needed to enroll allies (e.g. developing an interdisciplinary research program). Though related, the respondents' interpretations and anecdotes differed in marked respects from each other. At that early stage of the research, the respondents' viewpoints might have seemed "subjective", that is, idiosyncratic and without necessary foundation in an objective social reality. However, as I continued to interview more researchers I found that what first appeared to be idiosyncratic "takes" were in actuality perspectives on real group dynamics that

differed according to the role that individual researchers played in the group. Once I was able to identify a division of labor in the group ("bench" scientists, administrator/managers, leader(s)) the problem of incompatible perspectives disappeared. At this point not only had a rounded picture of certain key group dynamics that lead to solidarity and interdisciplinarity emerged, but a structural feature of the group, a division of labor, had emerged as well.

E. Summary

This dissertation draws on the interactionist tradition in sociology to guide and frame the research process. This actor-level approach treats social structure as an emergent property of interaction conditioned by existing structural constraints and opportunities. The rules of method developed by network theorists, especially Bruno Latour, fit within the interactionist framework. Studying translation networks requires examining the negotiations between actors in which interests, goals, and other meanings emerge. The translation network that is the subject of this dissertation is studied within the context of advocacy coalitions in a policy subsystem, which form a part of the social structure that shapes and is recursively shaped by the formation of the network.

Chapter Four

American Forestry and Ecosystem Studies

A. Introduction

In this chapter I discuss briefly the rise of American forestry and the establishment of what throughout this dissertation I call traditional forestry: the practices and organizations that evolved since the early 20th Century period of Progressive Era conservation reforms into the forest policy and management system. I then discuss the development of the ecosystem idea in ecology, which occurred over the same period in the U.S., and the institutionalization of ecosystem ecology through the International Biological Program run by the National Science Foundation. The purpose of the chapter is to provide the context in which the forest management crisis in the Northwest occurred and in which the Andrews Group was formed. The environmental movement is not treated directly, but its effects on the forest policy system most relevant to this dissertation, are reviewed. Because the U. S. Forest Service is the most important public forestry organization in the history of American forestry and in the context of the Northwest, it forms the center of my narrative. Other agencies, especially the Bureau of Land Management, are treated incidentally in later chapters.

B. The Tradition of Forest Management in the Forest Service

1. Forestry in the Progressive Era

The American forestry movement formed a part of the larger "conservation" movement during the Progressive Era, a reaction against what was perceived to be the anarchy, wastefulness, and general social corruption of the unregulated, free market development of industrial capitalism in the nineteenth century (Hays 1959; Wiebe 1967). Unconstrained capitalism was seen by the Progressives to have brought social problems on a vast scale. Progressives believed that the new economic and social order had to be brought under rational control through administrative and political reform in order to advance the public good. Administration meant rationalization, and rationalization was linked with science. Scientific administration was, for its most enthusiastic proponents, more than just a pragmatic program, it was also a way to eliminate society's problems by controlling and planning social development. Progressives thought that the uncertainty and the waste of resources that unregulated markets produced could be eliminated through the application of scientific knowledge for planning and decision making.

Hays describes the conservation movement in terms of "the role it played in the transformation of a decentralized, non technical, loosely organized society, where waste and inefficiency ran rampant, into a highly organized, technical, and centrally planned and directed social organization which could meet a complex world with efficiency and purpose" (1959:265). In regards to natural resources,

conservation was grounded in the "gospel of efficiency", which meant efficient use, not in an ideology of public ownership for the sake of egalitarian or anti-capitalist purposes. Conservation was meant to be a means through which sustained economic growth in the resource production sector of the economy could be achieved. Efficiency entailed consolidation and rational planning, goals that fit nicely with long term industrial needs (Hays 1959:264-265). Timber on the public lands was indeed barely harvested until after the Second World War due to pressure from private landowners not to flood the market and reduce prices as well as lack of access. As the founders the lands system envisioned, the lands were being held in "reserve" until a demand for their resources arose. This ideology of conservation echoed the utilitarian creed that the public good consisted of the greatest good for the greatest number, and that trained professionals could, through the application of science, direct society toward this goal.

Resource users organized around single resources and through Congress gained some control over appropriations for resource development projects. The resource management regime that developed was based on a relationship between Congress, the agencies that specialized in single resources, and local interests, with sometimes more and sometimes less friendly relationships between agency and industry. While the tension between the need for comprehensive planning for economic efficiency and the local desire for participation was recognized by the conservationists at the time, it was a contradiction they could not resolve (Hays 1959:275).

The early responsibilities for the forest reserves of the Division of Forestry (located in the U.S. Department of Agriculture), forerunner to the Forest Service, were limited to planning for the management of publicly reserved forest and rangelands, since they were administered by the Department of the Interior. The Organic Act of 1897 gave the Secretary of the Interior the authority to "improve and protect the forest" within the federally reserved forest lands or to manage them "for the purpose of securing favorable conditions of water flows, and to furnish a continuous supply of timber for the use and necessities of citizens of the United States" (16 USC 473-478, 479-482, 551). The Secretary was also to protect the forestlands from fire and other kinds of destruction.

The Division of Forestry became the Bureau of Forestry in 1901. In 1905, the forest reserve lands were transferred to the Bureau of Forestry after a campaign by Gifford Pinchot, the chief of the Bureau of Forestry, and others who wanted administrative control over the lands for the purposes of practicing forestry. In 1907 the Bureau of Forestry became the U.S. Forest Service. The first chief of the Forest Service was Gifford Pinchot, the most influential figure in the history of the agency from that time, and for whom forest conservation was a moral crusade (Clary 1986). For Pinchot, the main responsibility of the forester was "to promote and perpetuate its [the forest's] greatest use to men. His purpose is to make it serve the greatest good of the greatest number for the longest time," (Pinchot 1914:23). When the agency was created Pinchot wrote himself a letter, signed by the Secretary of Agriculture, directing the agency to manage its lands according to the "greatest good of the greatest number" philosophy.

For Pinchot, conservation meant "wise use" of the forests, not preservation as in a park. Indeed, Pinchot equated conservation with efficient use, that is, the absence of waste. "Uncle Sam's woodlot" was to make its contribution to the development of the nation by providing its resources to home builders rather than commercial enterprises, and with the least possible waste.

> In its natural state a forest is an inaccessible and undeveloped property, of a very low per-acre value, and capable of making very low returns. As with any other undeveloped property, if we invest money in its improvement, develop its resources, attract population to its neighborhood, and provide the means for getting out its products cheaply, the returns will be enormously increased. The returns from the National Forests are contributions to the general welfare. The important thing is not that our forests should be made to pour great sums into the National Treasury in the form of cash, but that they should add to the national wealth, thru the wise utilization of all their resources. (Pinchot 1908: 1377)

The wise use ethic was seen by conservationists and Progressives as a rational, scientifically based approach to managing natural resources that would replace the anarchic plundering of resources produced by the natural market and unrestrained capitalism (Hays 1959). Indeed, the concept of management itself embodies the principle of rationalization. Pinchot and other Progressives believed that science and the development of professional expertise could impose a rational order on the chaos of the market, thereby increasing the net social welfare. Conserving resources, in addition to bringing greater benefits to society as a whole, would also conserve the industries and jobs dependent on the availability of resources by ensuring that there would be no resource famines.

The direction that Pinchot gave the Forest Service has "permeated the agency's policies to this day" (Clary 1986:22), although the Forest Service's original distrust of private timber interests, reflecting Pinchot's, gave way to an alliance between the agency and industry that began with the second Chief of the Forest Service, Henry Graves, and accelerated through the 1950's. In the meantime, the agency went about refining its mission and acquiring more lands as national forests.

2. The Pre-World War II Era

In the 1920's and 1930's the Forest Service developed a "multiple use" framework for managing the national forests—the lands were used for grazing, recreation, and wildlife habitat as well as timber production and protection of water flows, as specified in the Organic Act. However, the agency's leadership would not sanction any management action as multiple use if it left merchantable timber standing, which it considered wasteful[7] (Hirt 1994:36-37). The multiple use philosophy that the agency was developing had timber cutting as its primary use, yet due to the Great Depression and a still abundant private supply of timber, the demand for public timber was low. It was not until World War II that timber production on national forest lands began to reach nationally significant levels.

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[7]Forest managers worried about "high grading", the practice of taking only the highest quality and value timber from a stand, which can leave a forest looking frail and failing to regrow vigorously due to the overabundance of weak and undersize trees.

Since the early days of the agency, the Forest Service had been working with a notion of "sustained yield" of timber imported from European forestry. Pinchot's conception of sustained yield meant a steady flow of timber which represented the net incremental growth of a forest after mortality and decay are subtracted. By suppressing fire, controlling insects, and manipulating tree species composition, the net incremental growth could be increased. However, because, most of the Western national forests were in a virgin condition in which old forests, or old growth, predominated, the net annual growth was very low. The Forest Service developed a new formula for measuring sustained yield in 1922 which included liquidation of old growth. Old, slow growing, forests would then be replaced by young, "vigorous" ones, increasing the net annual growth substantially (Hirt 1994:39-40). Liquidating old growth was particularly important in the Pacific Northwest because the Douglas fir/Western hemlock forests dominant in the region yielded the nation's most valuable timber. The belief that leaving old growth forests standing is wasteful has been a mainstay belief among silviculturalists and foresters, and in the Forest Service which they controlled, until recently (Hagenstein 1978). The belief in the virtue of intensively cutting old-growth forests to "make way for the new" was thought to be part of the cannon of forestry ethics.

> Professional foresters are trained to accept the philosophy that the conversion of an old growth unmanaged forest (like the one in the Northwest) to a managed forest, with its favorable distribution of age classes, is desirable from social, economic and forestry points of view (Hagenstein 1978:492).

Moreover, the preferred method of removing these forests was to clearcut them. Because of the characteristics of Douglas fir, the tree grows more slowly in the shade, therefore, selectively cutting a Douglas fir forest will result in a forest that grows more slowly than would be possible if all the trees were cut and new ones planted. One of the standard textbooks in the field, David Smith's *The Practice of Silviculture* (1962) summarizes the forestry professions stance toward old-growth:

> The failure of the selection method in West Coast Douglas-fir is an outstanding example of the difficulty of attempting to convert overmature stands into productive units by selective cutting. Stands of this kind are often best stored on the stump until needed and then swiftly removed by application of the clearcutting or shelterwood methods. (Smith 1962:512)

The commitment to converting old growth forests to new plantation style forests put the Forest Service on the path to trying to make tree farms out of the natural forests over which it had custody (Hirt 1994). Because the agency produced relatively little timber up to World War II, holding its forests in "reserve" until such a time as the market demanded their products, the significance of this commitment was not seen or felt by those members of the public who had an interest in the national forests: conservation organizations and citizens who used the forests for recreation and solitude. This would gradually change as the agency stepped up its lumbering during and after the war.

3. World War II and the Post War Period

During World War II the rate of timber harvest on national forest lands increased dramatically. Prior to the war, the national forests supplied less than one half of one percent of nation's timber, by the end of the war their share had risen to 3.1 billion board feet, or 10 percent of the national total. After the war, the rate of cutting increased even more as the agency allied itself with the industry in meeting the boom in housing demand. The cut from national forest lands increased to 6.3 billion board feet by 1955 and 9.4 billion board feet by 1960 (Hirt 1994:50). Under the direction of Chief Richard McArdle in 1952 the agency also dropped its campaign to regulate the timber industry, adopting a program of cooperation "as the best means to serve the public interest" (Steen 1976:271). The push for regulatory authority could not be maintained during what was shaping up as a conservative period under President Eisenhower, who strongly opposed expanded Forest Service control over private capital (Clary 1986:150). The agency was thus left free to pursue a collaborative relationship with the timber industry.

The Forest Service had won a large store of public trust and legitimacy by both providing recreational opportunities for anyone who cared to use the forests for camping, hunting, fishing, boating and so on, and by mounting successful public relations strategies depicting itself as a defender of the public interest like the Smoky Bear campaign as well as its long-standing campaign against "destructive" (inefficient and wasteful) logging (Clary 1986:152). The nonconsumptive users of the forest could, however, increasingly see the effects of logging on the

national lands and to them it looked a lot like the destructive logging they had been hearing the agency rail against for years (Steen 1976:302). Moreover, citizen based groups like the Sierra Club were now organized to lobby for values such as wilderness and wildlife (Clary 1986:152).

The 1950's also ushered in the era of antagonism between the Forest Service and the traditional conservation organizations such as the Sierra Club and Wilderness Society. These, organizations, which were staunch advocates of wilderness and recreation on the national forests, perceived the Forest Service's accelerated timber cutting program and alliance with the timber industry as a threat to their interests. Though supportive in principle of multiple use, the conservation organizations challenged the agency on its interpretation of the concept. By the mid 1950's the divisions over the agency's management of the national forests led Congress, at the prodding of the Forest Service leadership, to begin considering codifying the multiple use and sustained yield approach to management. The Forest Service favored codification because the National Park Service sought to acquire Forest Service recreational lands and the Forest Service leadership saw multiple use as a way to hold onto those lands.

The Multiple Use-Sustained Yield Act (MUSY), passed in 1960, was the codification of the multiple use philosophy. The act stated that National Forests would be "administered for outdoor recreation, range, timber, watershed, and wildlife and fish purposes" (USC 74 Stat. 215). Multiple use was defined as

> the management of all the various renewable surface resources of the national forests so that they are utilized in the combination that will best meet the needs of the American people; making the most judicious use of the land for some or all of these resources or related services over areas large enough to provide sufficient latitude for periodic adjustments in the use to conform to changing needs and conditions. (USC 74 Stat. 215).

Sustained yield was defined as

> the achievement and maintenance in perpetuity of a high-level annual or regular periodic output of the various resources of the national forests without the impairment of the productivity of the land. (USC 74 Stat. 215)

MUSY legitimated the conservation of non-timber resources on the National Forests, thereby creating a legal structure to bring these resources into a rationalized management regime. Experts in recreation, wildlife, and so on were utilized to integrate management of these resources with timber and range management. The act expanded the purposes of forest management to include recreation, forage, and wildlife management while at the same time retaining its relationships with the forest products and range industries (Dana and Fairfax 1980). MUSY did not result in a lower timber cut from the National Forests. Indeed, the agency pressed hard to increase the timber cut from its lands (Clary 1986:170) while trying to use the act to resolve conflicts over resource uses (Steen 1976:309). As the rise of the environmental movement in the 1960's and 1970's demonstrated, this balancing act was unsuccessful.

4. The Environmental Challenge to Traditional Management

Up until the 1960's, the community of non-governmental conservation organizations consisted of such groups as the Audubon Society and the Sierra Club that had been in existence since the 19th Century. These organizations had relatively few members and were staffed largely by volunteers and a small number of committed "amateurs" (Mitchell et al. 1992). These organizations were heavily involved in protecting pristine wilderness areas and conserving wildlife. Wildlife conservation had become a major issue for conservationists around the turn of the century with the disappearance of the American buffalo and the rapid decline of bird populations as a result of sport hunting and shooting. Some organizations, such as the Sierra Club, also emphasized the expansion of recreational opportunities (Hays 1988). Wilderness, wildlife, and recreation have been called "first generation" environmental issues (Fox 1981) because they grew out of the same spirit of concern drove the conservation movement of the Progressive Era. In fact, early non-governmental conservationists felt themselves allied with their governmental counterparts, although some splits in philosophy were evident from the start. For instance, Gifford Pinchot and John Muir, the founder of the Sierra Club, expressed sharp differences over the defining interest of conservation. Pinchot's utilitarian emphasis on efficient use for the benefit of the greatest number brought him into public conflict with Muir who favored preservation of wildlands. Not surprisingly, Muir and the Sierra Clubbers were strong supporters of the preservation and recreation oriented National Park Service rather than the use oriented Forest Service.

By the late 1960's, new organizations sprang up that distinguished themselves from traditional conservation by focusing on issues such as air and water pollution (Hirt 1994). In the meantime, many traditional conservation organizations broadened their focus to include issues resulting from industrialization as well as issues relating to population growth, the decline of ocean resources, and the proliferation of nuclear power. This second wave of the conservation movement adopted the name environmentalism, and the new or renewing organizations began to professionalize, hiring lawyers, scientists, and lobbyists (Mitchell et al. 1992). The environmental organizations opened offices in Washington, D. C. where they focused much of their effort on reforming federal environmental/natural resources policy. Within the federal forest policy subsystem environmentalists lobbied not only for the protection of wilderness, but also the reform of forest management practices on federal lands.

One of the first great victories of the environmental movement was the passage of the National Environmental Policy Act in 1969. NEPA directs the executive branch agencies to disclose the impacts of federal actions which significantly affect the human environment, a requirement that usually entails scientific analysis (Caldwell 1982). NEPA articulated the concerns and the hopes of the environmental movement, and established a comprehensive federal policy for dealing with the environmental effects of federal actions. The philosophical underpinning of the act is stated in section 101.

> The Congress, recognizing the profound impact of man's activity on the interrelations of all components of the natural environment, particularly the profound influences of population growth, high

> density urbanization, industrial expansion, resource exploitation, and new and expanding technological advances and recognizing further the critical importance of restoring and maintaining environmental quality to the overall development of man, declares that it is the continuing policy of the Federal Government, in cooperation with State and local governments, and other concerned public and private organizations .... to create and maintain conditions under which man and nature can exist in productive harmony, and fulfill the social, economic, and other requirements of present and future generations of Americans. (83 Stat. 852)

NEPA required the federal government to "utilize a systematic, interdisciplinary approach .... in planning and in decisionmaking which may have an impact on man's environment" by reporting on the "environmental impact of [any] proposed action" (83 Stat. 852). This provision of NEPA led to the creation of the environmental impact statement, which has now been widely applied throughout the world. NEPA led the agency to begin hiring greater numbers of biologists, hydrologists, and other "ologists" in order to meet the mandate to produce an interdisciplinary understanding of environmental impacts. The hiring of these disciplinary experts introduced new voices into the Forest Service, voices that did not automatically support the dominant timber orientation in the agency.

The loss of wildlife became an issue for the public by the end of the 19th Century when many species of wildlife were thought to be endangered, especially birds whose plumage was in demand for ladies' hats (Bean 1983). The states traditionally had authority over wildlife as it was not an area of jurisdiction reserved to the federal government by the Constitution. The Lacey Act of 1900 was the first federal law that specifically addressed wildlife conservation, and

established the federal government's right to regulate the wildlife under the Commerce Clause of the Constitution. The Lacey Act prohibited transporting wildlife killed in violation of state laws across state lines. It also directed the Department of Agriculture to regulate the international trade in wildlife if such trade hurt agriculture. The Migratory Bird Treaty Act of 1918 expanded federal regulation of wildlife under the its treaty powers. However, the treaty also established a federal emphasis on the conservation of birds (which crossed international boundaries). By the 1960's it was becoming clear that many kinds of wildlife were being extirpated from their habitat, and were at risk of extinction. The Endangered Species Preservation Act of 1966 was the first federal statute to establish protection for non-bird species of wildlife threatened with extinction. In 1973, the Endangered Species Act replaced the previous statute, broadening the federal government's authority to protect wildlife and plants. The Endangered Species Act authorizes the Fish and Wildlife Service (in the case of terrestrial wildlife and plants and freshwater fish) and the National Marine Fisheries Service (in the case of marine mammals and saltwater fish) to list and protect species threatened by foreseeable extinction and species endangered with imminent extinction. The purposes of the ESA were conceived to go beyond the protection of the lives of endangered species (e.g. disallowing hunting or harassing them) by "provid[ing] a means by which the ecosystems upon which endangered species and threatened species depend may be conserved" (USC 1531 (2) (5b)). The ESA forces action when a species is listed, including a prohibition against almost all forms of "taking" (exceptions by permit) and the designation of critical habitat that the species needs to survive. The ESA introduced the concept of "critical

habitat"—habitat essential to a species' survival which the governing agencies were required to designate and protect.

In 1978, the Congress amended the ESA, establishing an "Endangered Species Committee" composed of key cabinet members and heads of agencies. The Committee is authorized to grant exemptions for projects that violate the ESA. Known as the "God Squad" because an exemption granted by the Committee might result in the extinction of a species, this controversial provision of the ESA has rarely been used.

The ESA also requires federal agencies to consult with the Fish and Wildlife Service or the National Marine Fisheries Service on any project that carried out in an area where a threatened or endangered species might be present. Carried out under Section 7 of the Act, the consultation process requires federal agencies to prepare biological assessments of the effect their actions might have on listed species. A "jeopardy" assessment, concluding that the action is likely to jeopardize the continued existence of the species, is rare. However, Section 7 consultations are sometimes resented by agencies because of their costs, time consumption, and because as a regulatory agency the Fish and Wildlife Service is sometimes viewed as intrusive on the management discretion of other agencies.

One area which foresters considered within the inviolable domain of their expertise is the harvesting methods used to cut timber. As mentioned, the cultural and practical logic of American forestry led foresters to adopt a policy of replacing the natural forest with a managed, plantation or tree-farm style forest in

many places. Clearcutting is the foresters harvesting method of choice when the desirable tree species are shade intolerant. Douglas fir in the Northwest, for instance, grow best in direct sunlight. Consequently, timber harvests in the Northwest have almost all been clearcuts, up until the end of the 1980's.

Environmentalists and local citizens whose communities were dependent on timber became concerned about the rate of clearcutting and the size of the cuts on federal lands in the late 1960's and early 1970's. On the request of Congressman Lee Metcalf, the University of Montana School of Forestry produced a report in 1970 analyzing the controversy over clearcutting on the Bitterroot National Forest. The report, which was became notorious, found that multiple use and sustained yield management did not exist on the forest. The report concluded that the mismanagement of the Bitterroot National Forest was due to a congeries of structural and cultural factors which resulted in an imperious and rigid agency deeply resistant to change.

> In a federal agency which measures success primarily by the quantity of timber produced weekly, monthly, and annually, the staff of the Bitterroot National Forest finds itself unable to change its course, to give anything but token recognition to related values, or to involve most of the local public in any way but as antagonists.
>
> The heavy timber orientation is built in by legislative action and control, by executive direction and by budgetary restrictions. It is further reinforced by the agency's own hiring and promotion policies and it is rationalized in the doctrines of its professional expertise. (Select Committee 1970: 14; quoted in Hirt 1994: 249)

The campaign against clearcutting lead to a suit against the Forest Service 1973 brought by the Izaak Walton League, a "sportsman's" (hunting) organization with conservation values. The suit charged that the Forest Service violated the Organic Act of 1897 in three proposed timber sales on the Monongahela National Forest in West Virginia. Arguing that the proposed clearcutting violated the provision of the Act that required that only "the dead, matured, or large growth of trees" be cut after they have been individually "marked and designated" (30 Stat. 35), the Izaak Walton League was challenging the practice of clearcutting in general. The district court agreed, as did the appellate court. Subsequently, a federal district court ruled that clearcutting on the Tongass National Forest in Alaska also violated the Organic Act. Congress responded by considering new legislation governing management of the National Forests.

In March of 1972, the Public Lands Subcommittee in the Senate issued guidelines for Forest Service timber harvesting practices. The so-called "Church Guidelines", named after Subcommittee Chairman Frank Church, addressed clear cutting on the National Forests. The guidelines directed the Forest Service not to clearcut under certain environmental conditions, and to limit the impacts of clearcutting when the practice is used (Wilkinson and Anderson 1987:146-147). The Church Guidelines were largely incorporated into the National Forest Management Act of 1976 (NFMA). The NFMA attempted to balance the desire of the agency to have autonomy in running its timber program and the desire of environmentalists to force the agency away from having timber production be its main objective, and to impose environmentally sound management standards. The NFMA established a set of procedural and substantive guidelines that

significantly narrow and regulate the management activities of the Forest Service. The law directed the agency to limit the size of clearcuts and make them less visually offensive. The law also created a forest planning process for each national forest in which plans are to be revised or amended at least every 15 years. It provided for significant public involvement in the planning process, and provided substantive regulations that establish standards and guidelines for resource management, including timber, water, wildlife, and other renewable resources (Wilkinson and Anderson 1993).

The draft planning regulations for the NFMA were adopted by the Department of Agriculture in 1979. In 1982 the Department revised the regulations, adding significant biodiversity protections that played a particularly important part in the spotted owl/old growth issue. The so called "viability regulations" written in 1979 provide for the requirement to "maintain viable populations of all existing native vertebrate species in the planning area and to maintain and improve habitat of management indicator species" (36 CFR 219.12(g)). "Indicator species" that representative of selected habitats would be monitored for changes in habitat conditions. The spotted owl was picked as an indicator species for the old-growth forest ecosystem in the Northwest. The 1982 revisions tc the viability provision stated that " A viable population shall be regarded as one which has the estimated numbers and distribution of reproductive individuals to insure its continued existence is well distributed ... to insure that viable populations will be maintained, habitat must be provided to support, at least, a minimum number of reproductive individuals and that habitat must be well distributed so that those individuals can interact with other" (36 CFR). This provision of the NFMA

regulations provided the basis of the lawsuits brought by environmental organizations in the Northwest that led to the injunctions on the Forest Service's timber program.

As it turned out, the NFMA did not resolve the contradiction between the timber emphasis in the Forest Service and the mandate to accommodate other uses. On the one hand the agency interpreted the law in ways most favorable to its timber bias (Hirt 1994). On the other hand, the law and its regulations provided citizens and environmental groups with another legal tool with which to challenge the agency's policies on various grounds, including failure to maintain viable populations of native vertebrate species. Of 98 final forest plans submitted by 1990, 95 had been appealed and four had been the subject of law suits (Adams 1993).

5. The Forest Policy System After NEPA, ESA, and NFMA

Federal forestry policy in the post NFMA period until the 1990's was in most respects remarkably similar, even unchanged, from the period before. The Forest Service continued to set high timber harvest targets, the allowable sale quantity (ASQ), relying on a computer planning model called FORPLAN which could not take account of ecological relationships on the land. Worse yet, in some cases individual national forests programmed their FORPLAN model to not generate an ASQ below a minimum set in advance by the staff (Hirt 1994:272-275).. The agency also systematically overestimated forest growth rates and underestimated the amount of time it would take second growth forests to grow, thereby

undermining the non-declining even-flow provisions of the NFMA (Hirt 1994:272-275).

During the 1980's Congress frequently directed the agency, through the appropriations process, to exceed even its high level of planned timber harvest. Members of Congress from the Northwest were especially eager to see the national forests produce wealth for local and state economies, causing even the leadership of the Forest Service to complain that harvests were unsustainable (Hirt 1994:272). As a result, the volume of timber cut on the national forests reached all time highs under the Reagan and Bush administrations. This in spite of decades of protest from environmentalists and legal reform.

Yet, the environmental laws, including the NFMA, were far from toothless, and environmentalists had by the 1980's acquired experience and were developing sophisticated strategies challenge the agency. At the local level, environmentalists brought administrative appeals against Forest Service projects under NEPA and the NFMA. Nationally, environmentalists organized the "ancient forests" campaign to protect old growth, the largest and most coordinated environmental campaign since the Alaska lands protection campaign of the 1970's. And now, environmentalists had a number of legal "levers" with which to pressure the agency.

As it turned out, attempts to reconcile the practices of the Forest Service with the values and objectives of environmentalism, and thereby restore the agency's authority backfired. The environmental laws gave environmentalists new and

more potent legal tools with which to challenge the agency, and the agency gave them greater cause to do so by imposing its program of intensive forest management in spite of the restrictions of the laws.

Caught between the Congress, environmentalists, and its own difficult mission to simultaneously conserve forest resources and produce commodities, the Forest Service became an agency deeply at odds with itself and embroiled in interminable conflict. Within the Forest Service, employees not trained as foresters increasingly found themselves opposing agency policy, and their loyalty to the agency wavered (Mohai 1995) at a time when the leadership still expected and rewarded loyalty, especially in the face of external critique (Kennedy 1991).

The result was an agency that was internally divided and unable to form policies which satisfied its many critics. What was variably called policy "gridlock" or a policy "trainwreck" in the Pacific Northwest was a very visible example of the Forest Service's problems. In hindsight, one can see that the historical process leading to this policy failure began decades earlier with the agency's turn to timber dominance over all other legitimate uses of the forest, and was planted in seed form in the earliest ideological direction given to the agency during the Progressive Era. Before I turn to the development of the policy crisis in the Northwest, however, I will briefly review a parallel history, the development of ecosystem ecology. For when the Forest Service's timber program finally ground to a halt in the Pacific Northwest, it was the voice of ecology that provided guidance for a new management regime.

C. The Ecosystem Idea in Ecology

1. Ecology and Forest Management

This section shows that the institutionalization of ecosystem ecology provided the context for the development of the Andrews Group, and gave the group the initial direction that informed its approach to forest management. The development and institutionalization of ecosystem ecology provided researchers with symbolic and material resources with which to challenge traditional forestry practices. However, the concept of the ecosystem, so central to the ecosystem management policy of the Northwest, began as a concept enclosed within the discourse of ecology.

2. The Science of Ecology

Ecology is the study of the relationships between "living systems and their environment" (Golley, 1993:6). It focuses not on the individual organism or species, like biology, but on processes and functions that characterize the interactive biophysical system of which organisms and species are only a part. Ecology is, therefore, in the broadest sense, a part of one of the most difficult and ubiquitous human intellectual enterprises: the attempt to understand complex wholes, in this case natural wholes. It is not surprising that the history of ecology is filled with attempts to find unifying concepts (van Dobben and Lowe-McConnell 1975) that can provide a framework for analysis and research on what would otherwise be an incomprehensibly complicated tangle of "fascinating but

apparently unrelated observations" (Lawton 1974:537).[8] The ecosystem idea is one such concept.

Ecology began as a self-conscious, named science when Ernest Haeckel coined the term "Oekologie" in 1866 (Haeckel 1866). Haeckel related the emerging science of evolution to animal morphology, thus establishing the notion of dynamic change at the center of ecology from the start. However, ecology had been developing as a line of inquiry well before Haeckel, and can be traced to the general interest in natural history of the 18th and 19th centuries. Egerton (1973) traces the origin of ecology to about 1800 and identifies the concept of the "balance of nature" as the "oldest ecological theory", thought of as the stable composition of species over time.

Since then concepts such as species succession and ecological climax have provided theoretical elaboration to the idea of evolution toward a stable set of biological relationships within an ecological unit. More recently, concepts of dynamic and unpredictable change have challenged the more mechanistic views of nature prevalent in ecology (McIntosh 1985). However, there is a prior problem for ecology which is of first concern for this research, namely, the question of what is the proper unit of ecological study.

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[8]Although I will not go into it here the reader should be aware of the tension within ecology between those favoring "holistic" versus "reductionist" approaches to ecological phenomena (see Levins and Lewontin 1985).

3. Populations, Communities, Microcosms and .... Ecosystems

Population ecology began as a highly mathematical field in which the interactions of organisms and their environment formed the focus of study. There is a close relationship between the development of population ecology and human demography (McIntosh 1985), and thus the field can in principle be traced back to Malthus. Population ecologists studied the population trajectories of single populations as well as interactions between populations of different organisms with an aim toward predicting the population fluctuations of species. One of the more unexpected outcomes of this line of research was that under certain environmental conditions population trajectories became stochastic and that prediction had to be based on probabilistic analysis. With its species orientation and emphasis on predictive, mathematical models of population responses to environmental changes, contemporary wildlife biology has to be reckoned a descendent of population ecology. Its sibling, wildlife management, seeks to use the knowledge of wildlife biology to predict and control the effects of management activities on specified species of wildlife. An often elusive goal of wildlife managers, especially of game species, has been to produce an equilibrium among the populations of species reminiscent of the balance of nature ideal.

The concept of the community introduced a more complex level of organization in ecology. One of the more influential theses in this line of research was the concept of the organismic character of plant communities advanced by Clements ([1916] 1965). Clements developed the theory of a dynamic ecology in which "an orderly progressive succession" of organismic communities culminated in a

"stable self-reproducing climax" "association" that was integrated like one organism (McIntosh 1985). This concept of the "superorganismic community" with homeostatic characteristics is clearly in direct descent from the balance of nature idea. The concepts of progressive succession and climax associated with community ecology have proved fertile for ecological research and still play a role in the contemporary ecology of ecosystems.

Systems ecology got its start with the study of lakes. In 1887 Stephen Forbes published "The Lake as a Microcosm" which he began with the elegant assertion that "A lake ... forms a little world within itself—a microcosm within which all the elemental forces are at work and the play of life goes on in full, but on so small a scale as to bring it easily within mental grasp" (Forbes [1887] 1965:168). Limnological studies continued the transition toward the development of the ecosystem concept. Edward Birge and Chancy Juday at the University of Wisconsin made major advances in the study of the energy budgets of lakes (Juday [1940] 1965). Moreover, they were pioneers in the development of interdisciplinary ecological studies, employing chemists, physicists, bacteriologists, algologists, plant physiologists, and geologists on their team (Frey 1963). Juday defined the energy budget "as comprising the energy received from sun and sky each year and the expenditures or uses which the lake makes of this annual income of radiation" (Juday [1940] 1965:174). Juday and his colleagues distinguished between the energy budget in terms of heat and the biological budget, which "involved the energy converted by photosynthesis and its use by each organism" (Golley 1993:47). These lake studies provided an example of an ecological system that could be studied in terms of primary processes, and in so

doing aided the development of a concept introduced at about the same time, the ecosystem.

Alfred George Tansley coined the word "ecosystem" in 1935, defining it as "including not only the organism-complex, but also the whole complex of physical factors forming what we call the environment of the biome—the habitat factors in the widest sense." He went on to argue that "ecosystems ... are of the most various kinds and sizes. They form one category of the multitudinous physical systems of the universe, which range from the universe as a whole down to the atom" (quoted in Golley 1993:8). Thus, Tansley argued that the ecosystem was "(1) an element in a hierarchy of physical systems from the universe to the atom, (2) the basic system of ecology, and (3) composed of both the organism-complex and the physical-environment complex" (Golley 1993:8-9). Here the individual organism and even species is left behind for a study of basic functional and structural properties that remain relatively stable through time even as the species composition of ecosystems changes. As "energy-processing systems" (Reichle and Auerbach 1972) occurring at a variety of organizational levels, ecosystems have been able to accommodate and bring coherence to a variety of different kinds of ecological studies, from those dealing with primary production to those dealing with population dynamics. The ecosystem concept has proven to be one of the most persistent unifying concepts in ecology, perhaps in part because it has never been more than loosely defined, and can therefore be adapted to evolving research and conceptual paradigms (Shrader-Frechette and McCoy 1993).

Ecosystem studies advanced considerably with the work of Raymond Lindeman, who also argued that a lake constituted a discrete ecosystem (1942). Lindeman developed the concept of the "trophic dynamic aspect" in which "biota could be described as a network of interactions with groups of organisms linked by feeding" (Golley 1993:50). He focused his work on the food cycle of the lake that linked all organisms to their environment. In it species formed groups of organisms (browsers, benthic predators, etc.) that played discrete functions in the cycling of food energy through the lake ecosystem. Moreover, the lake was seen as a dynamic habitat in which successive organizational structures of organisms and non-living material evolved toward a relatively stable system. Lindeman's work set the stage for a post-war boom in ecosystem studies that gradually led toward an ascendancy of the concept of ecosystem as the basic unit of study for ecologists.

4. The "New" Ecology

Both the environment for and content of ecology changed dramatically after World War II. The National Science Foundation, established in 1950, and the Atomic Energy Commission became major funders of ecological research, moving the discipline for the first time into the ranks of "Big Science" (that is, science funded with large government grants), which became institutionalized in the International Biological Program of the NSF (Golley 1993). The increased funding made more sophisticated sampling techniques possible and led to a new emphasis on quantitative analytical techniques (McIntosh 1976). There was also an effort that grew throughout the 1950s and 1960s to produce an "ecosystem

ecology" which would erase the distinction between plant and animal ecology and order ecological research (functional, trophic, energetic, etc.) around a common unit of analysis (Odum 1977).

The push for ecosystem ecology was led by Eugene Odum who in 1953 published what would become the dominant textbook in the field for decades, *Fundamentals of Ecology*. Odum used the concept of the ecosystem as the organizing principle of his book. He defined the ecosystem as an "entity or natural unit that includes living and nonliving parts interacting to produce a stable system in which the exchange of materials between the living and nonliving parts follows circular paths is an ecological system or ecosystem" (Odum 1953:9). The components of ecosystems included inorganic substances, organic compounds, the climate regime, producer plants, consumer organisms, and micro-consumer organisms such as bacteria. Ecosystem processes included the energy flow circuits, food chains, diversity patterns through time and space, nutrient cycles, development and evolution, and control processes. Together, these ecosystem qualities form the structure and function of the ecosystem (Odum 1972:15-16).

Ecosystems could either be studied as wholes, as Lindeman had thought to do, or one could study parts of the ecosystem and work up to the whole. Most ecosystem studies took the "merological" approach of focusing on a structural and functional properties of the ecosystem and working up to the level of the whole. The trend toward quantitative analysis and modeling provided the means by which to understand the whole and predict its behavior without having to study every aspect of the ecosystem in a single set of studies. In the mid 1960s a team

of ecologists at the Oak Ridge National Laboratory led by Stanely Auerbach adopted a systems approach to studying ecosystems that relied on computer modeling to represent and predict ecosystems and ecosystem changes. This approach required the development of a team (Golley 1993), and the team approach soon became standard in ecosystem ecology (McIntosh 1976).

The ecosystem concept was inclusive enough to accommodate areas of ecological research such as succession, adaptation, and selection. Though the trend toward quantification and modeling would become dominant in the 1960s and through the early 1970s, ecosystem ecology, with its focus on ecosystem structure and function, was inherently ecumenical, and ecosystem concept has proven to be adaptable to theoretical and methodological changes in the discipline.

Evolutionary ecology has matured alongside ecosystem ecology but initially had little impact on ecosystem scientists because they had no direct interest in individual species and furthermore tended not to study ecosystems through space and time. Ecosystem ecologists tended to search for ecosystem structures and functions that became stable in a steady state, a homeostatic system that may have had short-term fluctuations but was characterized by "self-regulating mechanisms ... which bring about a return to constancy if a system is caused to change from the stable state by a momentary outside influence" (Odum quoted in Golley

1993:98). Evolutionary ecology brought attention to longer-term changes that occurred in ecosystems, calling into question the steady-state concept.[9]

An obviously related research area in ecology is succession, the sequence of compositional changes in a disturbed ecosystem. The climax state was thought to be the final, stable community. Clements had thought of the climax community as an "organic entity" that "arises, grows, matures, and dies. Its response to the habitat is shown in processes or functions and in structures which are the record as well as the result of these functions. Furthermore, each climax formation is able to reproduce itself, repeating with essential fidelity the stages of its development ... Such a climax is permanent because of its entire harmony with a stable habitat. It will persist just as long as the climate remains unchanged..." (Clements [1916] 1965:140-143). Clements is credited with the idea of the "monoclimax" (Ricklefs 1983), the climax state as a kind of teleological inevitability, but is often not given enough credit for his caveat that climate was the ultimately determining factor (for example, Golley 1993:100). Whittaker (1953) elaborated that idea, arguing that climax conditions were only temporary (though they might persist for thousands of years and therefore seem permanent to humans) and were contingent on a "pattern of environmental gradients" which included climate.

Ecosystem ecologists incorporated studies of succession into their work, showing how ecosystems changed over time and operated within predictable disturbance

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[9]It should be evident that steady-state concept derives from the old balance of nature idea. The tension between change and stability within ecosystems is a fundamental political issue as well as a source of debate in ecology.

and regeneration patterns. Ecosystem scientists "accepted the reality of an object consisting of many different species" (Golley 1993:104) that changed over time and in space. Succession studies were one way that these questions could be addressed, and point to an ecumenical tendency that grew up in ecology wherein change and permanence, evolution and steady state could be accommodated under a dynamic conception of the ecosystem.

D. The Institutionalization of Ecosystem Ecology: The IBP and Long Term Ecosystem Studies

1. Background and Purposes of the IBP

In October of 1970 President Nixon signed a Congressional resolution authorizing $40 million for the National Science Foundation's participation in the International Biological Program, a grand enterprise involving modeling the world's ecosystems. Planning for the IBP had been ongoing throughout the 1960s and US participation had begun in 1968 with minimal funding from the NSF. The large scale funding secured the future of the IBP in the U. S., significantly raised the status and funding structure of ecological research, and institutionalized the ecosystem concept in the mainstream of science policy (Kwa 1987).

The impetus for the IBP was a recognition among ecologists as early as the 1950s that humanity was placing an increasingly heavy burden on the ecological systems of the earth, and that resource and environmental problems were going to become significant problems in the near future (McIntosh 1976:363). In 1961 an

organizational meeting in Amsterdam established three core areas that the IBP would investigate: human heredity, plant genetics and breeding, and the study of ecosystems that were likely to suffer negative effects of human activity (Golley 1993:111). In 1965 the National Academy of Sciences created a United States National Committee for the IBP. A meeting in Williamstown, MA in 1966 established a particularly American focus for the US/IBP: an ecosystems emphasis that involved "relatively well-funded, closely-linked, cooperative studies of whole ecosystem" (McIntosh 1976:363), what would become the "biome program".

The IBP thus began with broad concerns that reflected a growing societal awareness of human impacts on nature and worries about the future capacity of humanity to utilize natural resources. Much of this concern was based on the fear of resource scarcities and food shortages resulting from an exponential growth in the human population (McIntosh, 1976). The logic behind the three emphasis areas established in Amsterdam was that knowledge of natural systems would be needed both to protect them and to more intelligently manage them; that knowledge of human genetic diversity could help us understand how genetic adaptations to environmental conditions had helped human populations survive in the past; and that knowledge of plant genetics and breeding would contribute to higher sustained crop harvests. The idea behind IBP was clearly to put science to use in a big and coordinated way to solve emerging environmental problems that might one day threaten human well being or survival. However, the IBP was a basic research endeavor; applications of the knowledge gained through the

program were intended to come at a later date and most likely under other institutional auspices.

The US/IBP put a particularly American slant on the program by working off the development of ecosystem ecology to give it an ecosystems focus. Thus, the overall objective of the US/IBP was framed as an effort "to improve understanding of the interrelationships within and among ecosystems". This would be accomplished by

> •Formulating a basis for understanding the interactions of components of representative biological systems
> •Exploiting the understanding of biological systems to increase biological productivity
> •Providing bases for predicting the consequences of environmental stresses, both natural and man-made
> •Enhancing man's ability to manage natural resources
> •Advancing knowledge of man's genetic, physiological, and behavioral adaptations (National Research Council 1974:1-2)

Hearings of the Subcommittee on Science, Research and Development of the House of Representatives were held in 1967 to gain Congressional support for the IBP. Subsequent to the hearing the subcommittee issued a report urging funding for the U.S./IBP (Subcommittee on Science, Research and Development 1968). The report relied heavily on the testimony it had heard concerning the grave environmental dangers facing humanity and the necessity of creating a science-policy infrastructure to begin to address them. As the subcommittee concluded, the justification for the IBP was that it would bring science to bear on "one of the most crucial situations to face this or any civilization—the immediate or near

potential of man to damage, perhaps beyond repair, the ecological system of the planet on which all life depends" (Subcommittee on Science, Research and Development 1968 :2).

The testimony before the subcommittee indicated that the U.S./IBP would make significant contributions in developing a theoretical ecology that would have predictive capacities then lacking, advance knowledge of ecosystems in order to more intelligently management natural resources, develop an international network of researchers that would be the basis for knowledge transfers, and develop a large cadre of ecological scientists (National Research Council 1974:12). However, some witnesses expressed a larger vision of what the ultimate ends of the IBP might be. Stanely Cain, the Assistant Secretary of the Department of the Interior for Fish, Wildlife and Parks argued that the

> IBP is really the world's first organized effort to face up to this class of vital problems that deal with the limits of natural productivity in various ecological systems. The possibilities of human management of such systems extend before us new frontiers that can be reached if we develop and apply ecological knowledge (National Research Council 1974:54).

The ambition to manage ecosystems as systems was an extension of the then popular cybernetic systems theory to ecology. The notion of cybernetic control of society, in which society is conceived of as a closed system that the controller can stand outside of and manipulate, developed a following among some policy makers and bureaucracies in the 1960s. Therefore, the utilization of the concept in the context of the environment would have resonated with the "more general

cultural repertoire" that Congressmen were acquainted with at the time (Kwa 1987:425-26).

The US/IBP was distinguished by the biome studies[10] which divided the country into 5 large ecological regions which were to be studied as whole ecosystems. The biome studies fell under the Environmental Management Component of the U.S./IBP, which also included Origin and Structure of Ecosystems and Conservation of Ecosystems studies.[11] Seventy percent of the funding allocated to the U.S./IBP went to the biome studies. The biomes were: the Grasslands Biome, the Eastern Deciduous Forest Biome, the Desert Biome, the Tundra Biome, and the Coniferous (or Western Coniferous) Forest Biome. The central goal of the biome program was to model ecosystems as comprehensively as possible.

2. Organization and Goals of the Biome Program

The biome studies were all conducted with the cooperation of various public land management and other agencies (federal and state) as well as private landholding companies and other government agencies, notably the Atomic Energy Commission, the Department of Defense, and the National Oceanic and Atmospheric Administration. The Eastern Deciduous Forest Biome and the

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[10] A "biome" is a "broad, region wide association of plants and animals, such as tundra, boreal forests, and so forth" (Golley, 1993:110).

[11] The other component of U.S./IBP was the Human Adaptability Component. These studies focused mainly on the genetics of indigenous peoples and received less than ten percent of the funding allocated to the Environmental Management Component.

Western Coniferous Forest Biome were both administered with extensive support of the U.S. Forest Service, among other cooperators. The Grasslands Biome worked closely with the Agricultural Research Service, the Desert Biome was associated with the Bureau of Land Management and the Agricultural Research Service, and the Tundra Biome was supported by a complex array of federal and state partners that included the Army and the Navy.[12] The close relationships that the biomes established with federal agencies were designed to both enlarge the funding base for the studies and disseminate the knowledge gained through the studies to practitioners who could make use of it. Though a basic science program, the IBP was intended to produce results that could be applied by managers and policy makers in the long term.

The particular goals of the biome program were established during the Williamstown meeting in which the program was envisioned, and which was led by Eugene Odum. The general purposes of the biome research were:

> •to study whole systems, such as drainage basins and landscapes, through team effort
> •to study interactions between components
> •to emphasize primary production, trophic structure, energy flow pathways (food chains), limiting factors, interactions of species, biogeochemical cycling, species diversity, and other attributes that interact to regulate and control the structure and function of communities
> •not to restrict the studies only to natural areas. Ecological succession was to serve as a background in which general objectives could be pursued

[12]The list of cooperating agencies, universities, municipalities, and companies is too extensive to review here. For a complete list of cooperators for all the biomes please refer to U.S. Participation in the International Biological Program (National Academy of Sciences, 1974:17-18).

> •to consist of collaborative studies in major biomes, in drainage basins, where terrestrial and aquatic studies can be simultaneous
> •to catalyze new techniques, developing theory from small field and laboratory studies
> •to involve systems analysis techniques for examination of existing data on ecosystem processes by sensitivity analysis as an aid in allocating resources for integrated system studies, for rapid organization and analysis of data collected by electronic recording equipment and for analysis and integration of results designed to test and develop theory
> •and finally, to establish centers to store and distribute information collected at the different study sites (reproduced from Golley 1993:118).

Although the ecosystems analysis studies had a heavy systems modeling emphasis, the goals established a broad conceptual framework that allowed for multiple methodologies and disciplinary approaches to interact (Golley 1993; interviews of participating scientists). Thus, community ecologists with a primary interest in succession could work with population ecologists with a primary interest in species to develop an integrated structural and functional understanding of an ecosystem that systems ecologists could then attempt to model. In this way, the seeds of an ecumenical ecosystems ecology were present in the IBP. As this research revealed, this emergent interdisciplinary collaboration had important implications for future science policy and understanding of ecosystems.

One of the more controversial aspects of the ecosystems analysis studies was their emphasis on interdisciplinary teams. Indeed, the team approach was an explicit goal of the studies, in that the biome program necessitated teams because the inherent complexity of ecosystems required multiple disciplinary approaches in

research. However, not all the ecosystems studies used the team approach. For example, Hubbard Brook Experimental Forest in New Hampshire (a U.S. Forest Service property) was another important research effort, and it was organized on a traditional individual scientist basis and by all accounts has been quite successful. In any case, the debate over teams became a matter of great contention and came to represent a split between conservative and liberal attitudes towards individualism and community (Golley 1993). As will be shown in the next chapter, the team question played a defining part in the history of the Andrews Group as well as of the researchers who were their counterparts at the University of Washington.

3. Results of the Biome Program

In spite of many shortcomings, the IBP had a great impact on the development of ecosystem studies in the U.S. and also on the future of resource management, though the latter is even now only becoming evident. The Analysis of Ecosystems program received approximately $57 million from 1967 to 1973, and the funding rolled over into a new program in the NSF called "Ecosystem Studies". The continued funding for the biome research even after the IBP had ended allowed all of the biomes to produce synthesis reports on their work (Golley 1993). Some IBP research sites such as the H.J. Andrews became part of the Long Term Ecological Research (LTER) program, a network ecosystem research areas with permanent staff to which the NSF has dedicated continuous funding. A program officer for the NSF who has been a close observer of

ecosystem research at the NSF for twenty-five years made the following assessment.

> Well, I think that probably the most important result of the Western Coniferous Forest Biome was the completion of the invention of the science of ecosystem research, whole, large, ecosystem research. Not any kind of breakthrough or discovery or result... I have consistently said that the WCFB of the IBP along with the other biome projects solidified and scientifically legitimized this construct of ecosystem science. Which today is very strong and healthy and competitive. It created the track and the track record in the mainline journals for the publication of results at that level of biological complexity. It brought about the creation and dedication of topical sessions at the annual meetings of the major societies, it drove the creation of the ecosystem program at the NSF, and whatever successes it had contributed strongly to the institutionalization and the continuation of that program into the present... a lot of things, all of which are blocks in that structure that has become that construct of ecosystem science.

Other outcomes of the IBP included the establishment of centers for ecosystem studies at five major universities which have helped develop the field by providing an infrastructure for ecosystems research and a network for researchers. The IBP also trained almost two thousand scientists in ecosystems studies, a training which they took with them into their academic or government careers (Golley 1993). The IBP was responsible for the initial diffusion of the ecosystems idea outside of the narrow confines of intra-ecology debate and vague public discourse. Ecosystem research has since become an attractive career choice and the ecosystems approach to understanding ecological phenomena and framing resource management has become common, perhaps even dominant (Golley 1993).

The IBP was less successful in meeting some of its own theoretical goals. The hope that predictive ecosystem models could be developed proved elusive. However, descriptive models of ecosystem processes worked well and ecosystems modeling has grown into a large field in the meantime (Golley 1993; McIntosh 1977). Though in most cases the biome studies did not advance a landscape-level ecosystems view out of their intensive studies of particular sites, the Coniferous Forest Biome and the Eastern Deciduous Forest Biome did develop models of ecosystem processes at the landscape level (National Academy of Sciences 1974). As I will discuss in the next chapter, the Andrews Group continued to develop landscape-level ecosystems analysis and has invested a great deal of effort in integrating ecosystem studies at various spatial scales, from the stand to the regional level.

Finally, research conducted under the IBP raised basic questions about the nature of ecosystems. Ecosystem models often portrayed a stable system of interactions, implying that ecosystems function (and evolve, in the case of succession) in a kind of deterministic fashion. Yet change through natural and man-caused disturbances was clearly a part of the ecosystems that were studied in the IBP. Ecosystems researchers have in the meantime incorporated the study of disturbance into their frameworks. Disturbance is the organizing principle of the Andrews Group's ecosystem research program.

4. The IBP and Ecosystem Management

Given the concern that ecologists developed for the state of the environment, it is not surprising that the rise of the ecosystem concept led ecologists to consider the ecosystem as a unit not only for analysis but for human management. As the IBP had "Enhancing man's ability to manage natural resources" as one of its objectives, the program provided a context for the first application of the ecosystem concept to resource management.

During the IBP the terms "ecosystem management" (Van Dyne 1969), "ecosystem perspective" (Bakuzis 1969), and "ecosystem approach" (National Academy of Science 1974) were all used in reference to applying the ecosystem concept to resource management. Because of the emphasis on mathematical modeling of ecosystems and the belief that systems, once well enough modeled, could be controlled in a cybernetic regime, the conception of ecosystem management that emerged from the IBP was rather more ambitious in its eventual goals than the aims of today's ecosystem management. Yet the core idea of ecosystem management, that multiple resources can be managed in reference to each other with the overall ecological health of the ecosystem as the main goal, was the same.

Ecologists believed that the ecosystem "approach is particularly suitable to the analysis of natural resource problems on an integrated and holistic basis" (Spurr 1969:7). This meant that multiple use management, which in practice meant maximizing single resources on given land areas, could be reconceptualized with

the ecosystem rather than the resource as the basic unit of analysis and planning (National Research Council 1974:89-99). It was thought that ecosystem models would be used to predict the "combined effect" on ecosystem parameters of land conversion, resource management, and reserved lands (National Research Council 1974:91-92).

Ecologists also struggled with the problem of scale during the IBP period. The Analysis of Ecosystems program was organized according to biomes, yet the studies themselves were primarily conducted on small-scale sites, and the results extrapolated to the ecosystems and biomes of which they were a part. The ecosystem seemed well suited as an analytical concept for management because it contained the notion of interdependence of organisms and environment and promised, ultimately, to provide the basis for a more rational management of nature by taking all aspects of the system into account. But because ecosystems exist within ecosystems, ecosystem studies run quickly into the necessity of describing a hierarchy of spatial scales and organizing research appropriate to each. The theoretical problem of describing systems embedded in each other is considerable, but on an operational level some ecologists thought the issue of scale could be resolved according to the purposes of management. For instance, Bakuzis (1969) thought that for watershed, wilderness, and wildlife management the appropriate level of management was the broad landscape level. He defined landscape rather loosely as "a part of the earth's surface with a certain physiognomy, or a characteristic appearance with causal relations and structure" (Bakuzis 1969:250). Landscapes could thus be described in terms of ecosystem characteristics, and could contain multiple levels of ecosystems up to the large

phyisiographic region scale. The management "problem is whether or not it is possible to serve, at least partially, all systems of different sizes and systems constructed from different points of view" (Bakuzis 1969:250).

IBP researchers made some preliminary attempts to apply ecosystem analysis to regional land use planning. Developing the capacity to make models that could guide regional planning was a significant part of the Eastern Deciduous Forest Biome's modeling committee's work (National Research Council 1974). In several cases, ecosystem modelers linked up with other modelers to produce integrated predictive models of such things as the effects of pollution and human demographic change on terrestrial and aquatic ecosystems (National Research Council 1974).

5. Continuing Ecosystems Research: The Long-Term Ecological Research Program

IBP money was rolled over and gradually reduced until 1977. In that year the concept of establishing a long-term ecological research program at the NSF was discussed (NSF 1977) and by 1979 a call for proposals was made. There are now 17 LTER research sites, including the one at the H.J. Andrews forest. The LTER program continued much of the work of the IBP though it is not constrained by a primary focus on modeling. Rather, the LTER approaches ecosystems research from a number of substantive areas, including primary production and disturbance patterns. It has provided an increasingly detailed understanding of ecosystems across the United States (Franklin et al. 1990).

As the first long-term program of ecological research, the LTER holds a unique position in ecology. Like the biome research of the IBP, the LTER research is based on interdisciplinary teams that have been making linkages between disciplines and across temporal and spatial scales. LTER researchers have organized much of their work to address, through basic research, pressing environmental problems such as climate change and threats to biological diversity. Moreover, the LTER provides not only a network of research sites for ecologists, but also networks of university researchers and various partners such as the Forest Service, Department of Energy, and the Park Service (Franklin et al. 1990).

6. The Ecosystem Idea and Environmentalism

The term ecosystem is in frequent use by environmentalists, and some "instant ecologists" (McIntosh 1977:368) like Barry Commoner have helped to link environmentalism and ecology in the public view. Yet the relationship between the scientific discipline and the social movement are by no means straight forward. The environmental movement and ecology have separate institutional and ideological histories; they belong to separate social worlds.

The modern environmental movement, which is reckoned to have begun in 1970 with the first Earth Day (Dunlap and Mertig 1992), has its roots in the century old conservation movement (Caldwell 1970). In many cases, the same organizations, such as the Audubon Society and Sierra Club have been dominant actors in both

waves of concern over human impacts on the environment. However, while the conservation movement was mainly organized to protect open space and wildlife through the creation and management of public lands, the environmental movement is considerably broader in scope, encompassing pollution issues as well as substantive reform of the system of public lands.

Environmentalists have long utilized the concept of the ecosystem to make their arguments, and as early as 1970, Lynton Caldwell argued that "The ecosystem is scientifically the most fundamental concept for environmental analysis and control" (Caldwell 1970: 19). Though clearly both groups are interested in environmental protection, environmentalists have not until recently created a policy agenda on the basis of the ecosystem. Rather, preserving wilderness (unmanipulated areas) and single species conservation have formed the core of the land protection oriented part of movement's goals over the course of the last quarter century (Brower 1990). Understandably, environmentalists use the concept of ecosystem opportunistically to further their main objective, which is to protect lands and resources from adverse human impacts. To the extent that ecosystem refers to the whole habitat-species complex, environmentalists are happy to advocate ecosystem protection. But to the extent that knowledge of the ecosystem can be used for an ecosystem management which entails active (however ecologically sensitive) resource production and which may even be broadened to include consideration for the human elements of the ecosystem, environmentalists feel more ambivalent.

The environmentalists interviewed for this research sometimes expressed a satisfaction that ecosystem science was showing that the old-growth ecosystem of the Northwest was suffering greater harm from timber harvesting than had previously been thought, requiring greater levels of protection. However, they also expressed ambivalence towards ecosystems science and scientists because they did not always produce findings or make recommendations that fit with the environmentalists' objectives.

> I think certainly the scientists have their own agenda. I mean, first of all they want to get funding for their research and do more research ... and their research can be used to keep right on harvesting trees, because the science doesn't tell you how you should use it, you can use it to manipulate the ecosystem like Jerry [Franklin's] New Forestry.
>
> It goes back and forth. We learn what we can and we incorporate that, but it's not going to just change the direction that we're going in. If it's helpful we use it, and if it isn't we don't. We're an advocacy organization, not a science group.

Thus, while the ecosystem idea remained a rhetorical resource that environmentalists relied on, they rejected an interpretation of it that would sustain timber harvest. Environmentalists have filed eight lawsuits against the design or implementation of the Northwest Forest Plan which came out of the FEMAT process because they do not believe that the ecosystem-based approach in the plan will adequately protect the forests. They fear that the ecosystem concept will be used to weaken legal protection of individual species, thus turning ecosystem management as a subversive tool for undermining ecosystems themselves. As one environmentalist told me, referring to the provision of the Endangered

Species Act which states that one of the purposes of the act is "to provide a means whereby the ecosystems upon which endangered species ... may be conserved" (USC 1531 §2 (b)), "We already have an ecosystem management act, it's called the Endangered Species Act. And the last thing we should do is try to dismantle that." The respondent was here alluding to the provision of the Endangered Species Act which states that one of the purposes of the act is to "provide a means whereby the ecosystems upon which endangered species and threatened species may be conserved" (16 USC 1531 (2) (5b). Environmentalists would prefer to use the ecosystem concept as an argument to create park or wildness-like land reserves of whole ecosystems.

> Ecosystem management emphasizes the management, and we emphasize the ecosystem ... The fact is that those forests have been creamed and the responsible thing is to stop cutting ... It's going to take generations for those forests to come back ... And in the meantime our best bet is to just let nature, let evolution take its course ... If that's ecosystem management, I'm all for it. Otherwise we're just being co-opted.

Ecologists also express ambivalence in regards to the environmental movement. Because ecology, especially ecosystem ecology since the IBP, has often dealt with environmental problems, ecologists have at times felt their scientific credibility threatened by a too close association with environmentalism.

> Ecology was dubbed the subversive science and was itself in danger of subversion and incorporation into various ideologies associated with the environmental movement ... The environmental movement threatened to turn ecology from science to ideology ... (McIntosh 1977:368)

E. Conclusion

Gifford Pinchot and the foresters who followed him into public service believed that the interests of the nation, the greatest good for the greatest number, would be served if forestry were rationalized through scientific planning and management. Their vehicle for accomplishing this task was public forestry, in particular the U. S. Forest Service, which could lead by example and possibly regulation. Although the ambition of federally regulating private forestry was eventually abandoned (the states exercise regulatory authority), the Forest Service set on a course of harvesting its own forests, and after World War II, or cooperating with the industry to supply the voracious post-war demand for housing. The agency fostered a culture of deep loyalty and single-minded commitment to agency objectives (Kaufman 1960) in which the ideal of the managed, homogeneous, and efficient forest became its lodestar. Foresters prided themselves on their ability to recreate the forest according to their ideal image of a fast growing and homogeneous farm of trees, and were convinced, even when seemingly incontrovertible evidence to the contrary began to appear, that their forest was a better forest than the natural one (Langston 1995).

The environmental movement succeeded in getting Congress to pass legislation, mainly in the 1970's, that directed how Forest Service would exercise its discretionary authority. Through NEPA, ESA, and NFMA the agency was charged with the legal responsibility to consider and minimize environmental impacts and to protect species and the habitats on which they depend. The Forest

Service's response to the challenge was to try to subsume the new mandates under its intensive forest management program. When lands had to be set aside for species protection, the agency managed remaining lands even more intensively, making itself vulnerable under the very laws it was trying to accommodate. However obvious it might have been that the agency could not abide by the environmental laws while managing forests intensively, it would not or could not see this.

Langston (1995) suggests that the Forest Service could not accept that it was severely damaging the forest and that its practices had to change fundamentally in order to protect environmental values because doing so would have threatened the core of what the agency saw as its historical mission. Foresters, she writes, are like others in that they constructed an ideological framework through which they interpreted the meaning of their lives, and that abandoning it would mean a kind of psychological death. Just as surely, however, the Forest Service was caught in a policy system which demanded the continued production of high timber volumes from the national forests, whether this made sense ecologically or even financially.

While the Forest Service had multiple use and sustained yield affirmed and reaffirmed throughout its history, including in the RPA and the NFMA, the agency's strong timber bias was never affected. Indeed, given that Congress first directed it to balance uses and produce timber on a sustained yield basis and funded primarily the timber program and demanded higher cut levels than even the agency deemed feasible, the Forest Service can be only partly to blame for the

eventual policy failure. More fairly, the forest policy system itself, including the contradictory mandates of Congress and the incompatible demands of industry and the environmental community, had become irrational. The rules by which the Forest Service was expected to do its job could not be reconciled with each other in the context of an intensive timber management program.

At the same time that the Forest Service entered the environmental era holding onto its ideal of the efficient, fully managed forest, ecosystem ecology became a big science project and developed an ideal of its own, cybernetic control of ecosystems. Though the sciences involved—ecology, mathematics, computer science—differed from the traditional forestry sciences of silviculture, tree physiology and so forth, the cybernetic ideal and the managed forest ideal were strikingly compatible on their face: both sought to impose rational, steering control over the natural world. However, as ecosystem ecology developed it became clear that the cybernetic ideal was only a transient aberration in a discipline whose axioms were fundamentally different from the axioms of forestry and its supporting sciences.

Ecosystem ecology revealed complexity, relationship, and interdependence, the very qualities that forestry sought to deny or abolish in the forest. Traditional forestry assumed that it could disaggregate those parts of the forest that it wished to favor from other parts of the forest, which were considered irrelevant and not interesting subjects for research. Foresters assumed that the forest could be made to resemble a machine, and that with sufficient manipulations (such as seed improvement) and inputs (such as fertilizer and herbicides) the forest could be

reduced to stands of trees. It is only in this context that the monumental blunder of thinking of old-growth forests as "biological deserts" makes any sense.

Ecosystem ecology, on the other hand, begins with the assumption that ecosystems *are* webs of complex relationships. When IBP researchers discovered that ecosystems were even more complex than they had thought and that simplified models of ecosystems only began to capture their structural and functional relationships, they abandoned the cybernetic ideal.

This chapter has laid out the general structure of the federal forest policy subsystem and the development of ecosystem ecology, which has slowly impinged upon the forest policy subsystem. The Forest Service has been the federal agency that has allied itself most closely with other actors in the traditional forestry advocacy coalition, such as the forest products industry and labor unions representing forest products workers. At the same time, since the passage of the National Environmental Policy Act the Forest Service has hired more specialists from disciplines outside of traditional forestry. These employees have formed a significant source of dissent within the agency. The Association of Forest Service Employees for Environmental Ethics has clearly allied itself with the environmental advocacy coalition, as have some research scientists in the agency. The narrative describing the evolution of traditional forestry, the challenge posed by the environmental movement, and the gradual changes in policy over the years substantiate Sabatier and Jenkin-Smith's (1992) contention that a kind of equilibrium of power among advocacy coalitions develops and lasts for long periods of time. The NFMA illustrates this phenomenon in that it contains

provisions favorable to both advocacy coalitions, representing no clear victory for either side. The history of federal forest management and policy since the passage of the NFMA in 1976 is one of incremental management and policy change, increasing intransigence, and a gradual movement toward policy gridlock. The near 100% appeal rate for final forest plans is illustrative of this process. The discussion in this chapter has focused on the forest policy subsystem on the national level. The way the dynamics of this policy subsystem have worked themselves out in the Pacific Northwest is of particular concern for this research.

Chapter Five

Forest Management and the Development of the Spotted Owl Issue in the Northwest

A. Conservation in the Pacific Northwest Before the Spotted Owl

1. The Federal Forest Policy Subsystem in the Northwest

Federal forest policy in the Northwest since is dominated by the U.S. Forest Service, the Bureau of Land Management, the U.S. Congress, the forest products industry in its diverse manifestations including politically active industry associations, labor unions, environmental groups and forestry colleges and professionals. State agencies and legislatures, state forest practices boards, and local governments have been the main actors on the state level. Localities and states have close ties to the federal agencies through cooperative management of wildlife and revenue sharing mandated by federal law, and as strong advocates for the federal timber program, and therefore belong to the traditional forestry advocacy coalition. Within the agencies, Congress, and the states there have long been departments, professions, and individuals who have not been a part of the dominant coalition. The environmental coalition that emerged in the late 1960s and early 1970s was composed of environmental organizations, environmentally friendly members and committees in Congress, local activists, many wildlife biologists and other resource specialists within the agencies (especially the Forest

Service after passage of the NEPA in 1969), and some scientists, notably wildlife scientists, in colleges and universities.

2. Early Conservation Disputes

The establishment of forest reserves, later to become national forests, created a storm of controversy at the end of the last century. On a single day, in February of 1897, President Cleveland established over 21 million acres of forest reserves in the Western states, including over 7 million in the Northwest. The "Washington's Birthday" reserves, as they were called in reference to the day they were set aside, unleashed a harsh reaction among many in the West, especially sheep growers who feared that their grazing rights would be affected on the reserved lands (Rowley 1985). The protests lead Congress to postpone official designation of the reserves for nine months, thereby stalling the drive to reverse the President's order altogether (Steen 1976:35). The bill that temporarily suspended the reserves contained a number of other provisions, among them one that established watershed protection and timber production as criteria for designating forest reserves. The bill also established the principle that the forest reserves should be actively managed rather then kept in pristine condition. These portions of the bill became known as the "Organic Act" and served as the mandate setting document for the Forest Service until the Multiple Use Sustained Yield Act of 1960 (Williams 1998).

It took decades for the federal forest policy subsystem to evolve into its present form, with managing agencies, timber workers, and the forest products industry

loosely allied as advocates for high-yield forest management and environmentalists and preservation oriented agencies advocating for wilderness, wildlife conservation, and milder forms of forest management. One of the seminal events in this evolution was the fight over establishing the Mt. Olympus National Monument, and later the conversion of the Monument into Olympic National Park.

Seattle-based recreationists and conservationists (a group called the Mountaineers) began to pressure for establishing a national park in the Olympic Range of Washington State in 1909 (Twight 1983). The idea was endorsed by the Biological Survey, the forerunner to the Fish and Wildlife Service. The proposed national park would have to be cut out of the forest reserves, and the regional representatives of the Forest Service, however, strenuously opposed the idea. The objections were overruled by the President, and in March of 1909 the 600,000 acre Mt. Olympus monument was established by Presidential proclamation. As a monument rather than a park certain resource uses could continue (Twight 1983).

One of the main arguments for establishing the national park had been that the resident Roosevelt elk, a unique species found only in the region, needed extra protection in order to survive. An elk hunt conducted on the monument in 1933 reduced the population by twenty percent, and resulted in a renewed effort by park proponents to make a park out of the monument. As in 1909, the Forest Service argued strongly against the park idea, in large part because the new park proposal would once again require the agency to give up lands under its administrative control, thereby limiting the potential of those lands to contribute to the regional

economy (Brant 1988; Brower 1990; Twight 1983). Park opponents in the Forest Service managed to antagonize President Roosevelt, who became an enthusiastic supporter (Brant 1988). A bill to establish the park was introduced in February of 1938, and became law later that year.

3. The Controversy over Wilderness

During the 1970s and early 1980's wilderness became the focal point of dispute in the federal forest policy subsystem. In 1971, the Forest Service conducted the first roadless area review and evaluation, RARE I, in which it evaluated all unroaded areas greater then 5,000 acres for suitability for inclusion in the national wilderness system. Designated wilderness significantly constrains land management agencies, prohibiting many forms of management, including timber harvesting. Grazing and mineral exploration are allowed on many wilderness areas. RARE I created a furor within the forest policy subsystem, polarizing the environmental and traditional forestry advocacy coalitions (Brower 1990; Allin 1982). The agency found 56 million acres that could potentially be designated wilderness, but the evaluation was conducted so quickly and was methodologically so flawed that no new wilderness designations resulted from it (Allin 1982). Instead, the Forest Service managed the lands as wilderness temporarily until another evaluation was conducted.

RARE II was even more controversial and fraught with implementation problems than RARE I. Conducted between 1977 and 1979, RARE II drew almost fifty thousand people to workshops around the country and produced a

recommendation to designate fifteen and half million acres of new wilderness. The results of RARE II were immediately challenged by environmental groups, who felt that the number of acres recommended for wilderness designation fell far too short. RARE II, like it's predecessor, did not result in any new designated wilderness. Instead, Congress adopted a state specific approach to designating wilderness that still continues and involves negotiations with interest groups and state and local government.

The controversy over wilderness in the Northwest was an impetus for environmentalists to organize around protection of the National Forests. The concept of wilderness allowed environmentalists to discriminate among forest lands that they considered worth spending resources to protect, and those they felt should be left to the timber industry. Environmentalists interviewed for this dissertation explained that the fight for wilderness provided them with the framework with which they approached later conservation battles.

> We thought in terms of wilderness, which meant large swaths of unroaded, uncut, un-anything land. So when the spotted owl came around it was a way to protect wilderness. It wasn't until later that we started thinking of it in terms of old growth, which as you know doesn't have to be in large contiguous blocks to be valuable ..... So wilderness was the main priority, and what wasn't wilderness we thought wasn't worth worrying about anymore.

The transformation of environmentalists' concern over wilderness protection into concern over protecting the old growth forest ecosystem occurred by way of the controversy over the northern spotted owl.

B. The Controversy over the Northern Spotted Owl

1. The First Decade of Spotted Owl Management and Research

The controversy over the northern spotted owl led directly to the controversy over old growth forests that forms the policy context for the subject of this dissertation, translation networks that link science, management, and policy. The story of the northern spotted owl's journey through management planning, policy making, and public debate is the story of the transformation of the way we conceptualize conservation and land-use issues. The owl controversy began as a wildlife conservation problem, became a flashpoint for concern over land management practices, and then turned into the issue that forced land managers and policy makers to consider an integrated and ecological view of land management across the landscape.

In 1969 the U.S. Fish and Wildlife Service listed the spotted owl as an Oregon endangered species, but did not put the bird on the national list. In 1971 the Oregon State Game Commission compiled a list of endangered vertebrates of Oregon with the owl included on the list. Less than a year later, in March of 1972, Eric Forsman, then a graduate student at Oregon State University, began research on the northern spotted owl and expressed concern over the loss of owl habitat—old growth forest. Various officials of the BLM and Oregon wildlife and research agencies exchanged letters discussing the spotted owl and its status as an imperiled bird. In August of 1972 the Director of the BLM issued a memorandum

to the state directors of California and Oregon directing them to contact Forsman, Howard Wight[13] , or Thomas Baskell[14] to establish habitat requirements for the owl. In the meantime, Forsman began to become active in the Corvallis area advocating owl conservation and voicing concern over timber sales in the media and to forest managers. Of this period he says, "It would quiet down for a while and then something would come up, a timber sale conflict, and it would start up again." Yet, overall, the owl remained a minor issue that was dealt with primarily by resource management agencies. Besides Forsman, who would go to work for the Forest Service, and some other biologists, no one took any great interest in the owl.

In 1973, the year that Congress passed the Endangered Species Act, the Director of the Oregon Game Commission proposed that a task force be formed to develop a list of endangered wildlife, coordinate inventory work of species and habitat, set management priorities and guidelines, and assess wildlife research needs. The Oregon Endangered Species Task Force, which contained representatives from the Forest Service and the BLM, place a high priority on the spotted owl. In June of 1973 the task force issued a report recommending the adoption of statewide owl management guidelines by June of 1974, with interim protection of 300 acres around each known owl nest in the meantime. The Forest Service and the BLM rejected this recommendation, arguing that temporary prescriptions have a way of becoming permanent ones and that they were confident that research would show that there were enough owls in the state and that the 300 acre rings around nests

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[13]Oregon Cooperative Wildlife Research Unit leader on the OSU campus.

[14]Chief, Division of Wildlife Research, BSFWL.

would not be necessary to protect the bird. Interestingly, the agencies also stated that "the 'management by individual animal location' philosophy, when applied to all species which may be identified as requiring old-growth habitat, presents a land management specter of considerable magnitude" (Lint no date:3). This would be the first of numerous occasions on which the federal agencies resisted attempts to settle the owl issue with a conservation plan requiring land set-asides dedicated specifically to the owl. More than one agency official has expressed regret at not having forestalled future controversy by accepting what in hindsight were very modest conservation proposals.

In 1975 the Oregon Wildlife Commission developed a list of threatened and endangered species in the state, listing the northern spotted owl as threatened. During this same year the BLM issued a final environmental impact statement for timber harvest in Western Oregon in which it stated plans to "harvest old-growth timber on lands available for timber production over the next twenty year period" (Lint, no date:3); almost simultaneously the agency signed a memorandum of understanding to implement the Sikes Act[15], which obliged it to protect the spotted owl. The basic contradiction in the federal policy—a large harvest of old growth trees while protecting wildlife species—had yet to be dealt with by policy makers.

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[15]Public Law 93-452, providing "for protection for fish and wildlife officially classified as threatened or endangered pursuant to Section 4 of the Endangered Species Act of 1973 or considered to be threatened, rare, or endangered by the State agency." As noted above, while it had not appeared on the federal list, Oregon had listed the spotted owl as threatened on the state list.

In 1976 the Congress passed both the National Forest Management Act, which pertained to the Forest Service, and the Federal Land Policy and Management Act, which pertained to the BLM. Both statutes contained significant wildlife conservation provisions. Regulations that would be written for the NFMA directing the Forest Service to maintain "viable populations" of species across their entire range would prove decisive in the legal campaign that the environmental groups mounted against the agencies in the 1980s.

Also in 1976 the Oregon Endangered Species Task Force issued new interim owl management guidelines and a long range management goal. The long range goal was to maintain 400 nesting pairs of owls on the public lands in Oregon in perpetuity. The interim guidelines recommended that the land management agencies manage for owls by protecting land around known or newly discovered nests consistent with the findings of Eric Forsman's master's thesis, which was completed that same year, as well as other studies which had been done. The task force also said it would develop long-term management prescriptions by 1977. The BLM and the Forest Service agreed to adhere to the interim guidelines. The final guidelines appeared late in 1977 and were considerably more stringent than the 1973 recommendations. Four hundred pairs of owls were to be maintained in spotted owl management areas (SOMAs) of 1,200 acres, of which 300 acres would be old growth for each pair of owls. SOMAs were to be established in clusters of three or more pairs separated by about a mile. The federal agencies, whose staffs had helped prepare the guidelines, accepted them in 1978. Yaffee (1994) argues that their motivation in doing so lay in the changing political, legal, and administrative environments of the post-NFMA and FLPMA era, a time in

which environmentalists had become emboldened to use the new laws to challenge the federal agencies. Although he believes the agencies' acceptance of the task force's management plan was a significant administrative adaptation, Yaffee maintains that the actual change in agency management activities was minimal. For instance, of 24 million acres of Forest Service land, only eighty-seven thousand acres were affected by the plan, and of these the majority could continue to be harvested at some level (the 300 acre old growth core areas being the exception).

By the late 1970s, then, the federal agencies had incorporated a scientifically based spotted owl management plan into their overall management planning and seemed to have the issue more or less in hand. The biologists who studied the owl had formed a loose professional network that served as the principal advocate for the owl during this time. Environmental groups had hardly even begun to take notice of the events surrounding the owl in the 1970s, having been too consumed with the process of identifying and designating wilderness lands for recreation and wildlife conservation.

However, the owl issue would not go away, due both to agency actions and the larger political and scientific environment. As Yaffee notes (1994:44), the agencies did not seriously attempt to implement the task force owl management plan on all of their lands. Rather, the implementation was left to the local manager, who in most cases chose to circumvent the requirement of the plan. By 1979 environmentalists had finally also noticed the owl and in early 1980 filed the first administrative appeal on behalf of the owl. The National Wildlife

Federation, local Audubon chapters, and some other groups appealed the BLM's decision not to issue an environmental impact statement (EIS) for the spotted owl plan. Although the agency eventually rejected the appeal, it set a precedent of environmental scrutiny of the federal agencies' spotted owl management activities.

The original Oregon Endangered Species Task Force had been reconfigured as the Oregon-Washington Interagency Wildlife Committee in 1978, and had established a subcommittee to deal exclusively with the spotted owl. In 1980 Eric Forsman submitted his Ph.D. research results (Forsman 1980) to the owl subcommittee. For the first time, scientific evidence showed that spotted owls required more than 300 acres for their home ranges, and on the basis of this evidence the subcommittee began to redraft owl management guidelines. By this time, the National Audubon Society had taken an active interest in the owl and listed it on its Blue List as an imperiled bird.

2. The Growth of Controversy

In 1981 Forsman submitted research results (Forsman 1981) to the subcommittee showing that of 14 pairs of owls studied the smallest home range was found to be 1,356 acres while the largest was 8,352. The minimum amount of old growth that owl pairs required was judged to be 1,000 acres. Four weeks later the subcommittee issued new owl management guidelines which directed the agencies to manage SOMAs in a way that maintains the option to keep 1,000 acre old-growth circles around each owl pair. The subcommittee also called for more

research and a revision of the Oregon Spotted Owl Plan in five years to incorporate the latest research on owl habitat requirements. The BLM and the Oregon Department of Forestry did not reply to the new guidelines from the subcommittee. The Forest Service initially rejected them, then said it would adhere to the 1,000 acre prescription, but in practice stuck to the 300 acre prescription from the initial guidelines (Yaffee 1994:53-54).

In 1981 the BLM plan for its Coos Bay district, the South Coast-Curry Timber Management Plan, was met resistance by environmental groups (including the Oregon Natural Resources Council (ONRC) and the National Audubon Society) and the Oregon Department of Fish and Wildlife (ODFW). The BLM had been advised by the Solicitor of the Department of the Interior that the Oregon and California (O&C) lands on which the management was to take place were to be managed primarily for timber under the O&C Act, and that the wildlife provisions of the FLPMA did "not affect the Bureau's management of the O&C lands to the same degree as it affects the Bureau's general administration of the public lands" (DOI memorandum 1981). However the ODFW found that the management plan for the district violated the Sikes Act, state wildlife law, the ESA, FLPMA, and the BLM's own planning regulations. Noncompliance with wildlife laws would subsequently constitute a violation of the Federal Coastal Zone Management Act, which would take precedence over the O&C ACT. The ODFW subsequently forced the BLM (in 1983), through the intervention of the Oregon Land Conservation and Development Commission, to revise the plan to include conservation provisions for the owl that would maintain 90 pairs on BLM lands.

In January of 1982 the Fish and Wildlife Service issued a status review of the spotted owl in which it described the owl as a "vulnerable" species requiring careful management to prevent endangerment or extinction. By 1984 a federal policy had finally, incrementally, been worked out. The BLM would maintain 90 pairs of owls according to the revised South Coast-Curry Timber Management Plan. The Forest Service issued a final guide for owl management that had 375 owl pairs as the minimum number necessary to maintain a viable population on its lands, as required by the NFMA regulations. Both agencies aimed at maintaining the "minimum" number of owls that the data indicated would maintain the species across its range on their lands. Taking a minimalist approach, the agencies hoped, would limit the damage to the timber program while meeting their legal obligations to conserve wildlife, and forestalling future environmental challenges based on the owl. They were wrong on all counts, and in retrospect 1984 can be seen as the year that the agencies began to loose control of the issue.

The Forest Service owl guidelines were successfully appealed by environmental groups who claimed that they did not comply with the viability regulations of the NFMA and did not analyze the cumulative impacts of the timber program on a regional scale. The regional office of the Forest Service was directed by the Department of Agriculture to prepare a supplemental environmental impact statement (SEIS) that laid out a full range of owl management options. The SEIS team took until August of 1986 to publish a draft SEIS. The DSEIS still focused only on the owl rather than the old growth issue. The preferred alternative called for establishing 550 2200 acre SOHA's. The DSEIS contained an innovative owl population viability assessment that used a risk analysis model; the risk analysis

rated the probability of the owl persisting throughout its range under the preferred management alternative as high in the short term but only medium to low in 100 years. Environmental groups immediately objected to the preferred alternative on the basis of the viability assessment. The Final SEIS was not released until 1988. It adjusted the preferred alternative in the draft so that the probability of owl survival rose to moderate in a hundred years; it also reduced the impact on the timber program to a loss of no more than 5% of what the cut would have been without the owl. However, by the time the FSEIS was released, the political environment had changed substantially, and the agency's attempts to contain and control the issue had failed.

In January of 1987 an unknown environmental group called Green World filed a petition with the FWS to list the spotted owl under the ESA. In August 29 other environmental organizations[16] supplied a second, more comprehensive petition supporting listing the owl. The FWS found in December that listing the owl was not warranted at that time. Also in December the Congress enacted Section 314 of the 1988 Interior Appropriations Act, which prohibited judicial review of BLM timber plans that fail to incorporate new information, such as the impacts of logging on the spotted owl. Section 314 became a notorious symbol of Congressional retrenchment for environmentalists, which they invoked frequently in the public relations campaign. The FWS decision not to list the owl was almost immediately appealed. In short, by 1988, Congress and the FWS had become deeply involved in the spotted owl issue, and though both actors were holding the

[16]These were the "mainstream" organizations such as the National Audubon Society and the Sierra Club.

issue at bay, the environmentalists' strategy of appealing all decisions they disagreed with ensured that the agencies would ultimately be held legally and scientifically accountable for their decisions. Given the resources at environmentalists' disposal, principally the NFMA and the ESA, scientifically unfounded decisions were destined in the long-term to be over turned.

In February of 1989 the General Accounting Office issued a report criticizing the FWS for its decision making process in denying the petition to list the owl. In March U.S. District Court Judge William Dwyer issued a preliminary injunction against the Forest Service's timber program, holding that the Spotted Owl Management Plan (the SOHA strategy) likely violated the NFMA and NEPA. Then, in April, the FWS announced that it would propose to list the owl as threatened under the ESA. The decision to go ahead with the listing process fundamentally transformed the dynamics issue because it meant that the Forest Service and the BLM had effectively lost the battle to maintain internal control over decisions regarding the owl, and by extension the management of their lands. Among the public, interests groups, and Congress, the FWS announcement set off a flurry of activity and anxieties, as no one knew what the consequences of a listing of the owl throughout the region would be. The proposed listing of the owl appeared in the Federal Register in June of 1989.

In October, Congress again tried to slow down the evolution of the conflict in the courts by adopting Section 318 of the 1990 Interior Appropriations Act, which attempted to insulate the Forest Service and BLM timber programs from judicial review by effectively suspending NFMA, NEPA, and other environmental laws.

Section 318 also called for the creation of a scientifically credible plan to manage the owl by the agencies. The immediate effect of this action was that the court's lifted the injunctions on the agencies. However, the reprieve for the agencies would be short lived—in less than a year the 9th Circuit Court of Appeals found Section 318 was unconstitutional, allowing lawsuits based on the environmental laws once again to proceed.

Before the Court of Appeals ruling came down the agencies made an attempt to regain control of the issue by establishing the Interagency Scientific Committee (ISC) according to a provision of Section 318 in October of 1989 to fashion a conservation strategy for the owl. Since the owl issue had increasingly been fought and decided on the basis of science, the ISC represented the agencies' attempt to reestablish the credibility of their technical expertise (Yaffee 1994). The ISC contained four scientists from the Forest Service, and one each from the BLM and the FWS. Their report, issued in April of 1990, was a politically potent document because it established a scientific position on the owl that had wide and lasting credibility. The agencies had made no attempt to supervise or interfere with the ISC and consequently the report did not have the taint of bias that previous agency documents had had.

The ISC strategy abandoned the SOHA approach in favor of Habitat Conservation Areas (HCA's) that aggregated owl pairs with a minimum of 20 pairs in each HCA. The strategy also included the so called "50-11-40" rule which called for maintaining at least half of the forest outside of the HCA's in trees at least 11

inches in diameter and with 40% canopy closure. The timber cut on the federal lands in the region would be reduced by about 30 -40%.

The reaction to the ISC strategy was swift and strong. The timber industry argued that the cost in jobs might reach over 12,000 if the strategy were implemented (Yaffee 1994:127), and the administration ordered the agencies, to convene a task force whose job it was to develop an alternative to the ISC strategy which minimized economic impacts. This task force failed to accomplish this task, and its implicit task of discrediting the ISC. In September of 1990 the task force released a two and half page press release, and was never heard from again. The Forest Service announced that it would "conduct timber management activities in a manner not inconsistent with the [ISC Report]", but did not formally adopt the strategy. The BLM came out with its own plan, the "Jamison Strategy", which ignored key provisions of the ISC strategy and allowed much higher levels of timber harvest than the ISC report supported. Environmental groups sued the Forest Service, arguing that NEPA and NFMA required that the agency actually adopt an owl management plan' the groups notified the BLM of their intention to sue over the Jamison Strategy. The agencies had now been put in the position of having sponsored a scientific analysis process, the ISC, the outcome of which they effectively rejected because it did not fit with their political goals. Possibly, there was no better way to destroy whatever credibility they had left.

The ISC was on the one hand an incrementalist approach in that it only tackled the issue of the owl, not old growth. It was the last of the series of efforts that began in the 1970's to find a way to manage the spotted owl within the context of the

existing timber program. At the same time, it established two key precedents—a large, for some a shocking, reducing in the timber harvest, and a management plan drawn up by scientists. As one Congressional observer who would be instrumental in establishing the Gang of Four told me:

> The most deliberate shift came about with the Interagency Scientific Committee report, the Thomas Committee report, when they actually wrote the prescriptions. There were a lot of examples where researchers made suggestions and researchers had input, but that's the first time that researchers actually came in and started writing a whole management prescriptions. Not just as a silvicultural scheme but as a whole scheme of management, land allocation and everything.

Clearly, the agencies had not expected the outcome that they got. A top Forest Service official at the time explained the agency had anticipated using the ISC report like it had other reports in the past: to take it under consideration, keep what it liked, and disregard the rest. Maintaining its administrative prerogative was still a goal and a felt right. A former high level Forest Service official explains:

> We were looking at it, perhaps naively, as being a report that says, here's some of the science, here's a plan for managing owls that would work--and then we would circulate that to forest supervisors and their staffs, and they would have the opportunity to make adjustments that you need to make to move it into a practical application. The problem was that we lost control. The quick media, as soon as it became known, the significance of their recommendations, ah, the administration didn't want to have anything to do with it at the time, they disavowed the thing. And we never had the freedom then to work within the Forest Service to make the adjustments and the things that might have made the thing manageable ..... That became impossible because of the pressures, the Bush administration didn't

> want to have anything to do with it ... But instead, it strengthened the role that the scientists played.

Though the ISC did not result in a policy, it did become a reference point, a standard against which subsequent management plans would be compared. It also gave prominent owl scientists a permanent place at the policy analysis table, which set the context for the conflicts with ecosystem scientists that would occur during FEMAT. The ISC also heightened the fears of timber communities and the industry because it significantly raised the bar in terms of owl protection and subsequent cuts in timber output.

3. Policy Gridlock

1991 became the year of policy gridlock, the search for a solution more urgent and more elusive. In May, the FWS proposed critical habitat for the owl, which was required under the ESA. Management activities on lands designated as critical habitat for a listed species are not proscribed, but the law requires that agencies consult with the FWS to avoid adversely impacting the species in the course of such activities. On private lands consultation is required when an activity normally requires a federal permit. The FWS proposed to designate 11.6 million acres in the region as critical habitat for the owl, 3 million of it private land. The proposed designation set off another flurry of activity, including a cascade of calls, letters, and lobbying in Congress.

Also in May, Judge Dwyer issued a temporary injunction on timber harvesting on 17 national forests in Washington, Oregon, and Northern California until the agency came up with a legal plan to protect the spotted owl, due by March, 1992. In his opinion, Dwyer noted that "More is involved here than a simple failure by an agency to comply with its governing statute. The most recent violation of NFMA exemplifies a deliberate and systematic refusal by the Forest Service and the Fish and Wildlife Service to comply with the laws protecting wildlife ... It reflects decisions made by higher authorities in the executive branch of government" (Seattle Audubon Society v. Evans, C89-160WD). No more timber could be sold on the national forests in the region of the spotted owl. Federal forest policy had finally ground to a halt.

The Bush Administration reacted by again asking Congress to "insulate the [timber sales] program from administrative appeal and judicial review or allow the program to be implemented notwithstanding any other provision of law" (Sierra Club Legal Defense Fund 1993). Agriculture Secretary Edward Madigan told reporters that "We think we could manage our national forests better if we were free from the interference of the federal courts" (Sierra Club Legal Defense Fund 1993). There was no longer even the pretense that the federal timber program could be made compatible with the environmental laws. The Administration's and the industry's goal was to amend or override the environmental laws, and later in 1991 such attempts were made in the case of the ESA, NFMA, and NEPA. However, on such a highly contentious issue, with no middle-ground visible to policy makers, the prospects of succeeding were very small. Moreover, the reaction to the administration's attempts to circumvent the

law and prevent judicial review was drawing sharp criticism. Twenty-four attorneys general sent a letter to the Congressional leadership opposing attempts to limit judicial review. This was followed by a letter from nearly 600 law school deans and professors to the same effect.

The pressure in Congress to act had become intense, and in May the Agriculture and the Merchant Marine and Fisheries Committees of the House of Representatives convened the Scientific Panel on Late-Successional Forest Ecosystems. The panel, known as the "Gang of Four" for the four principal scientists appointed to it, was the first group given the task of devising and evaluating management options based on the forest ecosystem rather than the owl by a policy making body.

C. Conclusion

This chapter reviewed conservation history in the Northwest in the context of a struggle between environmental and traditional forestry advocacy coalitions over forest management. Early issues such as the creation of Olympic National Park and protection of the Roosevelt elk represented a conflict over the designation of land and the conservation of particular resources. The fights over wilderness and the spotted owl were contemporary manifestations of that same struggle. The policy subsystem was set up to deal with these kinds of problems through designating land areas for particular purposes—setting aside a certain area for the National Park, drawing circles around owl nests in which timber would not be cut.

Lands not outside of the special designations would not be affected by these conservation efforts.

The spotted owl grew in complexity and controversy as an issue because the routine way of dealing with conservation problems that had been established in the forest policy subsystem was insufficient to solve this particular problem. The habitat requirements for the owl were such that the traditional forestry coalition deemed the cost in terms of lost timber cutting opportunities too high. And yet the law demanded that the spotted owl not be allowed to slide toward extinction. The Forest Service and the BLM made many attempts to find a conservation strategy for the spotted owl that did not result in significant reductions in the timber harvest region-wide. Having already set aside lands for wilderness and national parks, this was became an impossibility. To further complicate matters, the spotted owl crisis pointed to a more serious problem at the heart of the controversy: the traditional forestry management regime was endangering not only the owl, but potentially many other species besides. In fact, the spotted owl might only have been the tip of the iceberg. Part of the problem was the premise that conservation problems could be solved by setting aside some lands for special conservation purposes while maintaining an intensive timber harvesting program on the remaining lands. It is this premise that the Andrews Group among others challenged. The next chapter examines the development of the Andrews Group and its contribution to bringing an ecological understanding of forests into management.

Chapter Six

The Andrews Group

A. The Origin and Organization of the Andrews Group

1. Introduction

By the time the spotted owl had become an issue in the 1980's the group of researchers calling itself the Andrews Group had been working since the early 1970's to develop an ecological research program devoted mainly to old-growth ecosystem studies. The Andrews Group was formed as a part of the IBP and was the first and for many years only research group that performed studies of the old growth forest ecosystem. In this chapter shows how the Andrews Group developed the intellectual basis for reforming federal forest management in the Pacific Northwest from its studies of the old growth forest ecosystem, and that the group formed the nucleus of the ecosystem management network in the region.

The 15,000 acre H. J. Andrews Experimental Forest near Blue River, Oregon is a part of the Willamette National Forest, historically one of the National Forest System's most productive forests in terms of timber harvest. The H.J. Andrews Experimental Forest was established as a research forest in 1948. The Andrews Forest was established just when the Forest Service was beginning its post World War II transition to high timber production to provide for the newly booming

economy. The research program on the Andrews Forest began slowly, and for the first several years the main effort was geared towards laying out timber sales. The supervisor of the Willamette National Forest at the time insisted, as a condition of setting the Andrews aside for research, that 20 million board feet of timber be cut annually. The Pacific Northwest Research Station, which was now responsible for the management of the Andrews, estimated that the sustained annual yield was only 7 million board feet. Consequently, for the first decade of its existence most of the projects on the Andrews involved intensive logging (Silen 1992). These included much of the original research on staggered setting clear cutting as well as regeneration studies, salvage logging, and road building. The second decade of research focused on watershed research that included studies of soil stability and nutrient loss after clearcutting (Franklin and Waring 1986; Silen 1992). Thus, the first uses of the Andrews Forest were to cut timber and to develop and improve silvicultural techniques aimed at the rapid conversion of the region's old growth forests to younger stands.

The IBP program raised the level of activity at the Andrews Forest dramatically, and shifted the focus of research from improving silvicultural techniques to basic ecological research which included studies of old growth forest structure and function, geological studies, stream and fish studies, and succession studies. Moreover, since the IBP funding came through the university, the Forest Service relinquished some control over the research program on the forest. The group of scientists that formed around the IBP program at Oregon State University and the PNW Station in Corvallis, and that conducted the bulk of its research on the H. J. Andrews forest, has become known as the Andrews Group.

2. Oregon and Washington Components of the IBP

The Western Coniferous Forest Biome (WCFB) of the IBP was established in 1971, relatively late in comparison to the other biome programs, some of which were operational in 1967. The University of Washington was the lead institution on the grant application and Oregon State University was a junior partner. Researchers from the two universities could not agree on the research focus that their biome should take. The UW researchers favored conducting IBP funded research in much the same way that other research was conducted: grant moneys would be spread among professors and their graduate students, who would modify existing research interests to accommodate the funding requirements. Practically speaking, this meant maintaining a focus on younger stands with a long-term commitment to improving the efficiency of forestry practices. At OSU, a group of scientists, including Dr. Jerry Franklin favored studying old growth forests as well as younger forests, with the principal aim of producing basic ecological knowledge.

The conflict between the UW researchers and the Oregon group mirrored a conflict at OSU itself. A number of the original scientists involved in the Oregon portion of the IBP wanted to continue their work on younger managed stands and resisted the pull toward old growth studies. One reason that some researchers wanted to study mainly younger forests is that most old forests were deemed biologically uninteresting and were slated to be cut over the next several decades. However, the conflict was also over the interpretation of the objectives of the IBP.

As noted in Chapter Four, the US/IBP had a variety of stated goals, including the creation of basic understanding of ecosystem processes as well as "Exploiting the understanding of biological systems to increase biological productivity" and "Enhancing man's ability to manage natural resources" (National Research Council 1974:1-2). The goals of the IBP do not give obvious guidance on what seral stage ecosystem researchers should study, and a fair case could be made for both old growth and young stand research. The surface level of this conflict, whether to study old or young forests, contained within it the question of what the role of ecosystem studies (and ecology) would be in the future of resource management.

On the one hand, the IBP embraced the idea that ecosystems could be modeled and then controlled for the benefit of society. This cybernetic ideal extends the principles of scientific management adopted in the Progressive Era to the level of whole system management, and thus could be integrated into regime of traditional forest management without much objection. The first notions of ecosystem management developed at the time express the belief that ecosystem ecology would be the way to further rationalize natural resource management, for instance by integrating different resource uses into a holistic analysis (Spurr 1969) and forest management planning model (Bakuzis 1969). In fact, researchers at OSU who advocated studying young stands believed that their orientation correctly interpreted the mission of the IBP.

> I had been doing a lot of stuff that IBP focused on: the mechanisms of forest succession and the role of life histories of shrubs in shaping what became dominant... We had done work on the methods of

> controlling plant succession so we had an idea of how to get there from here once you decide what kind of a forest you want. So we had the technology for steering a forest .... We had the tools to do it and we had the ecological insight.

Here the cybernetic ideal of the IBP is made compatible with or even analogous to traditional forestry's goals of increasing the productivity of forests (tree growth) and "steering" the successional development of forests to favor the growth of species desirable for timber production to the exclusion of other species. Ecology is useful in this conception in that it can produce better technologies to meet the long standing goals of the forestry community.

Franklin and his colleagues brought a different interpretation to the objectives of the IBP. They interpreted the conservation goals of the IBP through the prism of the basic science objective of formulating "a basis for understanding the interactions of components of ... biological systems" (National Research Council 1974:1-2). Once better understood, ecosystems could be conserved using that knowledge. The production of resources would fall under the goal of conserving ecosystems rather than drive the conservation strategy.

Franklin and his group believed that an ecosystems research approach meant that they would have to study the old growth ecosystem because this was historically the dominant forest type in the region. They also believed that these forests had been undervalued by traditional forestry which favored the "conversion" of old natural forests to young managed ones.

> We wanted to know how the forest worked, I wanted to know how it worked.... It was incredible: no one had looked at these forests as ecosystems. So there was a hell of a lot to find out... And I knew intuitively that there was more to these forests than foresters were saying... that the only thing we could do was cut them up into boards.

The advocates for old growth research thus began with a fundamentally different premise from those who favored blending the IBP into the traditional forestry research program. Traditional forestry researchers thought that they could use the financial and conceptual resources generated by the IBP to further develop their long term objectives of managing the composition and growth of forests for maximum wood volume. This view seemed to fit well with the IBP objectives of enhancing man's ability to manage ecosystems and to increase their productivity, derived from the belief that ecosystems could be managed cybernetically. Those who wanted to study old growth assumed that their primary task should be to understand how the understudied forest ecosystem functioned; at this early stage, according to my respondents, they had only vague notions of how that knowledge would become useful in the long term.

> Anyway, that kind of stuff was going on in the IBP days. Those days it [management and policy concerns] wasn't real relevant. I remember some of our efforts to talk stories about the relevance of the stuff. You know, we could do it, it was vaguely relevant, but, you know, we're just light years out there in terms of policy and management implications today from where we were all through the '70s.

The OSU group resolved its internal differences and distinguished itself from the UW component of the WCFB after the first year of funding. Franklin and the

other advocates of old growth research, who were the project leaders at OSU, removed their adversaries from the program and began to replace them with postdoctoral fellows from a variety of disciplines who were hired specifically for the IBP work. They thus formed a team which could design an integrated and interdisciplinary research program. The team approach was especially viable at OSU because the researchers conducted most of their studies at a single site, the H. J. Andrews Experimental Forest on the Willamette National Forest. At the UW the IBP funding was distributed according to the more conventional model: individual professors received moneys for projects which they staffed with their graduate students.

As mentioned in Chapter Four, the question of whether a team or individual researcher approach to ecosystem studies was preferable had become a contentious issue among IBP researchers. In the WCFB the resolution of this debate had far reaching consequences for forest management in the long term. At the UW, when the IBP funding ended the research that it supported also ended. At OSU, the postdocs who came in under the IBP found permanent jobs either at OSU or PNW on the same campus. Their sense of "groupness", which I will discuss further below, led them to name themselves the Andrews Group, and they have continued to work together, expanding the research program designed during IBP, ever since.

In 1974, Jerry Franklin went to Washington, DC to work as a program officer at the National Science Foundation. The IBP had had its own line item in the NSF budget, and Franklin and others succeeded in continuing that line item under

ecosystem studies programming. In time, what had been the line item for the IBP became the base budget for the ecosystem studies program, which is now the biggest program in environmental biology at the NSF. This allowed what were judged to be the best of the IBP programs to continue to be funded over the next several decades. The research at the H. J. Andrews forest conducted by what became the Andrews Group was one of them.

The Andrews Group received funding from NSF over the next several years under the ecosystem studies program, but there was no single large institutional grant such as under the IBP around which to organize their work. Rather, the group patched its funding together from several short-term grants. This ad hoc funding structure sustained the group until the Long Term Ecological Research (LTER) program was established by the NSF in 1979. LTER was originally part of ecosystem studies but eventually was assigned its own program officer, the same person who had been the program officer for IBP. By this time the Andrews Group-NSF connection was solid, and the group had produced many publications and research findings. It's research agenda, focused as it was on the old-growth ecosystem, was still unique for the region and of national importance given a high rate of harvest of old growth forests by the federal land management agencies. Moreover, the Andrews Group's research program was already based on long term studies and fit the objectives of LTER. The first LTER funds arrived in 1980, and while members of the group still received other grants, many of them from NSF, the basic annual LTER grants provided the group with the core institutional support that has sustained it to the present.

B. The Andrews Group as a Cohesive Interdisciplinary Organization

The Andrews Group is an organization within two larger organizations, the U. S. Forest Service's Pacific Northwest Research Station and Oregon State University. The PNW station in Corvallis, Oregon is located on the OSU campus in the same buildings occupied by the College of Forestry. In most cases, PNW researchers are grouped together on floors or sections of floors, but in the case of the Andrews Group, the PNW and university researchers are located together with no physical demarcation between the offices of one or the other. The Andrews Group is constituted as a separate entity on the basis of its independent funding; its monetary distribution network (who gets the money); its symbiotic association with the H. J. Andrews forest; the organizational structure that manages its money, research agenda, grant writing, and site management; the personal loyalties and professional identities of its members; and because of shared values. Its composition is both defined and fluid, in that it interpenetrates two larger organizations that make demands, put constraints, and offer opportunities to it. Its in-between position has, in fact, been one of its greatest strengths as it has effectively overcome the weaknesses of each through the strengths of the other.

1. H. J. Andrews Experimental Forest

To the extent that the NSF funding is the object around which intellectual integration forms, the H. J. Andrews Experimental Forest (Andrews Forest) is the physical location, the place, that coagulates many of the social bonds and emotional commitments that hold the Andrews Group together and make it more

than simply an aggregate of individual professors and researchers who share a common funder.

> I became very aware that the Andrews Forest was a keystone piece of geography. And to be honest, I never really fully understood that as I'd go up there and there are a bunch of ratty trailers there that used to smell like skunks. I used to sleep there and when I was doing fieldwork and I'd see a lot of other people and it had a certain social environment that seemed pleasant to be a part of. You encountered people who were doing science and sciency types of things. You know, there was a big rainstorm in the night and you wake up and everyone will be drinking coffee and going, ah, you're going to have a hard time getting into blah blah blah. You know, it had that kind of communal aspect to it that I think actually is very, very critical in this kind of stuff. You start developing a certain kind of attachment to the place itself.

The mix of university and agency scientists who conducted the OSU component of the IBP institutionalized their relationship with the Andrews Forest and named themselves the Andrews Group. The next key institutional alliance that was made was with the Blue River Ranger District on which the Andrews Forest is located. The ranger of the district who was there when the IBP began is described by my respondents as having been hostile to their research mission on the forest and unwilling to engage in any cooperative ventures. When he left his position the Andrews Group was allowed by the Forest Supervisor to have some input into the selection of the next ranger, who was chosen in part on the basis of his desire to work with researchers. Successive rangers have also been chosen in part on the basis of that criterion, and the relationship between the district and the Andrews Group has become very close, involving large-scale joint research and

management experiments, publications, and an organization, the Cascade Center for Ecosystem Management.

The Cascade Center for Ecosystem Management is an organization officially sponsored by the PNW station, the Willamette National Forest, and the Department of Forest Science of Oregon State University. The Cascade Center's mission is to translate the knowledge gained through research on the Andrews Forest into management language and guidelines, and to disseminate that knowledge. At the time of my research in 1994, the Cascade Center employed a public affairs specialist who worked out of the Blue River Ranger District and whose job it was to disseminate information to the public and the media regarding the Center and its management recommendation. The Cascade Center serves as a publication outlet for Andrews researchers and district personnel who are involved in management experiments, the largest of which is the Augusta Creek watershed study that is focused on landscape-level analysis of the effects of particular forest management practices.

The Cascade Center represents an institutionalized linking of the Blue River Ranger District and the Andrews Group. It is also the expression of institutional support by the administration of the Willamette National Forest for the cooperative relationship between its ranger district and the researchers at the Andrews Forest.

2. Interdisciplinary Ecosystem Studies, Funding, and Group Culture

Andrews Group researchers have a variety of different disciplinary backgrounds, including ecology, forestry, geology, geomorphology, fish biology, and botany. Successfully integrating these disciplines into a coherent program of study has been essential to formation and continued existence of the group, and has defined the nature of the ecosystems studies that the group has developed. Interdisciplinarity depends largely on cooperation among group members, a shared purpose, and a sense of themselves as a distinct group.

The original IBP funding provided the resources to launch the Andrews Group and its research program and the continued funding has kept the research program integrated. Some of the scientists I interviewed said that an ongoing challenge that the group faced was keeping their work from becoming merely multidisciplinary rather than interdisciplinary. Multidisciplinarity, "where each person just puts in their part regardless of how it is related to the other parts", is countered by the need to present a unified narrative to the NSF for the LTER funding. LTER requires that interdisciplinary integration be a part of the group's work and the core institutional grant must be renewed every five years. The grant renewal processes are arduous as the researchers must take stock of what they have accomplished and design the direction of their future research. The grant proposal that goes to the NSF must describe a well-integrated research program.

> When we have to go in for money together there is a very real kind of integration that has to occur... Then I think it really does, then you're really trying to formulate concepts that are inclusive enough

> to provide an umbrella for the full set of ideas that are being worked out. For example, when we go in for LTER renewals that's exactly what happens around here. One or two or three people will take the lead but there'll be a lot of discussion within that or among those people to try to build a framework, and we've become much more conscious of trying to do integration, to consciously integrate.

While the NSF funded ecosystems studies provide the financial stimulus to form an integrated, interdisciplinary program, the experience of cooperating on research projects has maintained a culture of cooperation in the group. The capacity to integrate their work is generated through experiences of working together.

> After about four or five years I recognized the tremendous amount of interpersonal interaction that there was and it wasn't because it was required, it was because the people who were involved in the process really wanted to do it. So it became kind of the currency of the group that you would work toward the common goals, and you would pitch in and help everyone. And in research I just assumed that everyone pitched in. That is, if someone needed help on their project that people came in and worked on it, and it I needed help I'd call them in, and that's how things got done. You basically had a certain series of goals and objectives and everyone and all the resources to accomplish those. And you didn't worry about which grant was which and whose project was whose. So we found graduate students working with other graduate students, spending sometimes weeks helping them sample when not a piece of it was going to their research. So I think there was a collective nature that emerged from that. We were very lucky.

Moreover, the cooperative culture that made the team approach to research possible was self-reinforcing in that people who preferred not to work under these circumstances selected themselves out of the group.

> There was a spirit of cooperation that transcended the obvious fictionalization that you have. And a lot of people who were not team players left the group when it became clear that they were expected to work in a truly interdisciplinary fashion rather than multidisciplinary fashion... You had to be willing to work with other people because that was what this was all about.

> I don't have any animosity because we worked together for many years, we worked really well together. But there came a point, maybe because I was getting older, I don't know, but there came a point when I wanted to work more on my own again. So I continue to have an amicable relationship with the Andrews Group, no doubt, but now I've got my office down here and they're over there and we don't see each other very much anymore.

The cooperative nature of the group and the push to integrate their work and conduct ecosystem studies on, for lack of a better word, a "holistic" basis, runs counter to the disciplinary training that scientists usually receive. In order to cut across many disciplinary boundaries, ecosystem researchers must loosen some of the bonds to their original disciplines. Yet they must also maintain the disciplinary integrity of their work. Negotiating the complexity of doing interdisciplinary work while maintaining a disciplinary identity can produce a creative tension for individual researchers.

> What I became aware of was that there was a lot of stuff going on, and I found that if I hung out I started to learn about parts in ways that--I had never taken classes in this stuff but you start getting it through osmosis. And I liked that. It broadened my conception of things, although there was then and still remains for me a strong tension between focusing on what I do and the discipline that is, that is who I am, versus submerging some of that, loosening some of that identity in this larger process which is much more of an ecosystems, an ecological endeavor. I mean, I was trained in a physical science, I

> was bonded with rivers and I sort of had strong feelings about wanting to understand the physical dynamics of rivers. And here are all these people talking about biology. Now I'd left biology, I'd done it, I had done biochemistry and here I am back in it, and I had to make peace with that in some ways. I guess what I really saw, I saw models of guys who were also trained in a discipline who just weren't concerned about what discipline label they happened to have. And I thought, you know, I can get off on that, that makes sense to me, not to be tied, so tied rigidly to a discipline-based identity that I couldn't loose that in terms of something that seemed much more interesting, which was a conception of trying to understand how the whole system worked, biology, geology, animals, that whole thing. And that seemed to be what people were trying to do. They were naturalists. And that resonated with me, that resonated with my pre-science days of trying to figure out how everything is connected to everything else.

This "spirit" of cooperation, a cultural characteristic of the group, combined with the demands of its most important funder that it produced a coherent and integrated analytical framework have made it possible for the Andrews Group to develop a comprehensive research program geared mainly though not exclusively on the old-growth forest ecosystem of the Pacific Northwest. In due course, it allowed the group to speak with authority on all aspects of that system and, crucially, how those aspects fit together. The ability to combine, in a single presentation, certified knowledge of the system's disturbance regime, structures and functions, species composition and habitat requirements has been essential in giving the group a unique and at times dominant voice in the management and policy reforms that have occurred in the last decade.

3. Group Identity and Organizational Affiliation

Andrews Group members have had to forge a group identity not only against their disciplinary identities, but also their organizational ones. The Andrews Group does not have an official organizational status, rather it exists within the PNW station and OSU. Its funding and its linkage to the Andrews Forest are all mediated through these organizations which retain ultimate authority over the resources. Andrews Group scientists have developed an identity as group members to the exclusion of their organizational identities.

> No one really even mentions it that someone works for the Forest Service or OSU. It's totally irrelevant.
>
> There's sometimes some shit from OSU or some shit from the Forest Service and it's usually about money or where the mailboxes are or secretarial time or whatever. It's a turf battle because you sometimes get an administrator who's jealous because he doesn't have control over what we're doing here. But it's never had much of an effect. We can pretty much ignore it.

Andrews Group members can take advantage of their positions within these organizations to benefit the Andrews Group.

> And now, of course, what the group does is bring resources from a variety of institutions and institutional arrangements, and the interesting thing is loyalty of the members is primarily to the Andrews program and not to their home institutions. And that's very significant.

One of the ways that the Andrews Group disseminates information is through a very active tour program in which groups of scientists, managers, students,

journalists, and policy makers are brought to the Andrews Forest and shown the research sites from where the information is drawn. Giving tours is also one of the ways that scientists affirm or even discover their identities as members of the group. Finding themselves speaking for the group, they become more aware of their affiliation.

> Now, the field trips, and the fact that everyone around here would get asked to participate in field trips, I found myself speaking on behalf of the Andrews Forest to different groups, using Andrews based data as a way of making a point about something. All of that starts to give you an identity. In this case the identity is not just, I'm a member of OSU, or Forest Service scientist. I had very little identity as a Forest Service scientist, but I had a much greater identity as a member of this rather amorphous team.

The awareness of group identity is even more acute when the audience is hostile and one finds oneself defending the group.

> And there was [name deleted] who was there hollering that this was insane forestry, and he was holding up a sign and so forth. Well, that's when you realize that you're on one side and someone else is on the other. You take on a personality that puts you and your colleagues square against the point of view of the whole dominant paradigm.

Having enemies, which the Andrews Group certainly did develop, helped to create a sharper line between those inside and those outside of the group. It made group members more aware of their identification with the Andrews Group, and thereby helped forge stronger bonds between the members of the group.

Lewis Coser, an American sociologist who studied the social functions of conflict, pointed out that "conflict with another group leads to the mobilization of the energies of group members and hence to increased cohesion of the group" (Coser 1956:95). In the case of the Andrews Group, however, the centripetal effects of conflict with out-groups (perceived outsiders and opponents) create a tension with the group's professed commitment to openness. I was frequently told that the group was "porous" and that everyone was welcome to attend their meetings, including those who disagreed with them. While there is no reason to believe that such intentions are disingenuous, the requirements of making and maintaining a group capable of acting on a common purpose may inevitably be perceived by outsiders as exclusive. Antagonists to the Andrews Group who I told me sometimes in vehement terms that the they believed the group to be exclusive and hostile to the participation of those who disagreed with its basic philosophy, which antagonists usually described as some form of environmentalism.

4. Values and the Ethos of Science

Andrews scientists, like ecologists in general (Chapter Four) mediate their interest in and concern for the ecosystems that they study through the lens of science, which gives them a certain distance to the ecosystems they study while at the same time bringing them closer to those ecosystems. In other words, through learning more about ecosystems, ecosystem scientists learn respect for the complexity of those ecosystems. In some sense, they develop a special kind of intimacy. The regard for nature that Andrews researchers share helps maintain

their group bonds and sense of common motivation and purpose. The following statements are from separate interviews of Andrews scientists.

> I have never made any bones about the fact that my interest in those forests is basically motivated by my love of them.
>
> I'm motivated by a sense of place... I'm not motivated because it's managed by some agency who I have to work for, or that it's going to make me famous as a scientist, or anything like that. It's just an incredible place, and it has this profound effect. It's just a sacred place. When I get frustrated with all the bureaucratic crap I can think, or better yet, go out and remind myself why I'm doing this, which means go out to the forest, go along a stream. And I don't, I can't verbalize what it is, but it's just an important feeling there. And I think that one thing about this group, there's shared feelings about that but we don't talk about it. But I think working out of the same place and having some common experiences with the ecosystem that we each love in different ways is a form of bonding.... We can't get away from the forest or I think we're going to get away from the truth.
>
> I really love forests. I don't get to go out very much but I just love big old trees and big forests. I'm just fascinated by them. I really like to see forests that are natural, that don't have lots of stumps in them. That really pleases. Another value is that I really don't think we need to justify the existence of other species. I mean, that they have a right to exist, that we're not little gods running around on planet Earth determining, yes, this will live and this won't. In fact, even if they had no other function on Earth other than they were there, that's fine, that's all you need.
>
> It had a mystique about it, it just had an internal resonance that very few things I'd ever encountered had. And it almost invariably necessitated a kind of awareness of the landscape. I remember a couple of mornings on the river walking off by myself and just sort of going, What a place! I mean, I really love this place! And just really developing a very strong personal connection, experiential connection to this landscape. And that really was just a life transforming event.

The regard for nature that my respondents expressed is mediated through their identities as scientists, and Andrews scientists distinguish themselves from environmentalists in this way.

> Sometimes you want to say something that you know is right for the forest but you stop short because there isn't the scientific justification. And I guess that's one of the big changes that comes over you, science teaches you to demand a higher standard of proof and accountability than you would otherwise have. You don't need that when you're out there advocating.

> So that's really where the interest in the issue and then the follow through on the issue came from, was, it came from what I think was a strong environmental, what would be defined as an environmentalist personal experiential kind of mindset. But that got molded with a set of scientific tools. And what I found was, is that it's difficult to be faithful to both of those simultaneously. If you're really, particularly if you believe as I do, ahm, that while science is not the be all end all only way to experience the world, in fact I think in some ways it's kind of a limiting way to experience the world, it is the way that we have of reaching some agreement about how the world might be functioning. I mean it's one way that we have of reaching some agreement. And I discovered that I had to let go of some of those, some of the stridency that brought me into the field in the first place in order to be faithful to what I believed to be the sort of method, MO, of science. That you really had to try to keep an open mind, you had to work with multiple hypotheses rather than a single one, you had, to the extent you could, try to prove yourself wrong in things, not just try to find the data that supported your particular viewpoint. And that it required a constant kind of separatism, even about the things that you, if you put on a different hat, you might profess to believe. But when you're really doing science you have to be somewhat skeptical about how those things really played out. And use that skepticism to motivate better and better science.

Environmental values coexist with the ethos of science but are mediated through science such that science redefines the expression of those values. Researchers can continue to value nature for its own sake but discard preconceived notions about the effects of human activities on nature when they do not withstand scientific scrutiny.

> So I found that it sort of shook some of the assumptions that I had been operating with, and then I got into it more, I just have to look harder. It turned out to be difficult to support my assumptions and it's taken me many years to begin to really understand why that's true. But at the time I found myself in a sense stepping back from what I thought this whole thing was going to demonstrate, which was unequivocal damage to streams from timber harvest ... I look at this differently now, and I'm not so inclined to denounce the industry when it may not be doing as badly as I once thought.

Yet the science can also support the non-scientific valuation of nature by giving name to and thereby legitimating characteristics of nature not widely valued.

> Some of the concepts in what old growth is and giving it an identity from a scientific point of view and helping to define it's values in the biodiversity and ecosystem complexity point of view in science terms; it can be translated into aesthetic terms quite readily.

The mediation of environmental values through science has helped give the Andrews Scientists a unique sense of mission. This is especially true because Andrews scientists were the only scientists who had studied old growth as an ecosystem until very recently.

> Now when it comes to policy issues, my attitude is, OK, society can do what it chooses to do, but by God, it's going to get to base it on a

> sound set of facts. We're not going to have a bunch of bull, at least I'm not going to allow nonsense to go unanswered.
>
> [There is] a sense of mission, a shared sense of mission. We had a session one time where we did a retreat for three days with a facilitator to talk about integration and where we are going, and the facilitator brought several users in. Industry, environmentalist, housewife, teacher. And anyway, after the process was over we did a retrospective with him and he said, you know, you folks have to speak for the ecosystem, and nobody knows it better than you. So it's your responsibility as a research group to lay these things out there and to speak for the ecosystem... And boy, it just, it's still as powerful for me just to recount that today. But that's a tremendous sense of shared mission, and a sense of wanting the program to succeed beyond personal success. And with that comes a degree of unselfishness, a degree of openness that's unusual. You don't see that very often.

The culture of the Andrews Group fostered cooperation and integration of research in the context of what became a shared mission to study the old growth forest ecosystem and speak with scientific authority on its behalf. Andrews Group researchers carved out a group identity against competing identities thereby reinforcing their culture and their mission. As I will now discuss, the group also organized itself in a way to maximize its resources, thereby enhancing its capacity to develop the networks and authority that success in its mission would seem to require.

5. Division of Labor

The Andrews Group developed a division of labor that has allowed the group to more efficiently garner resources and build its scientific program. Before Dr. Jerry Franklin moved to the University of Washington in 1986, he was the project leader for the group. In this position he was very active in securing funding, establishing relationships with managers and Forest Service administrators, with the media, interest groups, and other scientists. More than any other member of the group, Franklin became associated with old-growth ecology in the public mind. Latour and Woolgar (1979) liken the credibility of an elite scientist who leads a scientific group to economic capital that can be invested and redeployed to amass more credibility and resources. While Franklin performed a year of service at the National Science Foundation as a program director in 1974 he helped establish the institutional support for the LTER program, which eventually significantly benefited the Andrews Group. Facilitating the work of the group is how Franklin himself has conceived of this task.

> Well, first of all, I think looking over the last twenty years what I do a lot is try to create context for things, trying to create an environment in which certain kinds of things can happen that I think are important. I've always thought long term research projects were important and I wanted to see the Andrews supported over a long term. So I ended up going to Washington and creating an umbrella in which those kinds of things can happen, in which the Andrews can prosper and long term research can be supported. I've often found myself elevating to higher levels of policy or influence in order to create the environment in which things I believe are important can happen. And so that's kind of been the vacuum that's sucked me sort

> of further from the field and into higher levels of both science and policy.

A group of scientists around Franklin composed the administrative level of the Andrews Group. Many of the scientists in this core set were the original postdoctoral researchers who joined during the IBP period. Over time, they received permanent positions either with OSU or the PNW station. These scientists also dealt with the media, worked with managers, gave tours of the Andrews forest, spoke to interested groups, sent out press releases, and so forth. Where Franklin provided leadership, the core set of researchers provided institutional stability. This group also shared among itself the responsibility for the day-to-day management of the Andrews Forest and research program.

When Franklin moved to the UW, Fred Swanson, a PNW scientist and one of the post docs hired during the IBP period, took over as project leader. The Andrews Group has now developed a consensus based decision making style that includes monthly meetings of the entire group (open to anyone else who is interested) and frequent less formal meetings to discuss research and upcoming decisions. Final decisions are made usually after extensive discussion.

Finally, there has always been a group of "bench scientists" who prefer not to deal directly with the media, policy makers, or funders. The knowledge that this group produces is translated into other forums by the leadership of the Andrews Group.

> My role really has been less on the management and more on the science, trying to get the science straight. And I see implications of what I'm doing and talk to managers occasionally, go on field trips, answer questions, but my role really is to provide the information. There are people in our group who deal with policymakers, and they do it a lot better than I do.

The informal division of labor in the group has helped the group take advantage of the individual strengths of its members. As I will discuss in the final section of this chapter, the Andrews Group had developed a network through which it translated its ideas about forest management reform prior to the direct involvement of some of its members in policy processes. The group also developed an extensive and respected publication history on which its legitimacy as "spokesperson" for the old growth ecosystem rested. It is to the Andrews Group's science to which I now briefly turn.

C. The Andrews Science

As discussed in Chapter Four, traditional forestry viewed old growth forests as "decadent" and "overmature" because old trees add so little to net annual growth, making them more financially valuable as lumber than as growing timber. To the traditional forestry "eye" the differences between the natural forest and the managed forest in the Northwest were in terms of vigor versus decadence, youth and health versus overmaturity. It is the ability of the ecological perspective to transcend such dichotomies that has been one of its most important policy attributes. The ecosystems view implied management that could simultaneously

produce timber while protecting ecological values, a middle-of-the-road solution particularly attractive to policy makers.

The IBP period established the research focus that the Andrews Group would follow, and though its findings were thought to be preliminary, they did make up a conceptual core that has not been superseded. From the point of view of researchers, while taking time to mature, the IBP studies set the basis for eventual reforms in management many years later.

The IBP was designed for system level studies which would model nutrient cycles and develop predictive capabilities. The Andrews Group worked to develop nutrient and carbon budgets, but also opened up topical areas for research that no one had pursued previously. For example, they studied below ground processes, specifically reproduction and soil turnover, finding that the below ground part of the forest is more dynamic than the above ground area. In one of the most widely known and important areas of study, the group discovered that large down woody debris on the forest floor is important in the nutrient cycles and as habitat in forests and streams. They worked in the tree canopies for the first time and discovered that lichens living there played a significant part in the nitrogen budget. Many of these findings were preliminary, their implications not yet clear by the time the IBP ended in 1974.

The Andrews Group summarized many of its early findings relating to old-growth forests in *Ecological Characteristics of Old-Growth Douglas-Fir Forests* (Franklin et al. 1981), an article that was widely read and considered to be a

landmark in changing the perception of these forests.[17] Astonishingly, when one considers the long tenure of federal ownership of forestland in the Northwest and the scientific capacity of the agencies and the regional universities, this was the first comprehensive scientific description of the old-growth ecosystem. It describes the old growth ecosystem in terms of its compositional, functional, and structural characteristics.[18] They found that

> most of the unique, or at least distinctive, compositional and functional features of old-growth forests can be related to ... structural features; that is... structural components make possible much of the uniqueness of the old-growth forest in terms of flora and fauna (composition) and the way in which energy and nutrients are cycled (function)" (Franklin et al. 1981:20).

This means that if the structure of the old growth forest is maintained after a harvest then functional and compositional characteristics can also be maintained. This quality of the forest implied some level of management flexibility that could serve as the basis for a middle ground in the conflict over how to manage the forests.

The structural components identified by the Andrews Group include 1. live old trees, 2. large standing dead trees, 3. large dead logs on the forest floor, and 4.

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[17]Although the paper was published years after IBP had ended and reflected work done in the transition period between IBP and LTER, the basic findings that supported the paper dated from IBP.

[18]"Composition refers primarily to the array of plant and animal species present in an ecosystem... Function refers to how various ecological processes, such as production of organic matter and cycling of nutrients... are accomplished and rates at which they occur... Structure refers to the spatial arrangement of various components of the ecosystem, such as heights of various canopy levels and spacing of trees" (Franklin et al., 1981:2).

large down logs in streams. The large dead material in the forest and in streams was collectively referred to as "down woody debris." The large standing trees provide habitat for specialized vertebrates, including the northern spotted owl. Standing dead trees, or snags, also provide wildlife habitat and are future down woody debris. Down logs also provide habitat, and they play a key role in bacterial nitrogen fixation "and are essential seedbeds for some trees and shrubs" (Swanson et al. 1991: ii). Large woody debris in streams is "critical to the maintenance of physical and biological stability in headwater streams" (Swanson et al. 1991: ii). They provide essential habitat for fish and other organisms, provide energy to the stream, and provide "the bulk of the nitrogen supply" (Swanson et al. 1991: ii) for streams. In short, structure is the key to managing old growth forests--or more precisely, for managing forests for old growth characteristics.

The LTER research program on the Andrews Forest began in 1980 and built upon the research conducted under IBP and the ecosystem program that immediately followed it. Each LTER grant lasts five years[19], and the Andrews Group has completed three full LTER cycles. LTER IV began in October of 1996.[20] The research program under the LTER is organized around the concept of disturbance. The natural disturbance regimes reveal the processes of change in the ecosystem, knowledge of which has allowed researchers to acquire greater predictive control over how forests will respond to human caused disturbances.

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[19]The LTER grant is a large block grant; NSF provides smaller yearly grants for specific study proposals.

[20]The amount of funding has steadily risen over time. LTER I began with under two million dollars, LTER IV was funded at $ 3.36 million.

During the LTER I and II the Andrews Group articulated the concept of the "biological legacy" as a result of studies done on the devastated landscape around Mt. Saint Helens after the eruption.[21] Legacies are the organisms and organic matter that survive major disturbances and then help recreate the ecosystem. The greater the biological legacy left after a disturbance, the more quickly the ecosystem can return to a healthy condition. The implications for management are apparent--even intensively managed stands can be helped to maintain complexity by providing for rich biological legacies after harvest.

Another key concept to emerge during this period was "bootstrapping", the mechanism by which "ecosystems create the conditions that allow the systems to persist" (Perry et al. 1989:230). The bootstrapping mechanisms studied by the Andrews Group are the self-reinforcing links in the plant-soil system that maintain the productivity of the system. The symbiotic relationships that fungi in the soil form with tree roots, called mycorrhizae, play an important role in plant nutrition and defense against pathogens. The Andrews Group found that they also fix nitrogen, produce hormones and antibiotics, and help maintain soil structure, among several other functions (Perry et al. 1989:231). Moreover, the fungi die when the plants are destroyed, such as during harvest, and reinnoculation of the soil may be necessary to maintain productivity. Also, fungi eating mammals

[21]The concept of a biological legacy predated the Mt. St. Helens studies. The IBP research showed the importance of an ecosystem's history on the present and future, and the general idea of a legacy may have been in use among the group since the early 1970s, though not the term itself.

which disperse fungal spores can be retained on site by leaving large woody debris on the ground after harvest (Franklin 1989:41).

Plant community succession studies showed that edge effects occur deeper in the forest than expected. This would have a significant effect on the Andrews Group's view of cutting patterns and buffer zones. Plant succession studies also revealed that managed young forests contain only 40% of the carbon as old growth, indicating that Pacific Northwest forests alone may have accounted for 3-6% of the carbon released into the atmosphere during the past century (Swanson et al. 1991:5). LTER 3 further intensified the focus on the regional contribution to the global CO2 regime.

Young-stand productivity and snowbrush studies were aggregated in LTER III under the long-term site productivity study area. Doing so provided a broader picture of the factors affecting long-term productivity. Soil properties, especially nitrogen content, were shown to have the greatest direct control over net primary production in young stands. However, long-term site productivity depends on the resilience of ecosystems, the "ability to absorb stress or change without significant loss of function" (Franklin et al. 1989:82). One way that ecosystems maintain resilience that has already been mentioned is through the retention of "legacies" after disturbance. Legacies from pre-disturbance conditions include structural (e.g. fallen logs), biological (e.g. plant propagules, mycorrihizal fungi), or chemical (e.g. nitrogen concentrations) (Swanson et al. 1991:12). "Bootstrapping", positive feedback mechanisms between plants and aspects of soil biology and chemistry, such as mycorrihizal fungi and soil nutrients, formed

another core subject of research under this topical area. When forest managers remove all plants and forest structure they may disrupt the sub and supra soil patterns of relationship that produce a self-generating forest, thus damaging long or even short term site productivity. The concepts were further refined under LTER III.

The forest-stream interaction studies were "set within a hierarchical framework extending the single particle (e.g. boulder or piece of woody debris) to the full river network: (Swanson et al. 1991:16). The principal focus of these studies was on the effects of geomorphology and streamside vegetation on aquatic ecosystems. These studies have had implications on the management of coarse woody debris in streams and the size of buffers between streams and management activities.

D. New Forestry and Creating a Network with Managers

1. New Forestry and the Mimicry of Nature

By the late 1970s, some Andrews researchers were thinking about how to translate what they were learning into useful management techniques. They believed that their ecological research perspective provided them with potentially unique insights for management.

> And all of the ecosystem research very clearly instructed us in looking at alternative ways of managing forests. Basically, no one had looked at forests and streams as ecosystems. And when you did

> it became very obvious to you that there's some important lessons here, there are some things that we haven't taken into account.
>
> Now, the other theme you alluded to before really has been this interaction between the science and the management. And now really the science and the management and the policy. The science and the management issue has been just a dominant issue because we, many people who started as basic science researchers have been very eager and willing to get in and sort of grapple it out with the managers about how you would use this information to improve your management. So we have things like the Riparian Management Guide written by Stan Gregory and Linda Ashkenas which flows directly out, in fact directly out of a lot of the work in the riparian [NSF] grant.

What to include in and how to package recommendations for managers was discussed in group meetings. The basic principle of maintaining forest structure in order preserve ecological functions and species composition was a guide to many of the management techniques and guidelines that the Andrews Group devised. Thus, leaving live green trees, down woody debris and snags, and woody debris in streams after cutting came to play an important role in the management guidelines that the Andrews Group proposed. The term that captured the media's attention in the late 1980s for the management reforms advocated by the Andrews Group for the Northwest forests was New Forestry.

Andrews Group scientists sought to use New Forestry to help forest managers move away from intensive timber management and preserve ecological values in doing so. At this time the spotted owl had already become a major public policy issue, but the issue of old growth had not yet been directly addressed in a policy forum. Maintaining the old growth forest ecosystem meant having to manage at

the level of the ecosystem, that is, across the landscape. This meant that management had to be fundamentally reformed in order to integrate all management activities into the larger purpose of sustaining the ecosystem. Jerry Franklin thus called New Forestry "a kinder and gentler forestry that better accommodates ecological values while allowing for the extraction of commodities" (Franklin 1989:38). This meant shifting the highest priority of management from meeting production schedules to preserving biological diversity (in the broadest sense) in all management activities.

> We could never hope to adequately protect biological diversity solely through preservation [land set-asides], since so much diversity occurs on commodity landscapes... Protection of diversity must be incorporated into everything we do every day on *every* acre" (Franklin 1989:44) (emphasis in the original).

In addition to the recommendations pertaining to maintaining forest structure at the cutting unit level—leaving live trees, down woody debris, snags, woody debris in streams, in short, significant biological legacies—New Forestry advocated landscape-level planning that could take cumulative effects of management practices on the landscape into account over long periods of time. Long cutting rotations were advocated along with aggregated cutting patterns rather than the method of small dispersed clearcuts practiced by the Forest Service (Swanson and Franklin 1992). The dispersed cutting method produces a patchwork forest with a large amount of "edge" area, the border between forest and clearcut, which has significant negative ecological effects on the forested area, even far from the edge area itself.

New Forestry asserted that conservation of ecological values and commodity use of the forest should be integrated across the landscape in order to sustain the ecosystem. The New Forestry approach differed from the way that the federal agencies, especially the Forest Service, had tried to negotiate the environmental and resource production contradiction in their mission. The normal agency approach was to divide the landscape into preservation and production lands—wilderness and intensively managed stands. As one retired high ranking administrator of the Forest Service told me, the agency tried to keep its timber harvest levels up in the face of land set asides for wilderness and sensitive species by very intensive management of the remaining timber lands.

> We set these large areas aside and tried to make up for that and maintain harvest levels by more intensive management practices. And so .... our plans began to incorporate much more intensive stocking control, genetics improvement, fertilization. And the result of that was that the practices you began to see on the ground were moving more and more towards an intensive tree farm environment.

The Forest Service's attempts to appease environmentalists and the public, and meet the minimum conservation requirements required by law by setting aside some lands for wilderness and wildlife while more intensively managing others sometimes exacerbated criticism of the agency. This occurred because the intensively managed lands suffered especially serious environmental consequences over which environmentalists could sue to press the Forest Service for even more land protection and less timber harvest. New Forestry was conceived as an alternative to the strict divisions between preservation and production, both between the environmental community and the land management

agencies, and within the agencies and their management approaches. New Forestry meant to combine conservation and utility "on every acre" (Franklin 1989) because only in this way would the mandates to maintain or produce ecological as well as economic values be met.

The basic practices of New Forestry—leaving down woody and standing live and dead trees, leaving or adding woody debris in streams, moving management slowly across the landscape, aggregating timber cutting—represent a transformation of the ecological or ecosystem management approach to resource management within ecosystems ecology. As I have said, the cybernetic ideal expressed during the IBP period by ecosystems ecologists involved the notion that ecosystems could be precisely modeled, and on that basis controlled by ecological technicians. The Andrews Group had given up that project as impossible and replaced it with a basic, descriptive ecosystems science program, and in the course of over twenty years the group had learned a great deal about how the old growth forest ecosystem functioned. The insight that ecosystem function and composition depend to a large extent on forest structure made it possible to develop management prescriptions that mimic the natural forest and the natural disturbance processes of the forest. Mimicking nature rather than controlling it became the guiding principle expressed in New Forestry.

During the course of my time in the field I interviewed several antagonists of the Andrews Group and of New Forestry, soon to be renamed ecosystem management

by the group[22], who expressed both deep disdain and hostility towards the group. The disdain was expressed in terms of their belief that New Forestry in fact provided nothing new to forestry. Selective cutting, for instance, has been a traditional management tool, and other prescriptions such as leaving down wood could easily be absorbed into the existing management regime. These critics also expressed hostility because they perceived the Andrews Group as a threat to their authority. Whether or not the group had offered anything new, it was gaining a voice in management and policy that once had been the exclusive domain of traditional foresters. Yet, at the heart of the dispute is a deep division over a basic axiom of the profession. Traditional foresters with whom I spoke uniformly said that the purpose of forestry is to produce the kind of forest that the landowner desires. "Tell me what kind of forest you want and I will produce it for you," was a typical reply to my question about what the forester's job is. In other words, the role of the forester is to control, improve, even recreate nature in a form most desirable to a landowner. New Forestry and subsequently ecosystem management split sharply from this view. New Forestry was intended as a set of guidelines that would help managers mimic nature, especially natural disturbances, in order to "maintain complex ecosystems" for the benefit of both species and human needs for forest products (Franklin 1989). Moreover, far from assuming that they knew enough to make consistently excellent decisions, Andrews Group members expressed skepticism about the adequacy of knowledge, and humility in the face of the complexity of the forest ecosystem.

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[22]Ecosystem management has come to mean more than New Forestry. This will become clear in the next chapter.

> If nothing else, the most important result of ecological research on forest landscapes and ecosystems has been an appreciation of their complexity and the limitations of our knowledge. Surprises and basic new insights into forest composition, structure, and function have been the hallmark of recent decades. And there is no reason to believe that the number and importance of new discoveries is likely to change. From this we are reminded of the very tentative state of our current knowledge and the iterative nature of learning. We begin, finally, to appreciate that each management prescription is a working hypothesis whose outcome is not entirely predictable. And, hopefully, we adopt humility as a basic attitude in all approaches to forests—whether as scientists, advocates, managers, or policy makers. (Kohm and Franklin 1997:5).

Several traditional foresters told me that they interpreted this stance as an environmentalist one, and they viewed the Andrews Group as an outpost of the environmental movement. This assessment is too simplistic. Rather, the Andrews Group developed the first large-scale basic ecological science program to examine the old growth forest ecosystem in the Northwest. The knowledge that they gained through their research led them to conclude that the traditional forest management regime of the federal agencies fundamentally undermined the basic ecological functions and structures of this ecosystem, and that if the ecosystem were to be maintained the management regime would have to change. This movement from pure to applied science is well within the normal bounds of what the forest sciences are expected by management agencies and forestry colleges to do. What is different is that the ecological perspective conflicts fundamentally with the utilitarian perspective of traditional forest sciences. In the past, "basic" research in the forestry context usually had as its aim an efficiency improvement in growing and/harvesting trees. Even ecological research could be

used toward this end, in so far as knowledge of ecosystems can be used to manipulate them. What the Andrews Group proposed was that ecological knowledge be used to understand what the natural condition of the ecosystem is in order to maintain an approximation of that natural condition. Forest management practices could be designed to mimic natural process, and thereby serve both utilitarian and ecological ends. This position is fundamentally a compromise between a preservationist position that would simply put the forest off limits to management, and the position of traditional forestry that would manage the forest as a tree farm.

2. Creating a Network with Managers and Positioning the Group

The district rangers for the Blue River Ranger District, on which the H.J. Andrews Experimental Forest lies, were the first link it the group's management network. The first ranger to work closely with the group in the 1980's, Steve Eubanks, played two important roles in translating the Andrews Group's ideas into a management network. First, he worked with the scientists to test their ideas on experimental plots on the Andrews forest or elsewhere on the BRD. Second, the ranger became an ally and a spokesperson for the group and advocate of its ideas to other managers, including the forest supervisor of the Willamette forest.

> When Steve came to the Blue River Ranger District... he was really interested in this log study we were setting up, he was very interested in the review that we had done, and all the information, and he saw this as an opportunity to apply some early time ecosystem management. Well, let's take an ecological objective, and then manage the forest that way. So we had lots of field trips and

> workshops. And eventually Steve was really responsible for stopping what they called the yum and pum yarding in the Willamette Forest. His pushing that idea and bringing the scientists to the managers convinced the managers that this was probably a monumental waste of time and money, and it was probably hurting the ecosystem.

The district ranger helped the Andrews group adapt its ideas so that they were more acceptable to other managers, in other words, he helped the translation process so that other managers could see that the group's ideas would help them in their own work. He formed the bridge between the scientists, who could not be sure that what they were developing would be attractive to managers, and the managers, who might be suspicious of what the scientists had to offer.

> Well, one very important aspect of the development and application of New Forestry was to have a few sympathetic managers involved. We had Steve, the ranger down at the Blue River District. In effect, first of all we had a group of people that was interacting, and that was very important in terms of stimulating ideas, stimulating issues, having a body of people to bounce your ideas off of, and people to tell you, well I think that idea's really full of shit. But, it was particularly useful to have some people involved in management interacting with the group because they brought a reality to it, you know, we couldn't do that, or we could do that. I remember specifically, you know, in January of '86 we met with Steve he was really interested in that minimizing fragmentation issue. We hunkered down with each other for a couple hours talking about implications, how you might modify the activities and how you might modify the message so it's more acceptable. And he began to implement it right away, so he provided a real world sounding board which was very important in making sure that we were in touch with reality and that the practicalities of these ideas were dealt with. Because it's very easy, it would be very easy in isolation to go down a road that turns out not to be very practical at all. So, you know, that was very important, and having a development group like that

> turned out to be all that was really necessary to launch New Forestry in terms of alternative harvest cutting and alternative patterns. And then what happened is once it began to surface and began to develop a profile and began to develop a credibility people began to pick up on it very quickly.

Many of the New Forestry prescriptions and ideas were incorporated into the forest plan of the Willamette Forest, often due to the advocacy of the district ranger. Managers and scientists explained that managers have traditionally been suspicious of scientists, especially when scientists recommend changes to standard operating procedures. With a manager acting as an advocate of the scientists, their ideas received a more favorable hearing than they otherwise would have. One of the more important changes that the science-management network made in the forest plan concerned riparian management. The riparian management guide that Andrews scientists prepared was incorporated into the Willamette National Forest Plan. At the time it represented a great advance in riparian area protection.

> And then a third area that's been really critical is the stream and riparian management, and Eubanks worked with us on that to write a riparian stream and riparian management guidelines. So basically then the Willamette Forest Plan was based on those guidelines which were the most progressive, I think of any national forest.

The experience of testing their management techniques out on the land and working with managers to improve those ideas allowed the Andrews scientists to begin to see their approach, basing management reform on knowledge of the ecosystem, as having the potential to at least partially solve the problems that had

begun to overwhelm managers in the 1980's. Andrews scientists interacted with environmentalists, timber industry representatives, and policy makers during tours of the H.J. Andrews Forest. These tours were given regularly on the forest as a way of demonstrating the group's research program and management techniques. As the following respondent describes, neither environmentalists nor industry representatives believed their interests were met with New Forestry.

> You've got the deep greens who are opposed to any additional timber cutting .... And then on the other hand, you know, you have the timber people .... and they don't like it either. It doesn't look like a clearcut, doesn't look like intensive plantation forestry .... And the politicians say, I wonder if I'm seeing multiple use management for the first time.

Andrews scientists were not naive in their positioning of themselves politically. In fact, they chose to attempt to occupy a center position between the two major environmental and traditional forestry advocacy coalitions.

> It offered a middle ground, it offered some .... potential solutions, that you could have some of both things by using these kinds of approaches .... It does offer some alternative to black and white. In fact, that's one of the reasons we designed it that way. At least the alternative harvest methods allows for removal of material for economic purposes and maintaining at least some levels of habitat and other environmental values that we want ... So, conceptually, you know, it provides a lot of middle ground.

Attempting to define a center position for science and themselves between the advocacy coalitions represents an overtly political move on the part of the Andrews scientists, and the basis of their translation strategy with policy makers.

If policy makers could be convinced that New Forestry practices represented the political center, and that New Forestry practices could be used to provide both legally mandated environmental values and economically desirable forest products, then the Andrews Group would become an essential "detour" on the way to resolving the forest management crisis in the region. The Andrews Group's program, represented by New Forestry, could be attached to the broader effort of solving the vexing problem in the Northwest that was starting to become politically costly to policy makers. The process of making this translation is the subject of the next chapter.

E. Conclusion

The Andrews Group organized itself under the International Biological Program of the National Science Foundation in the early 1970's. Unlike its partner, the University of Washington, the Oregon State University component chose to study old growth forests rather than younger forests, and it chose to do so as a team rather than as individual researchers. Putting together the team of postdoctoral fellows with a few team leaders was the first step in creating the Andrews Group as such. Since that time, the group has continued to be bound together through National Science Foundation funding. Moreover, through a complex and integrated process the group has established a set social dynamics that reinforce each other to produce group solidarity and productivity.

The division of labor among group members allows scientists to play different roles according to their talents not only within the group but outside of the group. While Jerry Franklin was the team leader, he garnered resources for the group through winning large grants and creating long-term funding opportunities at the National Science Foundation. He also made connections with policy makers, the media, and other actors. Other scientists assumed administrator/manager positions within the Andrews organization, while others still confined themselves to bench science. The efficiencies of this system of labor division should be understood as enhancing the group's capacity to act as agents in the social world—not only in terms of garnering resources related directly to conducting studies, but also in terms of translating its ideas with non-scientific actors such as managers and policy makers. Because there were always many scientists who

focused most of their energies on conducting studies, there was never any danger that the scientific program would suffer because time was spent enrolling other actors. Rather, in a reverse process, those enrollments (of funders and managers especially) further enhanced the capacity of the group to do scientific work. It is an example of how success breeds more success by providing greater resources to succeed.

The culture of the Andrews group further enhanced the group's capacity as a social agent. Andrews scientists learned to identify their professional selves with the group rather than with their actual employers, or even with their original scientific disciplines. Working together on the H.J. Andrews Experimental Forest created social ties that heightened this sense of identification. It also provided the context for scientists of different disciplines to learn from each other. This learning then helped the scientists develop the interdisciplinary concepts and research agenda that advanced them in the ranks of ecosystem science, and won them continued funding from the National Science Foundation and elsewhere. Sharing common values regarding the importance of maintaining the old growth forest ecosystem gave Andrews scientists a shared purpose, which was motivationally helpful and further created a sense of identification with the group and the group's purposes. Having opponents who both identified the group as a distinct group, and criticized its research agenda made Andrews group members even more aware of their common bonds. This intense identification with and loyalty to the group, what has been termed solidarity here, also enhanced the group's capacity for agency because it made cooperative and coordinated action among group members possible.

The network that the Andrews Group made with managers was the first important step the group took toward becoming a policy actor. Managers helped the scientists "ground truth" their management techniques. As allies, managers also could enroll other managers into a network of managers working with the Andrews Group or adopting its techniques. The most important enrollment was the Blue River District Ranger. The BRD Ranger acted as a liaison to other managers. As a "liaison ally", the ranger formed the essential link to actors who could not have been enrolled directly by the Andrews Group scientists. He linked the community of managers to the community of Andrews scientists, thereby facilitating not only many more enrollments for the Andrews Group but many more opportunities to test and improve their techniques, enhance their reputation, and develop a public identity. These attributes in turn further increased the Group's capacity as an agent—its capacity to enroll other actors in its projects.

Chapter Seven

The Gang of Four

A. Introduction

In May, 1991 the House Agriculture and Merchant Marine and Fisheries Committees commissioned a panel of scientists to examine alternative management strategies for the federal forests in the Pacific Northwest. Named the Scientific Panel on Late-Successional Forest Ecosystems the panel was colloquially referred to as the "Gang of Four" because there were four principal researchers involved. The Committee on Interior and Insular Affairs subsequently joined the other committees in sponsoring the panel. The committees charged the panel to identify old growth forest areas in the Northwest; develop alternatives for managing "ecologically-significant old growth and late successional ecosystems, species, and processes, including, but not confined to, spotted owls" (Johnson et al. 1991:44); prepare maps for each national forest and BLM district to show each alternative "as a graded series from most to least important for achieving protection and management objectives" (Subcommittee on Forests, Family Farms, and Energy 1991:3); and develop guidelines for managing unreserved lands associated with the alternatives, and to quantify the effects of each on timber harvest. They were also told specifically to take account of fish species as they

developed management alternatives.[23] This was the first time that a policy analysis process had been established to analyze the issue from an ecological point of view rather than exclusively for the spotted owl.

The panel included Jerry Franklin, who had by then left Corvallis and was teaching at the University of Washington; Jack Ward Thomas, U.S. Forest Service biologist and author of the ISC Report; John Gordon, Dean of the Yale School of Forestry; and K. Norman Johnson of Oregon State University and the author of the Forest Service's forest planning program, FORPLAN. The panel is sometimes referred to as the "Gang of Four Plus Two" because two fisheries scientists, Jim Sedell and Gordon Reeves, were added to the team to provide expertise on anadromous fish and streams. Both fisheries scientists were members of the Andrews Group.

The Gang of Four delivered its report to Congress in October of 1991. The report contained 14 alternatives with 3 options under each alternative except alternatives 1-3. The panel assumed that any alternative chosen from the ones that they prepared would be an interim solution for up to three years only; the panel also declined to recommend a alternative to the members of Congress. Instead, the panel quantified the effects of each option on timber harvest and employment, and prepared risk assessments for each alternative and option for owls, marbled murrelets, anadromous fish stocks, ecosystem integrity, and other vertebrates

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[23]The directive to anticipate the consequences for fish was given verbally by Chairman Harold Volkmer of the Subcommittee on Forests, Family Farms, and Energy of the Committee on Agriculture.

associated with the old growth forests. Members could see for themselves for the first time what the what the policy tradeoffs were. As will be discussed below, the panel showed that there could not be a "free lunch" alternative that would accommodate both a high timber harvest and high levels of protection the old-growth ecosystem and associated species.

The Gang of Four established the formal link between Andrews Group scientists and the Congress, and became a part of a translation network that translated the ecosystem knowledge of the Andrews Group into policy. It represents the extension of the network established with managers into the policy making arena. The key individual in making that linkage was Jim Lyons, a staff member on the Agriculture Committee. Lyons had been policy director for the Society of American Foresters and during his time there had organized an SAF report on the management of old growth forests in the Northwest. Scientists involved the report included Jerry Franklin, Jack Thomas, and John Gordon, and Lyons sought to bring them to the Congress to conduct an analysis process similar to the one they had done for the SAF, but now in the context of an urgent policy problem and for clients who would be eager to for their analysis.

This chapter argues that in order to work toward a legislative solution to the forest management problem in the Northwest, the traditional practice for making policy decisions within the framework of the advocacy coalitions had to be displaced. Had the coalitions been able to strike a compromise position that had majority support, this would obviously not have been the case. But under the circumstances, given the policy gridlock and the mounting pressure to find a

legislative solution, another option had to be created. The network constructed by the Gang of Four scientists and members of Congress and their staffs created this option. The chapter shows how this was done.

B. The History Leading up to the Gang of Four

1. Polarization and Policy Stalemate

The evolution of the old-growth/spotted owl issue in the Congress reflected its general political evolution. So long as the issue remained confined within the administrative domain as a single species management issue with significant but not dramatic implications for the timber program, Congress remained uninvolved. As the quantity of timber harvest grew on federal lands throughout the 1980s, concern over the status of the spotted owl became a symbol for environmental opposition to the increasing rate of harvest of old-growth forests. When the previously unknown environmental group in Massachusetts called Green World petitioned the Fish and Wildlife Service to list the spotted owl as an endangered species in October of 1986, members of Congress suddenly confronted a flood of mail and phone calls from constituents and interest groups. The first hearings to address the issue convened shortly thereafter in 1987.

The Subcommittee on Forests, Family Farms, and Energy of the Committee on Agriculture in the House of Representatives began its involvement in the old growth forest issue during field hearings in Medford, Oregon, in 1987. In between that time and May of 1991, when the Gang of Four scientists were

empanelled, this subcommittee as well as subcommittees of the Interior and Insular Affairs and the Merchant Marine Committees met on numerous occasions to hear testimony regarding old-growth forests and the spotted owl issue, and to consider a legislative solution. No legislation was passed out of any committee during this period. Instead, individual legislators and the committees themselves became polarized on the spectrum of "green" to "brown" with moderates in the middle unable to effect a legislative compromise. Conservatives and some members of Congress from the region favored legislation to guarantee a steady flow of timber from the federal forests. They also wanted to "streamline" the administrative appeals process that had been used by environmentalists to stop sales from being cut. Environmentally inclined members of Congress focused on a system of reserved lands. The Bush administration repeatedly advocated both for streamlining the appeals process and rewriting the environmental laws to accommodate its high-volume timber program.[24]

Members of Congress felt that the environmental and forest products industry lobbies work out the specifics of a compromise position on the spotted owl/old growth issue. As one Congressional staffer told me, "This is an issue that has proven to be so divisive, so polarized, and so difficult to resolve politically, that ... the institution could never make [a decision]." Another staffer said simply, "This was do or die for people on both sides."

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[24]The administration also opposed compensation provisions to workers and families in bills before Congress, for which it was accused of exploiting the distress of timber workers to pressure Congress to rewrite the environmental laws (see Subcommittee on National Parks and Public Lands et al. 1992).

Because of the very high stakes for the principal antagonists, neither the woods products industry nor the environmental community could agree to more than vague and general principles that might form the basis of a compromise that could be translated into legislation to end the mounting crisis.[25] A staff member to one Northwest lawmaker explained that "Members hated this issue. It was a loose-loose proposition." Sid Morrison, a representative from the state of Washington, reacted to the Fish and Wildlife Service's decision to reverse its earlier decision not to list the spotted owl as threatened: "A timely solution" would have to be found, he argued, "if the economies of our [Washington, Oregon, and California] states are to survive" because he feared an owl listing could put as many as 130,000 out of work. And yet the politics of the issue did not bode well for a solution:

> A good friend of mine describe[es] the scope of the old growth forest debate [as] "on the one hand, environmentalist spokesmen believe that the remaining ancient forests on public lands constitute a biological, recreational, and spiritual resource unmatched on this planet, which should be protected and logged no further. On the other hand, forest products industry spokesmen believe that if logging ceases on even a significant portion of the remaining ancient forests, their industry will be virtually shut down." As my friend describes, each side is firmly dug into their own position leaving the rest of us to find a workable answer to a no-win question. There are simply no easy answers. (Morrison 1989:2)

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[25]Representative Jolene Unsoeld reported in 1989 that environmental, labor, and industry representatives had in consultation with her agreed to affirm that any solution should 1. "provide[e] certainty of timber supply and community stability; and 2. Protect... wildlife habitat, water quality, recreational opportunities, and other non-commodity values" (Unsoeld 1989:185). Naturally, such agreement did not commit the interest groups to any specific proposals, which is where the controversy lay. Environmentalists believed that in order to satisfy the second principle cutting in old growth forests would have to cease, industry and labor believed that in order to satisfy the first principle that it must not.

2. Mounting Pressure to End the Conflict

Yet the pressure to forge a legislative solution increased over time. By 1987, environmental groups were regularly challenging the legality of individual timber sales in court and through administrative appeals. On March 24, 1989 Federal District Judge Dwyer granted a preliminary injunction against Forest Service timber sales in Oregon and Washington in national forests in spotted owl habitat (Seattle Audubon Society v. Robertson, C89-160WD). Although this injunction was lifted eight months later, the political pressure only mounted. Two subsequent events proved crucial in pressuring legislators to address the issue. The first was the Fish and Wildlife Service's announcement on April 26, 1989 that it would propose to list the northern spotted owl as a threatened species. Up to this time, at least from the point of view of Representative Morrison, the region had been in the "denial stage" about the possibility of "setting aside key old growth areas" (Subcommittee on National Parks and Public Lands 1991:68). Then, after the announcement to list the owl, legislators from the region and subcommittee chairmen began receiving volumes of mail from frightened and angry residents of the rural Northwest who feared they would bear the economic brunt of listing the owl (Subcommittee on Forests, Family Farms, and Energy and Subcommittee on National Parks and Public Lands 1989). Then on May 6, 1991, the Fish and Wildlife Service proposed to designate about 11 million acres of land in the Northwest as critical habitat for the spotted owl, including 3 million acres of private land. This caused an outrage among rural citizens in the region, who once again flooded Congress with calls and letters of complaint. At issue were the large tracts of lands that would now be "locked up", unavailable for timber

harvest. A Congressional aid interviewed for this research said he believed that the administration may have been trying to exacerbate the sense of crisis by deliberately proposing to designate such a large area of private land, some of which was not even suitable as spotted owl habitat.

> When proposed critical habitat came out, I think in '91, that really freaked people out.... The event that really catalyzed this was when critical habitat was proposed. I don't know if you've ever seen the critical habitat maps, but the first one covered most of western Washington and Oregon. In fact, what was crazy about them was that they were fairly broad brush, and one might argue intentionally confrontational, given the administration in question. You know, they included things like school yards and tire dumps, and other places where there isn't much of anything. And that ignited a public furor that got through to members of Congress in a big way.

It was in this context that negotiations over creating a panel of scientists to develop options and report directly to Congress occurred. On May 22, 1991, the formal letter requesting the scientists to identify the old growth forests and develop and evaluate management approaches was issued. It was signed by Walter Jones, the Chairman of the Committee on Merchant Marines and Fisheries; Gerry Studds, Chairman of the Subcommittee on Fisheries and Wildlife Conservation and the Environment; Kika de la Garza, Chairman of the Committee on Agriculture; and Harold Volkmer, Chairman of the Subcommittee on Forests, Family Farms, and Energy. The Subcommittee on National Parks and Public Lands of the Committee on Interior and Insular Affairs joined the other committees and subcommittees soon thereafter. A day after the letter was sent, the Federal District Court in Seattle enjoined the Forest Service from selling any timber sales in the region of the spotted owl until it had implemented a legal,

scientifically credible plan for the owl's protection. The judge accused the Forest Service and the Fish and Wildlife Service of a systematically refusing to comply with wildlife protection laws. Moreover, the court ordered the administration to devise a scientifically credible management plan for the spotted owl before the injunction would be lifted. Given its record in first trying to discredit and then ignore the ISC strategy, many in Congress did not believe that the Bush Administration would do any such thing. A Democratic staffer stated that,

> They [the administration] had no credibility up here whatsoever. There was no seriousness in trying to make a responsible decision, and holding out the hope that Congress would trash the ESA was not a responsible decision... And I think there was Sununu [President Bush's Chief of Staff] behind there who really wanted to see this thing boil over. He wanted to force us into a corner.

3. The Inadequacy of "Science as Usual"

In the normal course of conducting their business, members of Congress receive advice from many people, including scientists. Prior to the Gang of Four members had personal relationships with various scientists who acted as informal advisors to them, and who they dad invited to give testimony on various aspects of the issue. Jerry Franklin, for instance, had been a frequent witness before committees throughout the late 1980's and 1990 and 1991. Jolene Unsoeld especially championed New Forestry as an "ideal blend of commodity production and ecosystem protection" (Unsoeld 1989:4). However, as my informants explained, the model of individual scientists advising individual members of

Congress would never have been sufficient to form a consensus on the committees around a science-based solution.

> Before the Gang of Four there were individual efforts, a particular Congressman who had a personal relationship with Jerry Franklin or a personal relationship with Norm or a personal relationship with Lee[26], who asked for an evaluation of the impacts of this thing on the economics of rural Oregon, or something like that. And they'd get some report and they'd have a hearing and they'd flog the hell out of it. I wouldn't call that science so much as having a scientist do an evaluation for you.

"Personal relationships" and "individual efforts" did not form the basis of a consensus, in spite of the demand for science-based solution. While the science contained in the individual efforts may have been valid, it stood alone without institutional support from Congress, and was therefore subordinated to the previous political interests of the members. "You weren't going to get Smith [a Republican from Oregon and a strong timber supporter] to go along with Jontz because Jontz says, Hey look, I've got a study that says you have to set aside a million acres to protect the owl."[27] In other words, the normal practice of treating science like any other political tool prevailed.

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[26]Robert Lee is a sociologist at the University of Washington who has written extensively on forest industry workers and rural communities.

[27]The result of the political contestation was a series of bills, none with any chance of passing, that reflected the prior positions of their sponsors, with little evidence of substantive scientific influence. In 1990 the Interior Committee's Subcommittee on National Parks and Public Lands considered four bills that dealt with the spotted owl/old growth issue. H.R. 1645, sponsored by Republican Bob Smith of Oregon and co-sponsored by Republicans Don Young (AK) and Denny Smith (OR) was intended "To permit timber sales ... on the National Forest System lands during a 5-year period of study of the status of the Northern Spotted Owl..." In this case science was to be used as a delaying tactic in order to alloy business as usual to proceed. "Green" bills were introduced by Democrats Jim Jontz and Bruce Vento. Jontz's bill (H.R. 4492) would "provide for the protection of the remaining ancient forests on the Federal lands of ... Washington, Oregon, and California..." while Vento's bill would "provide ... an ancient forest reserve system..." Democrats from the Northwest introduced a bill that reflected their position, politically the most difficult

> Various organizations would go and contract with scientists. What you had was individual scientists who may or may not see a personal gain, whether through notoriety or financial. But it was one scientist who was asked to do a report for whomever, and then that was given to the member of Congress. It was kind of like how to lie with statistics, how to rig the data so you can interpret it so it will say what you want it to say. And so I think what you had was, you didn't have a coordinated effort, you had individual scientists in the employ of clearly vested interests, and somewhat suspect because of that.

Congressional staffers expressed disappointment and frustration over not having been able to rely on Forest Service and BLM administrators to provide credible technical arguments for or against particular management strategies. Rather than being viewed as politically neutral public servants, agency administrators were viewed as clear advocates for traditional forestry practices regardless of what scientific evidence might indicate. [28]

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because they were faced with the acute dilemma of having to balance their pro-environment leanings (and environmentalist support) with the political imperative to maintain the economies of their districts and satisfy their rural constituents. H.R. 5116 would "require the development and consideration of alternatives for the conservation of the Northern Spotted owl" "in a manner that minimizes the disruption of employment in public timber-dependent communities." The six bills considered by the Subcommittee on Forests, Family Farms, and Energy of the Agriculture Committee represented a similar spectrum of values from "green" to "brown". Three of the bills in that committee (H.R. 4492, H.R. 5116, H.R. 5295) were the same bills as in the Subcommittee on Parks.

[28]The record of testimony before Congress contains poignant evidence of this loss of trust over the course of several years. By 1992 the hostility between members of Congress and Bush administration officials was expressed openly. The following is an exchange between John Beuter, Deputy Assistant Secretary for Natural Resources and the Environment (Agriculture Department) and Rep. Jontz. Jontz has accused the Forest Service, under Beuter's jurisdiction, of inviting court appeals of its decisions by being unresponsive to complaints. Beuter refuses to answer directly to the charge that the agency hides behind its legal option not to respond to complaints. Instead he focuses on the agency's management obligations:

Beuter: There is an ethical and moral obligation to manage those forests and a legal one.
Jontz: Well, I hope that the folk who are involved feel that the ethical and moral obligation is adequate because otherwise you will be in court.

> And then what you had was moderates like my boss who really wanted something independent. You know, he was like, I'm not really buying what the enviros are saying, and industry is a little bit too close to this. I want something, I want the Forest Service to be an honest broker here, or Congress is going to have to be the honest broker... but there are big problems with that because their stuff was really slanted. Congress is going to have to commission this in order for it not to be tainted.

To summarize, the spotted owl had been listed as a threatened species and 11 million acres of critical habitat had been designated by the Fish and Wildlife Service, 3 million of it on private land; members of Congress felt under increasing pressure by their constituents and by interest groups to resolve the conflict but had neither the a common understanding of the facts or the political will to do so; members of Congress believed that science was being manipulated for political gain by all the protagonists who came before them; and the administration had lost credibility with Congress. Because members of Congress were sharply split among themselves, there were not enough votes to pass out of committee a bill that comprehensively dealt with the issue.

The proposal to create a Congressionally sponsored scientific panel gained broad support because it was hoped the panel could first provide the information that they needed and second enjoy sufficient credibility among all factions on the

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Beuter: All I can say is trust us.
Jontz: We have been trying and it is very difficult based on the record (Subcommittee on National Parks and Public Lands 1992:69).

My respondents spoke to their and members' lack of trust towards the agency and the administration. One aide said that "You knew they were lying, and even if they weren't lying they looked like they were lying."

committees to serve as the basis of legislation. According to one Agriculture Committee staffer, some members expected science to serve a role functionally equivalent to the political compromising that Congress was used to making but in this case could not:

> I think they [congressmen] viewed it in terms of interest that it was a cut both ways kind of thing. They could be, if they got behind the science that means they weren't getting behind either the environmentalists or the industry. Science cuts both ways. As long as you aren't relying on an industry scientist or the environmental community's scientists, science can cut both ways. It can give one side some of what they want and another side some of what they want. It's not any one side of it. And I think that was very appealing.... because in some instances the science would say, yes, we should do this, and that would be what the environmental community wanted; and in some cases the science would say, yes, we should do this, and that's what the industry wanted.

C. The Gang of Four Report Framework

The framework for policy analysis that the panel used to devise its alternatives is composed of 5 basic elements: a range of alternatives that represent existing management plans (actual or proposed) alone and in various combinations as well as additional plans devised for key resources (e.g. old growth and fish) overlaid on one another in the form of GIS generated maps; a quantified analysis of risk to species and other resources associated with each alternative; a quantified cost in jobs and income associated with each alternative; a quantified estimate of timber harvest allowable under each alternative; and particular management practices for the different categories of lands in the management planning area.

The mapping part of the Gang of Four involved making maps of the late-successional/old-growth (LS/OG) forests on the federal lands in the range of the spotted owl in the Northwest. The LS/OG forests were given three classifications, LS/OG1 as the most ecologically significant, LS/OG2 as ecologically significant, and LS/OG3 as the remainder. These maps could be compared with the existing Forest Plans and the ISC strategy, which was most credible plan to date to conserve the spotted owl. In addition, the Gang of Four "Plus Two" created maps of key watersheds for fish. Key watershed were those that had "1. habitat for potentially threatened species or stocks of anadromous salmonids or other potentially threatened fish or 2. greater than 6 square miles with high-quality water and fish habitat" (Johnson et al. 1991:18). This option, which they called the "watershed/fish emphasis" option was intended to retain and restore the ecological functions and processes of streams and the habitat of sensitive fish species and stocks. The provisions specifically for the spotted owl included adopting management practices from the ISC for LS/OG areas and "owl additions" for LS/OG based reserves. Owl additions were areas judged necessary to add to an LS/OG based reserve system in order to bring it into compliance with the ISC strategy.

Risk analyses were conducted to judge the probability of meeting certain management objectives under each alternative and alternative/option combination. The management objectives for which risk analyses were conducted were "1. Retaining a functional LS/OG forest network in which viable populations of LS/OG-associated species exist in LS/OG areas and individuals can move

between these areas; 2. Ensuring viable populations of northern spotted owls; and 3. Providing adequate habitat on federal land for marbled murrelet nesting, for other LS/OG-associated species, and for sensitive fish species and stocks" (Johnson et al. 1991:7). The scientists developed a seven point ranking scale that ranged from "very low" to "very high".

The timber harvest estimates for the federal forests in the region under consideration ranged from 5.143 billion board feet under the "high timber" alternative 1 to 814 million board feet under alternative 12 (forest plans + LS/OG1 &2 + owl additions + watershed/fish emphasis) option C (options are discussed below). The panel did not make timber harvest estimates for alternatives 13 and 14 because the analysis needed to do so exceeded their capacity given time and resources. The scientists believed that harvest estimates would have been no more than one half of those for alternatives 11 and 12 under the respective options.

Finally, the Gang of Four included management practices in the alternatives and options. Some of these practices had already been tried out by managers and some had been incorporated into some forest plans, but aggregated and applied to the entire region, they represented a significant reform of existing forest management practices. The options A-C which fell under each alternative represented different management guidelines of ascending levels of conservation for the lands outside of the LS/OG reserves. The practices included basic New Forestry techniques and principles that would make it possible for managed forest lands to retain some of the ecological values of old-growth. The watershed/fish

emphasis option also included management guidelines for riparian areas. The specific guidelines and standards of these options form the template for action that managers could adopt and adapt to their particular goals and land characteristics.

D. Creating an Ecosystem Management Network

The Gang of Four reported that there could be "no free lunch" for policy makers--no way to provide medium to high protection of ecological and biological values in the Northwest forests while still having a high-volume timber program. The Gang of Four scientists represented the inevitable tradeoffs in a chart that showed decreasing wildlife conservation values with increasing timber harvest, and vice versa. The chart summarized the harvest levels and risk analyses under alternatives key alternatives, showing the declining harvest with ascending probability for maintaining ecological and biological values. Alternative 8A is the first alternative under which all ecological and biological categories for which risk analyses were performed score at least a medium probability of being retained. The harvest level for alternative 8A was estimated to be about 1.3 billion board feet, a three quarters reduction over 1980's highs. The graphic quantification of their options produced a dramatic effect on lawmakers, and shifted the "decision space" in which they operated. The Agriculture Committee eventually passed an "8A bill" out of committee. The reduction in harvest that the committee accepted would was unthinkable prior to the Gang of Four. It is now important to discuss why the committees were prepared to accept the Gang of Four report and act on it when it represented such a fundamental

reconceptualization of policy and would require significantly more political courage to implement than the Congress had yet shown.

1. Clearing a Space for Legitimated Science

The first ally who linked the Gang of Four scientists to members of Congress was James Lyons. Lyons acted as the liaison between the scientists and policy makers. Like the BRD ranger, Lyons was already linked to both groups. As staff director on the Agriculture Committee, he occupied an important position within the political structure of the Congress. Previously, as the policy analyst for the Society of American Foresters, Lyons had worked with most of the Gang of Four scientists. He was very familiar with the work of the Andrews Group, and while still in his position at the SAF had become well familiar with the ecosystems view of analyzing the forest management problem in the Northwest.

In order to bring in the Gang of Four scientists and have their work count for more than the "individual efforts" that had occurred to that point, Lyons had to create a network of support for the Gang of Four process itself. This network of support for the process could then become part of the translation network of actors who were working toward an ecosystem management solution to the Northwest forest management problem.

The most important enrollment that Lyons made in his capacity as liaison ally was of Congressman Harold Volkmer. Volkmer was a conservative Democrat from Arkansas, and a prominent member of the traditional forestry advocacy coalition.

He was also the chairman of the Subcommittee on Family Farms and Forests of the Agriculture Committee. Congressional staffers all agreed that as chairman of the subcommittee that oversaw the Forest Service, Volkmer's position as advocate for labor and industry put him in a position to undermine a science advisory process seen as biased in favor of environmental protection.

> Harold Volkmer was widely viewed as a great friend of industry and a great friend of labor. But he, Jim getting him on board was a great coup ....
>
> One thing I do know about Harold is that although he's a very conservative Democrat, labor is also very important to him, and that was his initial interest, the job issue. He's a very no nonsense kind of person. It wasn't out of some mushy feeling about trees that he did this....

Understanding the political dynamics of the Congress and working within the framework of those dynamics to achieve his goal of creating the Gang of Four process was a significant part of Lyons' achievement as liaison ally.

> Understand, Jim always had the Congress in mind. This was a report that was coming back to the Congress. And that's why he got Volkmer on. He was always very conscious of the fact that it's the Congressman who votes. And you don't have enough votes just among your friends. So you've got to get more people to come on board.

Enrolling Volkmer as a supporter for the Gang of Four process meant that one of the most powerful Congressional members of the traditional forestry advocacy coalition would have invested his name in the process. Given the fact that a panel of scientists who would take an "ecosystem" approach to analyzing the forest

management issue could only have been attacked as being biased toward to the environment if they were to be politically attacked at all, enrolling a member of the advocacy coalition that would have done the attacking could only have been significant. Just how significant was proven by what Volkmer's enrollment made possible.

> And that was critical because if Harold Volkmer was signed on basically anybody, I mean, you know, you were free to sign on, if you weren't in the region. It was still pretty tough if you were in the region, but if you weren't in the region, even if you were a conservative member, there was no reason no to go for this. They could follow Volkmer's lead and feel perfectly, you know, this was a perfectly acceptable choice because Volkmer was on board.

Volkmer acted as a gatekeeper for other conservatives, he had the power to signal what was and what was not an acceptable position for conservatives on matters concerning the environment. His position in support of the Gang of Four process, never mind what the result of the process might be, was symbolically critical in making it impossible for other members of Congress to accuse the panel of being advocates for the environmental advocacy coalition. Because Volkmer had not suddenly become an environmentalist, his support for labor and industry did not disappear with his support of the Gang of Four process. Other members of Congress could then only interpret his support for the Gang of Four as support for a politically neutral science advisory process.

Not only did Volkmer's enrollment allow conservative members to also support the Gang of Four process, it created an alliance over the Gang of Four process among all those Congressmen who supported it. This means that in so far as more

liberal members of Congress also supported the Gang of Four along with their conservative colleagues, a center of consensus over the process had been created. This did not yet mean that a consensus over a solution had been created, but the first step was taken in this direction. Some of those who also supported the Gang of Four process was Agriculture Committee Chairman, Kika de la Garza, George Miller, the chairman of the Interior Committee, and Gerry Studds, the chairman of the Committee on Merchant Marines and Fisheries. The latter two were well known for their support of environmental values.

> And de la Garza, whose instincts I think are greener than Volkmer's, I mean de la Garza I think intuitively has more sympathy for environmental objectives than Harold Volkmer does, but on that committee is not really able to act on them as often as I think he would like because it's such a conservative committee. Well, once de la Garza knew Volkmer was OK on this it, gave de la Garza so much more freedom to speak out and operate and join up with a guy like George Miller. I mean, normally it's hard for de la Garza to stand in a trench with a guy like George Miller and Gerry Studds and take flack. But Harold Volkmer in that point in time, his support allowed de la Garza to be right there.

Volkmer served as a gatekeeper ally for conservatives, and his support for the Gang of Four process was symbolically necessary to allow conservatives to believe in the legitimacy of the process. Volkmer also served as the essential link between conservatives and liberals on the environment during the Gang of Four process. If the Gang of Four could not be attacked as biased, and therefore representing environmentalist interests, and yet its analysis was framed in terms of ecosystems, and pointed toward inexorable ecosystem decline if current management trends continued, then that meant that a responsible conservative

position could still include support for maintaining ecological values. This meant that liberals and conservatives on the environment could come much closer together than they had in the past, and that those such as de la Garza who might have had environmental sympathies but could not publicly act on them now could do so without being accused of being environmentalists.

Gaining Volkmer as an ally in supporting the creation of the Gang of Four panel in the first place, not knowing what the outcome of the panel's work would prove, was essential in maintaining his support when the Gang of Four report did finally come out. The reason for this is that Volkmer risked a great deal by supporting the Gang of Four process. The staffers interviewed for this study made it clear that industry was very skeptical of the process, and this is one reason why Volkmer's support was so symbolically important in the Congress. Given that Volkmer was a respected member and not just a supporter of the traditional forestry advocacy coalition, his view of the panel mattered more to conservative members than industry's. But, without the support of Volkmer or another gatekeeper ally, most conservative members would probably have shared industry's skepticism of the process. They would have stuck with their base of political support on this issue. Given that they didn't, they put themselves at some political risk. This disposed them, and Volkmer, to accepting, even if without enthusiasm, the Gang of Four report as legitimate; that is, as scientifically credible.

> So how do you get more people to come on board? You know, one of the obvious ways is you get people to have a stake in your outcome. And when you get someone who is not a natural ally like a

> Harold Volkmer to have a stake in your outcome--it was like I said, it was kind of brilliant.

The "stake" that Volkmer had in the outcome (the contents of the report) was his political reputation, which he invested in the process.

> And it was basically due to Jim Lyons because Harold Volkmer could sign on. This was his process. You know, he had signed onto the original letter, he wasn't going to let this process get attacked, he was going to defend, you know, they were tough choices but it was his process and he was going to stick to the tough choices.

Having "their own" scientific panel invested the members in the panel and gave them an interest in it beyond just the scientific content of the report. One respondent observed that while she thought the Gang of Four report contained new information in the form of a comprehensive regional map of old growth, and that the presentation of the information was innovative and effective, "a lot of it wasn't really new." She said that "The science alone isn't enough," it had to be communicated in a context in which it would matter. She compared the Gang of Four report with a report on managing old growth forests issued by the Society of American Foresters that was organized by Jim Lyons while he was a policy analyst at the SAF.

> And the big problem with the SAF report was that no one had asked for it. There had been no— they came up with this great report which if you go back to it says a lot of what these reports have started to say, but since nobody had, there wasn't a context for it, there wasn't someone saying, we need this... This time with Congress asking for the Gang of Four report it kind of put that into a whole new place in my mind.

When the SAF report came out "everybody kind of went, oh, OK, there's a report," but without an audience that wanted the report, there was no context for action or even critical reception.

> It's like this process that I see scientists going through to understand that they can't just do things and put them out there and expect them to be grabbed up and hailed as this wonderful information. There's got to be an audience, a customer, so to speak. Because so many members had shown a deep interest in this issue, and people said, this is a top priority for me. People like Harold Volkmer. There was a perceived desire on the part of Jim Lyons and the Gang of Four members that there was an audience for their work, that there was a group of people who wanted to do something with it. It wasn't just adding to the body of information.

Once a network of support for the Gang of Four process had been created, a network that included conservative members (on the environment) like Harold Volkmer and liberal members like George Miller, a kind of institutional legitimacy had been conferred on the Gang of Four scientists. The scientists had now really gotten the backing of "Congress", not just individual members of Congress who were acting in their capacity as members of one of the advocacy coalitions. In other words, the bipartisan/bipolar coalition of Congressional actors who formed the network with the Gang of Four made it possible to invoke the institutional prestige of the Congress in support of the panel.

> The Gang of Four was the first time it wasn't anybody's data. It wasn't Audubon's data and it wasn't the Wilderness Society's data, it wasn't the American Forest and Paper Association's data. You know, it wasn't some interest group who had a fiscal or moral outcome at stake. It was objective information as much as it gets.

> It wasn't industry's report, and it wasn't the environmentalists' report, it was our report...

What did this mean in terms of how members of Congress could relate their political positions to the analysis (what they thought of as the science) represented by the report?

> It made it not tainted. I think that a lot of members want to jump behind that because then they can be not on anybody's side. They can be doing the scientifically credible and right thing to do. Which was, in the general public, with everybody being ticked off at politicians being bought and sold, it's like I'm not bought by industry, I'm not bought by the enviros, I'm doing the scientifically credible thing to do.
>
> And it was like, it was like they could not be in anybody's camp. They could be in the science camp.

Members of Congress do not necessarily want to be in the "science camp" on any particular issue. In fact, as the literature on the effects of science on policy making discussed in Chapter Two makes clear, science is usually only one input into the policy process, and rarely the decisive one. Instead, science is more often used to support pre-existing political positions. So why in this case did members of Congress want to be in the "science camp"—a position, not incidentally, that at least symbolically takes power away from Congress and gives it to scientists? The answer to this question was essentially given at the start of this chapter. The policy subsystem had become gridlocked by the time the Gang of Four process was created because neither the traditional forestry nor the environmental

advocacy coalitions had enough political power to impose a solution for the spotted owl problem, neither side was willing to compromise with the other, and yet the pressure to find a solution had become intense. Members of Congress knew that they needed to make find a legislative solution to the problem, but so long as the members were split between the two advocacy coalitions, and each coalition could cancel out the power of the other, then no solution could be reached. The Gang of Four process brought together a majority of the members of Congress who served on the relevant committees that dealt with this issue. They invested their reputations in the process, and created a political space for science to "speak to power" without being immediately politicized. In effect, they had created a political center, the center that the advocacy coalitions could not create. The fact that the Gang of Four report presented the options in terms of tradeoffs meant that members of Congress could see how each advocacy coalition could achieve some of its goals, although each would clearly have to give up on others. The Gang of Four report showed that a scientifically credible and legally defensible solution to the forest management issue could be achieved without there being a clear winner or looser.

> Science cuts both ways. As long as you aren't relying on an industry scientist or the environmental community's scientists, science can cut both ways. It can give one side some of what they want and another side some of what they want. It's not any one side of it. And I think that was very appealing.... because in some instances the science would say, yes, we should do this, and that would be what the environmental community wanted; and in some cases the science would say, yes, we should do this, and that's what the industry wanted.

Having established a political center, the translation network was in a position to reframe the terms in which members of Congress understood the forest management problem.

2. From Traditional Forest Management to Ecosystem Management

The Gang of Four reframed the policy problem surrounding the Northwest forests from how to protect the spotted owl while maintaining a high timber output to how to manage the forest resources to maintain a viable old-growth ecosystem with all its associated parts across the region. Timber production was not eliminated as a goal, but the expectations in regards to quantity had to be dramatically revised according to the risk analyses that showed an inverse relationship between timber harvest and healthy ecosystems and viable old growth dependent fish and wildlife populations affected by timber harvest practices.

> This was laid out so that people sort of said, golly, if we do this, we want to get a high timber output, then this is the likely consequence of that, and we have to know. I mean, we now know that and the whole world knows it. So it was a very sobering moment for a lot of members. And Congressman Miller, whose political judgment I think is very very good, he thinks that at that point the whole debate on the Northwest changed from one of, of how much timber can we get out and how long can we ignore the long term consequences, to one where the Northwest people said, oh my gosh, we really have a real ecological problem.

> And they [the Gang of Four researchers] went through this thing and it was just very skillfully done on their part. I mean, they had alternatives and they basically said, well, you know, you can pick any one of these alternatives but these are the consequences. It was a brilliant move. And it just rocked everybody back on their heels

> because it really awakened everybody's eyes to how serious the problem was. And from that point forward, although each new round of scientific analysis produced changes, and now the Gang of Four is sort of old because so much more information and data has been developed it really isn't the best scientific statement anymore. But it's far and away the most important because it just changed everybody's thinking, it totally changed the debate.

> I think from my standpoint it was the discussion the scientists had about what our real range of options were. Not just the twelve options or fourteen options they set out in that report, but their description of the resource itself and that there was very little flexibility left in the resource to respond, so that if we were to sort of do the politically expedient thing of saying, well, let's drop the cut from five billion to four billion, then we, I guess at that point we really couldn't make politically expedient decisions anymore because if we were to do that we were going to loose a lot of values of those forests.

While the realities of the remaining timber and wildlife resources in the Northwest constrained current policy options, the concepts of ecosystem and ecosystem management promised flexibility in the future for solving resource management problems both on the ground and politically. The ecosystem idea could be translated into the political area at that point because it provided, at least in principle, future opportunities for all of the interests involved and a way of avoiding the kinds of political and policy debacles that the old-growth spotted owl issue had become. One senior, timber-friendly staffer told me

> The Gang of Four is kind of a bridge. Right now we're on the bridge and there's not much room to move around, we just have to get across it. On the other side of the bridge is ecosystem management. It's open country there because when you're managing ecosystems, getting away from single species management, you've got a whole

> lot more flexibility to manage. You can move around on the landscape, provide the commodities, and keep the ecosystem running.

More environmentally inclined staffers saw the ecosystem management concept embodied in the Gang of Four report as a way of anticipating future conservation issues and addressing them before they get critical, and before they become political problems for Congress.

> What happened was, when they were talking about, when Norm [Johnson] and all those guys would come back and talk about, they'd say, you know, this is not just about owls, we've also got fish, we've also, we really should be talking about the whole ecosystem, and the members were kind of going, oh yeah, we've got this fish problem coming down the pike, maybe we should do this fish option and combine this with this so that we take care of that problem. So you got people starting to think about, how do we avoid, and I think Jolene came up with this phrase, you know, the species by species of the month problem, you know, where each week there was going to be another thing on the horizon. And so that's what really got, that's what I mean about science sort of serving politics. Because ecosystems provided members a way to think about solving problems ahead of time before they became huge and intractable.

The Gang of Four had established the ecosystem concept in the Congress by first becoming a part of a network with members of Congress that protected the scientists from politicization, investing the policy makers in both the process and the outcome, creating a political center, and then convincingly reframing the policy problem. Understanding the problem an ecological problem that could only be addressed at the ecosystem level both limited options for policy makers and opened up new options. While the timber harvest clearly needed to be substantially reduced in order to maintain the ecosystem, ecosystem management

held out the promise of longer term sustainability of the ecosystem (and forest products outputs) and heading off future conservation battles as intense as the one over the spotted owl. The translation, "if you want to solve this political problem and prevent similar problems in the future", had been made.

However, it was not certain at the time of the Gang of Four whether the translation that brought ecosystem management into the Congress and gave members of Congress an interest in supporting it would last. Or how long it would last. The Gang of Four report had become uncontestable from the point of view of its technical validity—that is, because of the process by which the scientists were protected from politicization and their analysis placed in a politically centrist position, the analysis that the scientists produced could not be critiqued in an adversarial way in the context of the Congressional committees. Latour refers to uncontestable phenomena such as this as black boxes, as discussed in Chapter Two. In order to contest a black box the maneuvers that put it together have to be undone. In the case of knowledge alone, there have to investments made in scientific experiments that yield results that refute the original knowledge. In the case of knowledge stabilized by actors in a network for a collectively defined purpose, the alliances that form the network might have to be undone by constructing another network.

In the Gang of Four process, the "science", represented by the Gang of Four report, was deemed to be uncontestable by the members of Congress who had invested their political reputations in the credibility of the process and the report. "There was no argument about the science", one staffer stated. The report was

"untainted", "our" report. How long would more than respectful attitude toward the knowledge embodied in the report last? How long would the approach to ecosystem management provided by the Gang of Four scientists be the only and uncontested approach?

The Agriculture Committee did pass out a bill based on the Gang of Four report, the details of which will be discussed in the next section. Not long after passing the bill, however, the relationships between the scientists and the members of Congress began to loosen. In fact, although the scientists were still regularly consulted by members of Congress for technical advice and information, with the passage of the bill there was no longer any pressing reason to maintain a strong alliance. Congressional staffers interviewed for this study reported that once their interests in trying to settle the controversy in the Northwest were met by adopting the ecosystem management approach in legislation, members of Congress started to feel their power and autonomy threatened by the close relationship with scientists.

> At this point it kind of moved out beyond some comfort zone. It provided some cover and comfort for a while and now it's kind of a little out of their control.

The ecosystem management approach taken by the Gang of Four also lost some of the patina of uncontestability it had gained during the time of the Gang of Four process itself.

> There's been some criticism of that, you know. There's been a lot of water under the bridge since then with FEMAT and the Northwest

> Forest Plan. And there have been hearings in the Senate recently on ecosystem management, and we've heard some different versions, so I don't know where that's going to go .... The Gang of Four was what it was for its time, and it was the best information you could get. But there's always more information .... People are going to use that information in whatever way they want to. You know, science just informs, it doesn't create the policy. The members of Congress create the policy, and what you see as the final product may have some basis in science, but it is a product for the most part of a bunch of old white guys sitting around and trying to protect their constituents.

The Gang of Four report did not have to become a black box in order to influence the policy process profoundly. Rather, the inviolate credibility of the scientific panel and the uncontestability of the report had to be stabilized only long enough to produce policy action, in this case the passage of a bill out of the Agriculture Committee. It is more useful to think of this as the process of building a "gray box" that could stand uncontestable until the immediate policy goal for which the network had been constructed had been achieved.

3. The Gang of Four Bill

On May 6, 1992, Harold Volkmer's Subcommittee on Forests, Family Farms, and Energy of the Committee on Agriculture met to consider H. R. 4899 (the Northwest Forests Management, Planning, Productivity Improvement, and Protection Act), the "Gang of Four bill" that contained the 8A alternative from the Gang of Four report. After relatively little discussion the subcommittee passed the bill, ordering that it be reported to the full committee. On June 18, 1992, the

Committee on Agriculture passed H. R. 4899 on a vote of 27 to 15. The Committee on Agriculture, the most conservative of the three committees that dealt with natural resources to have sponsored the Gang of Four, passed out a bill that committed it to a reduction of the federal timber harvest in the Northwest from a 1980s high of over 5 bbf to about 1.3 bbf.

H. R. 4899 specified that the old-growth reserve be the 8A reserve consisting of the forest plans, LS/OG1 lands, owl additions, and the watershed/fish emphasis lands. Option A specified that non-reserve lands be managed according to the 50-11-40 rule and with New Forestry management practices such as leaving down woody debris and green trees after harvest. The bill also established a scientific advisory panel of 12 scientists nominated by the National Academy of Sciences and the chairmen of various House and Senate committees. The panel was to have reviewed the effectiveness of the Act's reserve system and management strategy; and made recommendations for long-term management, revised the boundaries of the reserve, and a long-term research and monitoring program of activities taking place in the forests.

The passage of H. R. 4899 through the Agriculture Committee made plain just how fundamentally the Gang of Four process had changed the terms of the policy debate in the House.

> The Gang of Four is far and away the most important [policy analysis process] because it just changed everybody's thinking. It totally changed the debate., and very soon after that the House Agriculture Committee marked up its forestry bill, and what passed out of, and I remember going down there and seeing these forestry,

> particularly industry guys, just come out with glazed looks on their faces. They just couldn't believe that this committee had just passed an 8A bill. I mean, the enviros thought it was completely inadequate, but given the history of the Ag Committee it was unbelievable.

After the Gang of Four delivered its report, there was a great enthusiasm in the Congress for conducting scientific assessments and moving toward ecosystem management in other areas of federal authority. The optimism that the Gang of Four process offered a model for resolving difficult natural resources controversies, first by establishing a scientific consensus on the status of the resources and then choosing an ecosystem management regime based on a scientifically determined range of options.

> You see it [ecosystem management] in rhetoric everywhere. Literally everywhere. It shows up, it showed up in that bill [a Montana wilderness bill], it shows up in certainly the Everglades. I mean, it's really become common parlance. People are still going to play lots of games and stuff for their own advantage, but it certainly is in my opinion a reflection of the fact that science jumped a bunch of pegs up on the chart of dealing with these natural resource issues, and that's due to the Gang of Four.

One respondents said that "members perceive this is a way to deal with all of these problems ... It makes them think they can get past the intractable conflicts." One of the areas in which conflict was looming was the Sierra Nevada forests of Northern California. Here too the old-growth forest too was under siege from having sustained a high level of timber harvesting over many years. Without a spotted owl as a legal lever for environmentalists, the conflict had not reached

Northwest proportions yet, but the prospects were not good for the long-term. The Agriculture Committee therefore included a provision in H. R. 4899 to establish a scientific committee, modeled on the Gang of Four, to conduct an assessment of the Sierra Nevada forests. The scientific report the committee was to have returned to Congress within six months was to have included a range of alternative strategies for maintaining the old-growth forest ecosystem in the Sierra forests, management guidelines, maps of old-growth for each national forest, watershed management guidelines, and risk assessments for species associated with the management alternatives. The guiding management principle for the Sierra forests embodied in H. R. 4899 was that the old-growth ecosystem in the region be sustained.

The Senate, which had also been considering various approaches to dealing with the old-growth/spotted owl issue in the Northwest, also adopted the Gang of Four principles in proposed legislation in 1992. Senator Brock Adams of Washington had crafted a bill in 1991 (S. 1536) with the dual purpose assisting timber workers and establishing "a sound ecosystem-based approach to the management of forest lands in the Pacific Northwest" (S. 1536) (U.S. Senate 1991:5). The management guidelines in the bill were based on the ISC report, and the overall objective of the bill was "to assure the production of timber and wood products and employment associated with such production on a long-term sustainable basis" (U.S. Senate 1991:5). After the Gang of Four process Senator Adams drafted a new bill with Senator Leahy of Vermont based on the scientists' report. The alliance between Adams and Leahy, who had been a strong advocate for conservation in the Northwest, represented an emerging compromise position based on the principles

of ecosystem management similar to the one that passed H. R. 4899 out of the House Agriculture Committee.

Having passed out of the Agriculture Committee late in the legislative session, H. R. 4899 would have to have been reintroduced in 1992 in order to become law. In the meantime, the crafters of the bill had to negotiate with Speaker Tom Foley's staff to win support. Foley, a long-time timber supporter from Eastern Washington, was wary of the heavy restrictions that the bill would place on forestry on the west side of the Cascades and worried that the ecosystem management idea, with its reserves and conservative harvesting methods, would reach his side of the state if the bill became law. Exactly how the negotiations would have turned out is impossible to say because they were never completed. Staffers who participated in the negotiations stated that a compromise was near and could have been reached.

However, neither H. R. 4899 or S. 2895 came to a full vote in their respective chambers. Just at the time that Congress was moving finally toward a legislative solution to the old-growth/spotted owl issue, the 1992 Presidential race produced Bill Clinton as front-runner. Candidate Clinton, during a stop in the Northwest, promised to hold a "forest summit" in the region and to craft a solution to the conflict. In spite of the progress they had made, leaders in the Democratic party in the Congress decided to wait and see if Clinton won, and if he did, to let him take the political risks of devising a new federal forest policy for the region. Some of my respondents regretted the decision to hand the issue off to the executive branch. Some saw it as an abdication of responsibility. In any case,

Clinton did win the race for the Presidency, did hold his forest summit, and did devise a new policy for the Northwest. The old-growth ecosystem management approach as first articulated by the Andrews Group and translated into a policy analysis framework by the Gang of Four was finally brought to fruition by the President's Forest Ecosystem Management Assessment Team in the Spring of 1993.

F. Summary and Conclusion

This chapter argued that the impasse in the policy subsystem, symbolized by court injunctions halting the federal timber program in the Northwest, the listing of the spotted owl as threatened, and the failure of the federal agencies to develop and implement a management strategy for the owl that met legal muster and reinstated the timber program, provided the structural conditions for a translation network to bisect the advocacy coalitions within the decisionmaking framework and establish a new conceptual basis for making policy. A liaison ally, much like the Blue River District Ranger, was needed in order to bring the scientists to the Congress. At that point another kind of ally, what will be called a gatekeeper ally, was needed to create a political space for ecosystem management in the Congress. This ally allowed the Gang of Four to place itself between the members of Congress and the advocacy coalitions with which they usually worked on federal forestry issues and of which they might even have been a part. This move effectively displaced the power of the advocacy coalitions during the Gang of Four process, thereby establishing the translation network between scientists and policy makers. During the process of translation it was necessary to "stabilize"

the knowledge and analysis represented in the Gang of Four report, making them incontestable. However, rather than becoming a black box in the Latourian sense, only a "gray box" was made out of the ecosystem knowledge and analysis which would be the basis for policy making in that they only had to remain incontestable so long as it took to draft and pass a bill. Thereafter, the normal contestation between advocacy coalitions over all aspects of policy making, including science-based knowledge, would be expected to continue. The ecosystem management translation network between scientists and members of Congress established, for the first time since the outbreak of the spotted owl issue, a political center from which compromise policy could be made. Consequently, the Gang of Four positioned itself as policy broker between the two advocacy coalitions.

Chapter Eight

Findings and Conclusions

A. Summary of Findings

The federal forest policy crisis in the Pacific Northwest provided the opportunity for opponents of the existing forest management regime to attempt to restructure relationships within the forest policy subsystem. The emergence of ecosystem ecology and its application to the old growth forests of the Northwest provided scientists and others with resources to construct alternative management strategies that addressed both conservation and commodity production interests. The Andrews Group found itself well positioned and prepared to develop translation and enrollment strategies that would lead to the translation of ecosystem science into techniques and a philosophy for management, and into principles of policy.

In order to translate its scientific knowledge into management and policy resources, the Andrews Group had to form relationships with managers and policy makers that transformed the interests, goals, and framework for understanding the forest management and policy problem of the managers and policy makers so that they became advocates for ecosystem management. The purpose of this dissertation was to examine how and under what conditions these relationships were created. The general conclusion of this research is that scientific knowledge can be translated into management and policy resources when the existing

advocacy coalitions structure fails to resolve a scientifically intensive policy conflict with high political stakes, and scientists with a coherent program and organizational resources become a part of a translation network seeking to broker a solution between the advocacy coalitions.

B. Organizational Capacity for Action

The Andrews Group developed organizational capacity for social action through an integrated process of dividing roles and responsibilities among group members and nurturing an organizational culture based on group solidarity. Taken together, these processes created a capacity for the group members to cooperate with each other in commonly shaped purposive behaviors. These behaviors included but were not limited to developing and implementing research projects. Among the accomplishments this capacity made possible: significant financial support and long-term links with the National Science Foundation; administrative control over the H.J. Andrews Experimental Forest; significant influence over selection of the Blue River District Ranger; cooperative relationships with managers, innovative forest management techniques; allies among the print and television media; Cascade Center for Ecosystem Management became an ancillary organization in order to institutionalize the dissemination of the Andrews Group's management techniques and ideas; and influence among policy makers.

Division of labor and roles. The division of labor and roles began at the inception of the Andrews Group, when Jerry Franklin emerged as group leader during the IBP period. Franklin gradually became the main link with the National Science

Foundation, and during his tenure as an NSF officer helped secure a place for the Andrews Group in long-term ecological research funding. Franklin developed an entrepreneurial leadership style, taking advantage of opportunities to advance the Andrews Group's interests as they arose, as well as developing such opportunities through enrolling allies and organizing resources. One of Franklin's greatest strengths as a leader of the group was the ability to synthesize and clearly articulate the practical relevance of the group's scientific knowledge for non-scientists. This talent allowed Franklin to become the main spokesperson for the group, helped him gain access to potential allies, and consequently helped him garner more resources for the group. As leader, even as Franklin spent less time conducting his own field research (doing "bench" science), he gained greater reputational capital because of his ownership and co-ownership of ideas and synthesizing concepts. In their study of a scientific laboratory, Latour and Woolgar (1979) referred to the laboratory leader as the "big boss", and found that the big boss also functioned as the main link with the world outside of the laboratory for the purposes of garnering and directing resources and making allies.

The administrator/manager Andrews Group members formed the nucleus of the group, and included many of the original postdoctoral fellows who were hired during the IBP period. This group provided the institutional stability and organizational effort required for the Andrews Group to exercise control over the H.J. Andrews Experimental Forest and maintain a long-term research program. This group of researchers assumed primary responsibility for managing research studies, distributing resources, and organizing tasks such as routine grant renewal and proposal writing. Now that Franklin has left the Andrews Group, the

administrator/managers perform by committee many of the functions that Franklin once performed alone. This stage of the Andrews Group's history could well be described as an institutional period during which the organizational and programmatic innovations brought by Franklin's dynamic and entrepreneurial leadership have been routinized and administratively maintained.

A number of Andrews Group scientists play the role of bench scientists. These scientists have very little if any routine contact with non-scientific actors, and play a small role if any in administrative tasks. Their primary occupation is conducting field research and publication. These scientists maintain their focus on the routine work of any scientific group or laboratory—producing and organizing facts and disseminating them through the usual channels of academic knowledge dissemination—publishing and speaking with colleagues.

Group Solidarity. The Andrews Group is characterized by a high degree of group solidarity. Andrews Group members, whether they are employees of the Forest Service or Oregon State University, identify strongly and primarily with the Andrews Group. In fact, group members typically dismiss their formal employee affiliations as irrelevant to their identities and loyalties. The Andrews Group has developed a self-reinforcing process of building and maintaining group solidarity through the cultivation of shared values, friendship, a common stake in place, professional collaboration, and having enemies.

The shared values that help bind group members to each other include an affection for the natural world mediated through scientific knowledge. That is,

Andrews scientists' affection for the natural world is at least partly a function of their scientific understanding of the natural world; conversely, their ecosystem research is also an expression of their affection. Group members express a special commitment to the H.J. Andrews Forest itself. The H.J. Andrews Forest has been the site where many of the social bonds between the researchers were established. Working and relaxing together on that one intensively studied forest provided the researchers with the necessary opportunities to interact and get to know each other. Having one primary research location also made it possible for researchers of different disciplines to learn from each other, thereby setting the basis for the kind of intellectual cross-fertilization that is necessary to create an integrated interdisciplinary research program. That the Andrews Group's research program has become more conceptually integrated over the years is evidence of the success of this cross-fertilization. Andrews researchers talk of having slowly become "naturalists" as a result of their intensive interdisciplinary work; that is, researchers have developed a more holistic scientific understanding of the forest ecosystem. The interdisciplinary approach to studying forest ecosystems, especially the old growth forest ecosystem of the Northwest, led to knowledge that challenged the assumptions of traditional forestry that these forests were decadent and ecologically worthless. Consequently, the Andrews Group was identified as a threat by academic and agency representatives of traditional forestry disciplines, further instilling a sense of group identity among Andrews researchers.

The combination of the division of labor within the Andrews Group and the emergence of group solidarity gave the Andrews Group the capacity to create an

innovative interdisciplinary science organization able to enroll non-scientific actors into its projects, garner outside resources, and develop original knowledge of the old growth ecosystem. The group was able to take advantage of the unique talents of its individual members (such as the enrolling abilities of Jerry Franklin) as well as generate the creative synergy of collaboration. These capacities have now been institutionalized in the group's cultural and administrative practices.

C. Linking Science to Power

The Andrews Group created a translation network that worked to reform federal forest management in the Northwest. As part of this network the group made allies and translated its scientific knowledge of the old growth forest ecosystem into management and policy resources, thereby extending the group's influence outside of the confines of science. The group made many enrollments among managers, policy makers, and other kinds of actors, among whom two types of enrolling allies stand out. In this dissertation these types have been referred to as *liaison* and *gatekeeper allies*. Liaison allies were defined as allies who provided the first link to another community of actors, and who took the initiative to both translate the Andrews Group's programs to their colleagues and to put those colleagues into contact with Andrews Group members who would then do the translating themselves. The two principle liaison allies identified in this research were the Blue River District Ranger during the 1980's and James Lyons, the staffer on the Agriculture Committee. The district ranger became an advocate for Andrews Group management techniques among his colleagues, who up to that point had had no cooperative relationship with the Andrews Group and who in

fact were typically uneasy with scientists, especially from non-traditional forestry disciplines. The district ranger "broke the ice" with other managers for the Andrews Group, and gave them the credibility among managers on the Willamette National Forest that allowed the Andrews Group to test its management ideas on a broader scale. James Lyons convinced the committee chairmen from the Agriculture and Merchant Marine and Fisheries Committees and the subcommittee chairman of the Subcommittee on Forests and Family Farms to request and endorse the Gang of Four process. This was considered a very significant achievement among other staff members, especially because the Agriculture Committee was considered to be hostile to ecological perspectives on resource management issues.

In order to gain a broad and bipartisan endorsement among members of the Agriculture Committee, including the chairman, Lyons first had to enroll the gatekeeper ally Harold Volkmer, the chairman of the Subcommittee on Forests and Family Farms. Harold Volkmer was a very conservative Southern Democrat and an outspoken member of the traditional forestry advocacy coalition and advocate of labor and industry. Prior to the Gang of Four process, it was a cultural taboo to use the word "ecosystem" during subcommittee hearings for fear of alienating the chairman. Harold Volkmer enjoyed a rare esteem among his colleagues: he was respected by both liberals and conservatives for his integrity; he had the support of Democrats because he was himself a Democrat; and he had many allies among Republicans because he was a conservative. When Volkmer agreed to sponsor the Gang of Four scientists, he made it possible, without having to become an advocate for the process to his colleagues, for conservative as well

as liberal members of Congress to follow suit and support the process also. The reason is that Volkmer's support for the Gang of Four was symbolically understood to mean that these scientists could not be labeled as "greens", or environmentalists. It was clear that the Gang of Four were not scientists who supported industry positions either. This meant that the Congressmen had to accept (and they were happy to do so) the Gang of Four scientists as politically neutral and scientifically objective, meaning that their report could be accepted as politically untainted, legitimate knowledge that could be used as the basis for decision making. Volkmer's support effectively made it impossible to accuse the Gang of Four of being environmental advocates because to do so would mean imputing the same labels to Harold Volkmer, which according to the culture of the subcommittee and committee was not thinkable. Volkmer was the gatekeeper of conservative values among his colleagues (and as subcommittee chairman he had the actual power to play this role), and when his support for the Gang of Four process was gained, it became possible for both liberal and conservative members to "stand next to" each other in supporting this process. Volkmer's support effectively displaced the power of the traditional forestry advocacy coalition on the Congressional committees during the Gang of Four process.

Once the veto-power of the advocacy coalitions was neutralized by the Gang of Four process, it was up to the scientists to create credibility for their analysis. They did this in part by showing clearly where the "decision space" lay—by showing tradeoffs between conservation and timber production that demonstrated the extent to which the legally and politically acceptable range of policy options had become very narrow. Members of Congress, many of them initially

discomfited, accepted the scientific validity of the Gang of Four's analysis because of the dynamic involving Harold Volkmer and the support of conservatives. This scientific analysis was not tainted (politicized) because the Gang of Four scientists themselves had been constructed as fully credible science advisors to the Congress, and not interested parties to the political dispute over forest management. Moreover, both environmental groups and the forest products industry expressed alarm over the bill that was drafted in the Agriculture Committee based on the Gang of Four report. This was a political signal for members of Congress that the bill, and the Gang of Four analysis itself, represented the political center in this debate. Having finally, and for the first time, reached an understanding of what the political center was, there was sufficient bipartisan support for a Gang of Four based bill to pass through Congress. As discussed in the previous chapter, just prior to the 1992 election, the Congressional leadership was prepared to bring a modified version of the bill passed by the Agriculture Committee to the floor of the House for a vote. This would have been the first time the full House had voted on a bill addressing the forest management crisis in the Northwest, and had it passed, it would have radically changed the policy for those forests.

During the Gang of Four process, the analysis of the scientists and the science that supported it appeared to become a black box in Congress, unassailable either in terms of its credibility or the motives of its authors. The knowledge was "stabilized" by translating the interests of the policy makers so that in order to achieve their goal of resolving the political problem over forest policy they adopted the goal of reforming the policy consistent with the philosophy and

techniques of ecosystem management. The knowledge invested in ecosystem management therefore was translated into the goals of politics and became "attached" to the broader effort to resolve a polarizing and costly crisis that had plagued policy makers, thereby gaining the "strength" of efforts to solve that crisis (Latour 1987:117). However, after the Gang of Four process was completed, and after President Clinton was elected and moved to solve the crisis himself, the ability of the scientists (who continued to advise the Congressional committees) to translate knowledge into political goals diminished considerably. In fact, over time the normal dynamics of interest group politics defined by advocacy coalitions reemerged within the Congressional committees. However, now the debate, negotiation, and struggle was over the definition and operationalization of ecosystem management. The network in which the Gang of Four scientists were key actors was no longer necessary to maintain ecosystem management as a framework for policy making in the Congress. The interpretation of what ecosystem management ecosystem management translated into policy could mean would be contested by members of Congress, interest groups, agencies, and scientists. Hearings before Congressional committees now involved some scientists, notably silviculturalists, who had significantly different interpretations of ecosystem management. The knowledge and the relationships that had been stabilized during the Gang of Four appeared to be more of a *gray box* in that members of Congress began to reinterpret its meaning according to their advocacy coalition commitments. In other words, the knowledge was the particular interpretation of ecosystem management and the network relationships of the Gang of Four were stabilized (kept unassailable) only as long as it took to reach a decision in the form of a passable bill. Once a new policy was in place or on its

way, the routine political process in which science is merely one tool in the struggle among advocacy coalitions reasserted itself. One Congressional staffer, quoted earlier, described this process as crossing a bridge. Introducing ecosystem management into the Congress and installing it as the basis for policy making was like the narrowness of the bridge. Once across, however, there was a wide-open field in which the political actors (members of Congress) would no longer be constrained by the particular definition of ecosystem management stabilized in the Gang of Four process.

D. A New Understanding of Science for Policy Making

This dissertation has shown that the translation network analysis and advocacy coalitions framework can be integrated to understanding how science affects policy making. The advocacy coalitions approach is necessary in order to understand why it was that the ecosystem management network was able to extend itself into the U.S. Congress. The inability to resolve the highly contentious forest management problem in the Northwest through the regular bartering and negotiating routines between advocacy coalitions in the policy subsystem left a political opening into which the network moved. Although the structure of the policy subsystem limited the actions that actors could take to resolve the crisis, and resulted in policy gridlock, it also contained the latent potential for innovative action by actors from outside of the advocacy coalitions.

This recursive relationship of agency and structure, or structuration, led to new forms of action and movement toward instituting new rules and organization and

deployment of resources. Taken alone, neither of the theoretical frameworks could have explained this process of structuration. The advocacy coalitions framework would have placed too great an emphasis on stability and the limitations on agency, while the network approach would have taken agency out of context, imbuing it with too much transformative capacity.

The Gang of Four process showed that it is possible to create a network that positions itself as a policy broker between advocacy coalitions under conditions of intense policy conflict. Certain conditions make this possible. These include, first and foremost, the capacity of the scientists themselves to deploy the resources necessary to make effective translations: strong reputations and a body of science backing up their statements that cannot be easily attacked, as well as a pragmatic understanding of the political dynamics in which they are working. Also, a context needs to be created in which scientists make statements without being vulnerable to the politicization. In the case of the Gang of Four this came about through the displacement of the advocacy coalitions by the support of a gatekeeper ally. The gatekeeper ally in turn was only enrollable because routine methods of decision making had failed, and yet the pressure to make a decision was rapidly growing. The creation of a strong network that displaced the advocacy coalitions made it possible to frame a Gang of Four based policy solution as representing the political center. It is from this position that the network could play the role of policy broker—staking out a policy position that is simultaneously constructed as the scientifically credible one and the one that strikes a compromise between the advocacy coalitions. This requires more than simply presenting scientific facts and analysis. In order to be policy brokers,

scientists must undertake to make the translations of scientific knowledge and goals into policy goals themselves. The science alone does not have agency, rather, it's capacity to change a policy process is dependent on the agency of people.

E. Conclusions

This research demonstrates that translation networks linking scientific analysis producing processes to political choices can create new policy options without jeopardizing the reputations of scientists through the politicizing attack of interest groups. Where it has been found by researchers (Brickman 1984; Gillespie, Eva, and Johnston 1979; Wynne 1987) that the U.S. political system tends to exert great politicizing pressure on science because it does not protect science from interest group attack, this research has found a case in which knowledge was both transparent (the analysis was available to all parties, assumptions were clearly stated) and insulated from effective political attack during the period in which a decision was made. This contradicts the view that science must be insulated from scrutiny in order to make a difference in a political context and shows rather that science must be protected from politicization through a process of constructing a political center for it to occupy.

The "over-critical" model of science for policy (Collingridge and Reeve 1986) in which the higher the stakes the more science is delegitimated as a result of unusual scrutiny and politicizing attack can thus be avoided by enrolling gatekeeper allies into the network with scientists. Gatekeeper allies are the key

allies who allow other political actors to enroll in the network and form a majority position. Gatekeeper allies are essential in displacing the power of the advocacy coalitions, because they allow networks to make alliances with actors whose existing political commitments to the advocacy coalitions would otherwise prevent them from enrolling in the network. Once these actors (in this case the majority of the members of Congress on the committees) are enrolled in the network the advocacy coalitions are reduced in their ability to influence the terms of policy.

Rather than becoming just another political weapon for advocacy coalitions (Nelkin 1987; Nowotny 1987) and thereby losing its special epistemological status (Weiss 1991), science can, even and perhaps especially when the political stakes are high, create a context in which new alliances and forms of social action become possible. Scientists must come to the policy arena prepared with resources to make their translations effective and their alliances strong. These include resources in status and reputation, and a body of applicable knowledge that is communicated such that potential allies can understand the relevance of the knowledge to their own projects, or can be persuaded that to accomplish their ultimate goals they must drop their projects and adopt those of the scientists.

This research demonstrates that the resources of reputation and knowledge that scientists bring to their work as network builders may have been built on another set of resources that gave scientists the *capacity* to develop good reputations and bodies of knowledge. In the case of the Andrews Group these capacity building resources included group solidarity and an efficient division of labor within the

group. Future comparative studies of scientists as network builders would shed light on the range of organizational structures and cultures that enhance or inhibit the capacity of scientists to enroll non-scientific allies.

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Alexios R. Antypas
216 Roosevelt Ave.
Syracuse, NY 13210
(315) 477-1189
arantypa@mailbox.syr.edu

SSN: 223-17-4159

Education

University of Washington, Seattle, Washington.
Ph.D., Forest Resources Management, December, 1998.

Social science concentration.
Specialization: Environmental and Natural Resources Policy and Sociology, Sociology of Science.

State University of New York, College of Environmental Science and Forestry, Syracuse, New York.
M.S., Environmental Science, 1991.

Specialization: Environmental and Natural Resources Policy, Natural Resources Sociology.

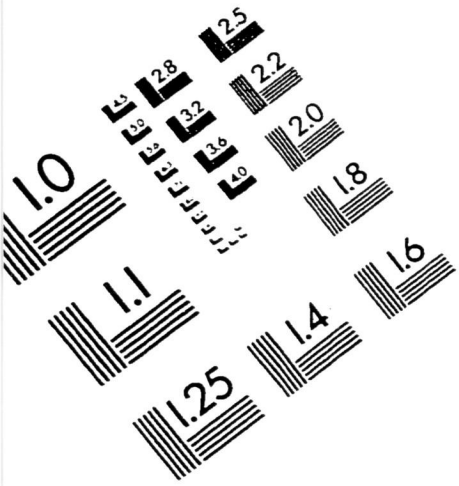
Georgetown University, Washington, DC.
B.A., History, Minor in Government, 1986.

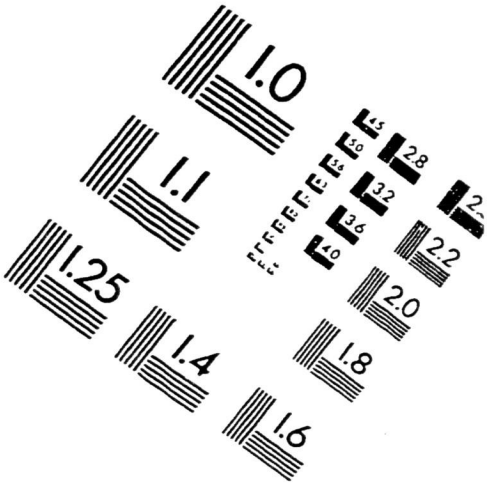
Specialization: Middle Eastern, African, and European History and Government

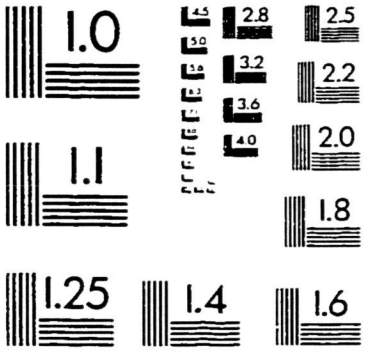
Universität Tübingen, Tübingen, Germany.
Junior year abroad, 1984-1985.

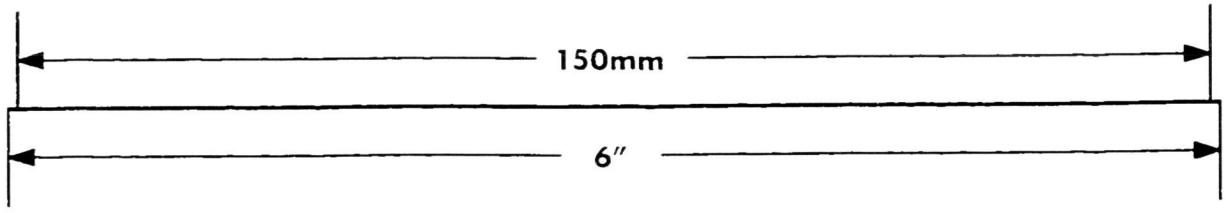
Specialization: German History and History of Ancient Greece

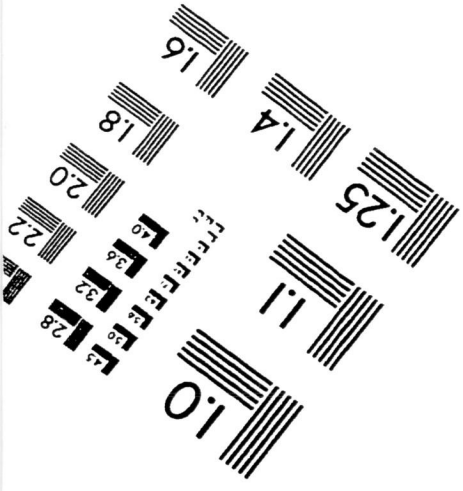
IMAGE EVALUATION
TEST TARGET (QA-3)

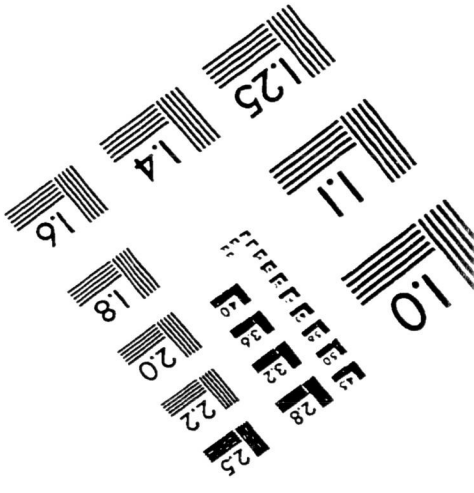












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