A Discourse Analysis of Stakeholders' Understandings of Science in Salmon Recovery Policy

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(ABSTRACT)

The purposes of this study were to examine 1) understandings of science expressed in formal salmon recovery policy discourse; 2) rhetorical practices employed to justify or undermine claims about salmon policy 3); and patterns of understandings of science and associated rhetorical practices between social categories of actors. This research contributes to scholarship in public understanding of science, discourse studies, and natural resource policy.

A constructivist discourse analysis was conducted using qualitative methods to analyze transcripts from over one hundred congressional hearing witnesses representing a wide diversity of stakeholder groups. Multiple coders organized discourses into analytic categories, achieving a final proportional agreement of 80% or greater for each category, at the finest scale of analysis.

Stakeholders employed a collection of prototypical understandings of the nature of science, boundaries of science, and roles of science in decision-making. The process of science was described as impartial and ideal, a way to reduce uncertainty through consensus and peer-review, and subject to changing paradigms. Scientific knowledge was sometimes represented as "truth" and other times as tentative, and scientists were portrayed as independent and objective as well as captured and interest-driven. Witnesses described science as separate from and superior to politics and management. Testimony included descriptions of science's role in developing decision alternatives, selecting among alternatives, and evaluating and legitimating alternatives.

Stakeholders used these understandings of science to construct justifications to support their claims about salmon policy and undermine opposing claims. Science-based justifications included externalizing devices, construction of consensus, category entitlement, and extreme case formulations. Other justifications invoked local control, treaty rights, and local knowledge, or relied on interest management.

This study has extended the theory and method of empirical discourse analysis, and produced a taxonomy of understandings that should be transferable to studies of similar policy settings. Additionally, conclusions from this study about differences between social groups in the presence, distribution, and frequency of expression of the discourses might be developed into propositions for further testing. Finally, the study has implications for communication about the role of science in collaborative natural resource decision-making processes.

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CHAPTER I: INTRODUCTION

Introduction

The arena of natural resource policy is increasingly characterized by inefficiency and paralyzing controversy. Pacific Northwest salmon recovery is emblematic of a class of "contentious, socially wrenching" natural resource policy problems that are characterized by complexity, polarization, high stakes, delayed consequences, divergence between national and regional priorities, and a problematic role for science in the decision-making process (Lackey, 2000, p. 91). In the case of salmon recovery, a majority of the public expresses support for restoration, at least in principle (Smith & Steel, 1997), and legal mandates such as the Endangered Species Act (ESA) are in place to guide recovery, but there has been little progress to date. It seems that society and decision-makers may be unwilling to implement the changes that appear necessary to restore wild salmon runs to historic levels. This issue is so contentious because there are competing social values at stake that are each legitimate, but may be partially or entirely in conflict (Lackey, 2000; Michael, 1999). Furthermore, the relevant decision-making agencies have divergent institutional priorities and entrenched bureaucracies that have stymied the development and implementation of a coordinated policy approach. Resolution of this complex controversy will ultimately require clarification of societal priorities, working through underlying social value conflicts, institutional reforms, and individual lifestyle changes.

Within this contest of social values, interests, and power, science has come to play an important role in policy discourse. To seek advantage in the policy arena by drawing on the cultural authority of science, stakeholders often propose that science should guide policy, frame their policy positions in scientific terms, and construct scientific arguments to support their positions. While the underlying causes of salmon recovery policy disputes are rooted in divergent social values and competing interests, policy discourse is often framed and conducted in scientific and technical terms. This tendency makes salmon recovery policy an excellent context for studying issues related to public understanding of science and discourse studies.

The primary goal of this study is to contribute to scholarship in the fields of public understanding of science and discourse studies by analyzing the content, structure, and distribution of understandings of science expressed in Pacific Northwest salmon recovery policy discourse. However, I also hope that this analysis might contribute to a better understanding of stakeholders' communication and persuasion strategies, and perhaps enhance reflexive and collaborative dialogue between stakeholders and policymakers. While it is clear that achieving salmon recovery will require much more than an analysis and clarification of language, studies such as this one that focus on discourse in democratic dialogue represent one part of an overall strategy.

Specifically, my study is designed to analyze: 1) understandings of science expressed in formal salmon recovery policy discourse; 2) rhetorical practices employed to justify or undermine claims (especially science-based claims), and support or condemn potential recovery actions and other policy actors, and; 3) patterns of understandings of science and associated representation practices between social categories of policy actors. Exposing and highlighting such rhetorical strategies is relevant for public understanding of science and discourse studies, especially in circumstances such as policy discourse, where science-based arguments are made to justify competing programs of action and competing institutional priorities.

In the interest of disclosing assumptions that frame my scholarship, it should be noted that in this study I proceed from the supposition that science is not constructed as a single, pre-determined set of methods, knowledges, and institutions, but rather, in discourse, science is an emergent category subject to active construction, representation, and negotiation. While I am certainly aware of the pre-existing and culturally prominent discourses of science that are likely to be encountered, I am also open to less common understandings. Of equal importance, the policy actors in this study are treated as a heterogeneous group comprised of individuals with agency, interests, and group affiliations. The socially constructed nature of science allows these diverse actors different, and perhaps differential, access to power. Thus, I am following the recommendations of Irwin and Wynne (1996) to examine relationships between science(s) and public(s) in such as way as to "interpret both 'science' and the 'general public' as diverse, shifting and often-diverging categories" (p. 7).

Furthermore, it is my position that a diversity of understandings of science is unavoidable and not necessarily detrimental to policy development. Rather, this ambiguity about science and its role in policy development, if dealt with constructively, could encourage policy actors to be more deliberate and reflexive in their discourse. That is, examining multiple and varied understandings of science in discourse may allow for more meaningful deliberation and help to overcome the conceptual disorder that impedes policy development in natural resource management. If actors in the salmon policy debate genuinely share the ultimate goal of recovery, but attainment of that goal is impeded by unreflexive communication about key concepts such as science, exploration of discursive patterns may lead to heightened reflexivity and thereby to better solutions. In such instances, this project may help analysts and participants develop a "more nuanced and less polarized view" (Yearley, 1994, p. 256) of both the capabilities and the limitations of science's contribution to solving policy problems. This awareness could in turn encourage more meaningful involvement of multiple stakeholders, enhance the efficiency of the policy process, and improve the effectiveness of scientific advice. However, when the policy actors do not share the ultimate goal, or other institutional and social structural problems exist, mere definitional clarity may not improve the situation. But even in such cases, stakeholders who understand scientific discourse would be more discriminating and critical participants, and thus more effective.

Research Context: Northwest Salmon Recovery Policy

This study explores understandings of science within the general context of natural resource policy. However, stakeholders usually do not discuss natural resource policy (or other important social phenomena) in the abstract, but rather engage the concepts through specific issues (Kendra & Hall, 2000; Richards, 1996). Therefore, my focus is on one of the most significant contemporary natural resource policy problems – recovery of threatened and endangered salmon in the Pacific Northwest. Salmon recovery is a vital issue because the fish have important ecological, economic, cultural, and religious significance to the Pacific Northwest and beyond. Also, science figures prominently in recovery policy development, where science mediates between the environment and the recognition of a problem by society (Beck, 1992; Eden, 1996). Science is especially prominent in policy issues such as salmon recovery because the environmental process in question is quite complex and global in significance (Eden, 1996). Moreover, the federal agencies with primary decision-making authority in salmon recovery have recently embraced the ecosystem management framework, which seeks to achieve integration of science and social values in natural resource management.

The specific policy setting for this study is the congressional hearing. Formal hearings before committees and subcommittees of the United States Senate and House of Representatives are an excellent study context because the plurality of viewpoints present in congressional hearings and the short time available to each witness – approximately five minutes – highlight the topics of concern in this study. Witnesses must establish the credibility and factuality of their claims and respond to others' claims forcefully and succinctly, and thus science-based justifications are thrown into high relief. Such hearings are pivotal in salmon recovery policy because these congressional committees have oversight responsibility for the involved agencies, including the National Marine Fisheries Service and the U.S. Fish and Wildlife Service. The scale and significance of salmon recovery as a policy problem require Congressional intervention, and thus the various stakeholder groups focus a great deal of effort on persuading committees. Finally, the so-called "Sunshine Laws" that frame decision-making in salmon recovery policy (e.g., National Environmental Policy Act of 1970 and Endangered Species Act of 1973) have significant public involvement requirements that encourage Congress and the federal action agencies to solicit a wide spectrum of viewpoints when crafting policy.

Topics of the Study and Research Questions

There are four topics of the study: 1) understandings of the nature of science (i.e., attributes of science as a way of knowing about the world, scientific knowledge, and scientists); 2) understandings of the boundaries of science (i.e., the difference between science and non-science); 3) understandings of the roles of science in decision-making (i.e., what science can/should or cannot/should not contribute to decision-making); and 4) representations of recovery (i.e., the argumentative strategies that are used to promote claims as factual and support recovery actors and actions or undermine claims and condemn actors and actions).

These topics were suggested by previous research in the fields of public understanding of science and discourse studies. This research, which is reviewed in detail in Chapter II, informed this study by suggesting the content and range of different understandings of science that may be present in stakeholders' discourse; patterns of differences in understandings of science between social groups; the types of rhetorical devices that are employed to establish claims as factual and to support or denigrate potential recovery actions and other social actors; and the potential social functions of discourse (i.e., how discourse serves to authorize and enable some groups or disenfranchise others). The four topics of the study and associated research questions are explained below.

Understandings of the Nature of Science

Research Question 1: What understandings[1] of the nature of science are expressed in stakeholders' discourse about Pacific Northwest salmon policy?

The first topic of the study concerns how stakeholders portray science as a way of knowing about the natural world and how they describe scientific knowledge and scientists. For example, science may be described as a dispassionate endeavor, generating objective, incontrovertible knowledge that accumulates in a progressive manner over time (Ozawa, 1996). Scientists might be represented as working independently from society, untainted by values, intelligent, socially withdrawn, rational, devoted to knowledge, and relatively indifferent to money (Mulkay, 1976). Such prototypes, or ideal types, of science (Michael, 1996) are commonly reproduced in the media and inculcated through socialization, and hence are common in contemporary American society. Actors who employ such understandings in their speech draw on the social authority and approval of science to bolster their position.

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[1] Various authors use the terms "discourse" (Macnaghten, 1991) or "interpretive repertoire" (Wetherell & Potter, 1988) to describe analytic units of speech that are distinguished by specific metaphors or grammatical forms and accomplish functions in social practice. I use the term "understanding" to recognize that descriptions of science in policy discourse are affected by cognitive and affective dimensions as well as discursive elements and intended function. In this study I focus on the discursive representation of science, and cannot make conclusions about the other dimensions of the expressed understandings (i.e., cognitive, affective).

However, from a different perspective, science may be represented as tentative and uncertain; scientists might be portrayed as more interest-driven, with no greater claim to decision-making authority than any other policy actors. Stakeholders might challenge the objectivity of science and scientists by questioning who funds research, how the results will be used and who will benefit, and how certain the results will be (Hagedorn & Allender-Hagedorn, 1997; Harrison, Burgess, & Clark, 1998; Hornig Priest, 1995). Such prototypical understandings are also culturally available and may be used to undermine claims.

A limited number of culturally available understandings of science are possible, with differing degrees of complexity and consistency. This research seeks to characterize the understandings evident in public discourse. Based on theory and prior research, which is reviewed in Chapter II, differences are expected among stakeholders based in part upon their interests, affiliation with institutions, and social roles.

Understandings of the Boundaries of Science

Research Question 2: What understandings of the boundaries of science are expressed in stakeholders' discourse about Pacific Northwest salmon policy?

The second study topic is stakeholders' understandings of the boundaries of science. This concerns the question of what exactly counts as science and scientific knowledge and who counts as a scientist. Establishing conceptual boundaries between science and non-science, whether done tacitly or explicitly, functions to empower certain actors and disenfranchise others. The negotiation of science's boundaries is critical to many disputes because of the historically prominent status of scientific knowledge and scientists in natural resource decision processes. Because stakeholders may define science by comparison (e.g., to policy) or by negation, the second topic is a clear extension of the first. Stakeholders' understandings of the boundaries of science may include the perspective that science is unique and clearly distinct from non-science. Science might also be described as similar to other social endeavors. The study of how people distinguish science from non-science has emerged as a concern among sociologists, who term the practice boundary work (Gieryn, 1983, 1995, 1999; Guston, 1999; Jasanoff, 1987, 1990, 1995).

Boundary work is relevant to my study because success in defining boundaries can significantly alter policy outcomes. This literature is reviewed in Chapter II.

Understandings of the Roles of Science

Research Question 3: What understandings of the roles of science in decision-making are expressed in stakeholders' discourse about Pacific Northwest salmon policy?

The third study topic deals with stakeholders' ideas about the roles that science should play in decision-making, which is often a point of contention in policy disputes. From one perspective, scientists are believed to be able to collect relevant data that will solve problems, and adherents of this view often advocate a central role for science as an arbiter or formulator of policy (Abraham & Shepard, 1997). For example, Wilkinson (1998) argues that the crisis in natural resource policy can be traced to "a nearly complete abdication of important scientific decisions by the executive branch of government to senators, Congress and western good-ol'-boy governors" (p. xviii). Some scientists have suggested that they possess exclusive knowledge and should be privileged in decision-making because the public is ignorant, irrational, or emotional (Pouyat, 1999).

However, from a different perspective, stakeholders may argue that science should not be the most prominent factor in decision-making. Policy actors sometimes downplay the role of science by focusing on the social values underling disputes, or by highlighting democratic ideals of shared decision-making. In recent decades, the privileged position of science has been increasingly challenged on many fronts. Some stakeholders question whether scientists should retain a central role in decision-making (Foltz, 1999; Sclove, 1998). Although they accept science as providing useful information, science is subordinated to other considerations. This study seeks to characterize the roles that stakeholders' ascribe to science in public debate and explore how perspectives differ across social roles. Success at defining on or another role for science would significantly alter policy-making processes and outcomes.

Representations of Recovery

Research Question 4: How do stakeholders represent recovery actions and actors in discourse about Pacific Northwest salmon policy?

The final study topic concerns how stakeholders support their own claims, and support or condemn potential recovery actions and other policy actors. Recent scholarship in discourse studies has illuminated the discursive practices by which arguments are constructed as factual or valid (e.g., Potter, 1996). Salmon recovery offers a particularly fruitful case to study for this topic because the scientific basis of potential recovery actions (e.g., dam removal, harvest restrictions) is hotly contested, so that all sorts of evidence is marshaled and rhetorical devices are employed to influence decision-making. Furthermore, conflicts over social values underlying salmon recovery are often played out through scientific discourse. Sometimes science serves as the basis of truth claims; other times different rhetorical devices are employed to construct factuality. In this research, it is of interest whether stakeholders differ in their use of science to support or oppose proposed management, versus other ways of establishing credibility.

Summary

To introduce the dissertation, the previous section identified the purposes and topics of the study and introduced the types of understandings of science and discursive practices that might be encountered in policy debate. Although a diversity of understandings of science and discursive practices is at least potentially available to any actor (Abraham & Shepard, 1997; McGinnis, 1995; Williams, Brown, & Greenberg, 1999), patterns of similarity within social groups and patterns of differences between social groups are anticipated. In the political context of Congressional hearings, descriptions of the nature, boundaries, and roles of science's in decision-making are likely to be determined in large measure by the interests of the organization that a witness represents. Thus, it is necessary to consider the witnesses self-identified affiliations, allegiances, positions, and interests when evaluating their discourse.

Outline of the Dissertation

This dissertation is presented in six chapters, including this introductory chapter. Chapter II includes a review relevant literature focusing on science in the context of the salmon recovery policy problem. Additionally, Chapter II includes a review of literature from the fields of public understanding of science that shaped the direction of the study. Chapter III details the theoretical and methodological approach that is employed in this empirical discourse analysis. The results of the study are contained in Chapter IV, which focuses on stakeholders' understandings of the various dimensions of science, and Chapter V, which discusses representations of recovery. Finally, Chapter VI includes conclusions and discussion of the significance and implications of the study.

CHAPTER II: THE SALMON "PROBLEM"

Introduction

Pacific Northwest salmon recovery is one of the most intractable problems ever to face natural resource policymakers. This chapter outlines the current status of the salmon problem in the Pacific Northwest and briefly summarizes the reasons that the policy debate is degenerating into what van Eeten (1999) terms a "dialogue of the deaf." Also, I review the relevant literature from the fields of public understanding of science, boundaries of science, and the roles of science in policy making.

The current status of wild salmon runs in the Pacific Northwest is extremely poor. As a result of social and ecological changes in the Columbia River Basin, the range and number of the once abundant fish have declined since the middle of the nineteenth century:

> Pacific salmon have disappeared from about 40% of their historical breeding ranges in Washington, Oregon, Idaho, and California over the last century, and many remaining populations are severely reduced. Most runs that appear plentiful today are largely composed of fish produced in hatcheries. (National Research Council, 1996, p. 1)

Within the seven Pacific salmon species (chinook, chum, coho, pink, and sockeye salmon, and the anadromous steelhead and sea-run cutthroat trout) there are fourteen populations, or evolutionarily significant units (ESUs), listed as threatened or endangered in the Columbia River Basin (Federal Caucus, 2000). ESU is the term for a subspecies or distinct population segment of fish used for the purposes of implementing the Endangered Species Act (National Research Council, 1995).

The most widely cited causes of salmon decline are the so-called Four Hs: habitat, harvest, hatcheries, and hydropower:

> The deterioration of the Columbia's once-numerous fish runs can be traced to the economic development of the basin. Human activities have caused the decline of these fish. Forestry, agriculture, mining, and urbanization have destroyed or altered tributary

> *habitat*. Fishing, or *harvest*, has reduced the number of adult fish that return to spawn. Some *hatcheries* have introduced inbreeding and competition, may have been a source of disease for wild fish, and have in some cases induced fisheries to harvest at rates too high for natural stocks. And *hydropower* dams on the Columbia and Snake rivers have blocked and inundated mainstem habitat, altered natural flows, impeded passage of migrating fish and created a series of pools where fish predators reside. (Federal Caucus, 2000, p. 186, emphasis in original)

The effects of the Four Hs have been exacerbated by the life cycle of the anadromous fish, which spawn in freshwater, migrate to the ocean, and ultimately return to their natal streams to reproduce: "Salmon thus require high-quality environments from mountain streams, through major rivers, to the ocean" (National Research Council, 1996, p. 3).

Salmon Recovery Policy: A "Dialogue of the Deaf"?

From a public policy perspective, the problem is a nearly complete failure of recovery efforts to address the effects of the Four Hs and restore salmon stocks to sustainable levels despite legislative mandates, agency policies, market incentives, and volunteer efforts:

> With early recognition of the problem, over 100 years to respond, and the expenditure of billions of dollars on research by fishery scientists and managers, it might reasonably be expected that the problem of declining salmon populations would have been solved by now. In fact, however, most fish advocates agree that the problem has become progressively worse. (Campbell, 2002, p. 1)

While the Four Hs may be proximate causes of salmon decline, Lackey (2000) summarizes the issues underlying the failure of the policy system to respond to the problem. First, the issue is politically complex because there are a number of viable policy options with associated trade-offs that the public and decision-makers must consider. Second, the policy community is polarized and positions are entrenched because there are conflicting social values, such as economic development and environmental preservation, which may be, or may be portrayed to be, partially or entirely incompatible. Third, there are significant consequences for individuals and groups from the various policy alternatives; that is, there are likely to be big winners and big losers and tremendous amounts of money are at stake. Fourth, the costs of salmon recovery are great and immediate, whereas the benefits of recovery, if possible, are less well documented and not likely to be enjoyed for some time. Fifth, traditional decision-making models are ineffective in resolving controversies such as salmon recovery, where multiple, legitimate and deeply held social values are in competition. Sixth, national and regional priorities are divergent. For example, Northwest economies have benefited greatly from cheap electricity from hydropower, and regional industries that have profited, such as the aluminum industry, are openly hostile toward salmon recovery despite the national and even global significance of salmon. Finally, Lackey recognizes a problematic and ambiguous role for science as a contributing factor to the gridlock. While the policy choices may be based in value preferences, the debate is often carried out through scientific discourse characterized by competing, science-based claims.

To disentangle the salmon policy problem will require effort to resolve each of the complex causes and of course, there is no single solution. In this study I focus on one dimension of the policy process, communication between interested stakeholders and policymakers, specifically focusing on the nature, boundaries, and roles of science in decision-making. While I recognize that promoting more reflexive and deliberate communication among the policy community will not "fix" this policy system that seems to be "broken" on so many levels, if the system is to have any chance of working though this issue, there must be progress on each front, including understanding the structure and function of communication between stakeholders and policymakers. Furthermore, precisely because of the policy community's apparent inability, or unwillingness, to decide between competing and legitimate social values among stakeholders, policy discourse often focuses on science and science's role in decision-making, which makes this an excellent case for studying public understanding of science and discourse studies issues.

As a result of the various causes discussed above, the policy discourse among the various interested parties seems to be degenerating into a dialogue of the deaf (Sabatier, 1988; van Eeten, 1999). In a dialogue of the deaf, multiple arguments are advanced that are each valid within their own frameworks and assumptions, and efforts to decide a course of action based on the merits of some rational, objective criteria are ineffective. Dialogues of the deaf can ultimately result in decision-making paralysis, as is the case with salmon recovery. The debate may then turn on how the issue is framed, what counts as knowledge, and which actors are empowered or disenfranchised as a result of adopting particular understandings of key concepts such as science.

In the case of salmon recovery, the dialogue of the deaf includes myriad individuals, social institutions, and groups that have a stake in salmon recovery – collectively known as a policy community (Kingdon, 1995) – that have divergent viewpoints about science and science's role in decision-making. The diversity of the policy community for this issue is astounding. For example, a sampling of the federal governmental or quasi-governmental organizations includes: National Marine Fisheries Service, U.S. Fish and Wildlife Service, Bonneville Power Administration, Army Corps of Engineers, Bureau of Reclamation, Environmental Protection Agency, Bureau of Land Management, Bureau of Indian Affairs, Northwest Power Planning Council, and Columbia Basin Fish and Wildlife Authority. In addition to the federal interests the stakeholder list includes the nation of Canada, several sovereign Indian tribes, the state, county, and local government structures of Oregon, Washington, Idaho and Montana, and a broad range of other groups and interests with widely divergent degrees of social organization, power, and resources (e.g., conservation organizations, port districts, agriculture, forestry, ranching and mining interests, private property advocates, commercial and recreational fishers, students, politicians, scientists, coalition groups, etc.). An illustrative and up-to-date sample of publicly expressed viewpoints about salmon recovery policy is maintained online by Bayer (2002).

The aforementioned policy community engages in debate about salmon recovery in a number of different settings, from the informal to the formal. Congressional hearings are one example of a formal setting that is an appropriate context for examining how understandings of science are expressed in public debate. The rationale for including the specific committees, subcommittees, and hearings chosen for this study is detailed in Chapter III. However, a brief mention of the hearing process is appropriate for this section.

The U.S. House of Representatives and the U.S. Senate conduct most daily business through approximately two hundred and fifty committees and subcommittees. Standing committees generally have jurisdiction over legislation but usually delegate specific issues to relevant subcommittees (United States Senate, 2002). For example, salmon recovery policy has been deliberated in the Senate by the Subcommittee on Fisheries, Wildlife, and Drinking Water, which is part of the Committee on Environment and Public Works. When a committee or subcommittee deliberates an issue, hearings are routinely called to solicit information from interested members of the policy community. The committee invites the witnesses and generally solicits feedback from a diverse group of stakeholders. In regard to salmon recovery, congressional hearings have been called to discuss implementation of the provisions of the Endangered Species Act, to provide oversight to the federal agencies responsible for salmon recovery, and to debate new pieces of legislation that would affect ongoing recovery efforts.

A cacophony of voices can be heard in the Pacific Northwest salmon recovery policy debate. However, stakeholders often talk past one another in a dialogue of the deaf. There is no clear solution to such intractable policy debates (Allen & Gould, 1986); if there were, salmon policy would not continue to attract the attention of so many analysts, and recovery might be underway. In the next section, I discuss three key areas of research that informed the development of this study, beginning with public understanding of science, followed by sociological studies of the boundaries of science, and concluding with policy studies about the role of science in decision-making.

Public Understanding of Science

Public understanding of science (PUS) is a broad and loosely defined field, and no single theoretical or disciplinary perspective currently dominates. However, historically there has been an ideological thread running through PUS research that has influenced the way issues have been framed (Wynne, 1995). Specifically, the public's *understanding* of science was problematized, but *science* itself was not. That is, early PUS research focused on the public's cognitive processes (and deficits) concerning knowledge of accepted scientific facts and methods, as well as public support for scientific institutions and scientists. As public understanding of science emerged as an issue in the years following World War II, attention was "focused on promoting an *appreciation* of science, and especially the 'benefits' of science to society" (Lewenstein, 1992, p. 62, emphasis in original). The main concern was improving the public's *scientific literacy*. There was virtually no attention to improving scientists' *public literacy*.

Contemporary PUS research has become more ideologically, theoretically, and methodologically diverse. Wynne (1995) provides a review of three identifiable approaches to contemporary PUS research. One approach – stemming from the earlier focus – involves the use of large-scale quantitative surveys of representative samples of the public. This approach dates back to the early 1970s and the development of the National Science Board (NSB) science and engineering indicators reports, which are now produced regularly (e.g., National Science Board, 2000). Since the 1980s NSB research has been paralleled by similar efforts in Japan and Europe. The focus of this class of studies is on developing a reliable system to measure public support for scientific institutions and various aspects of public understanding of science, such as scientific literacy. This research approach, exemplified by the work of Jon D. Miller (1983; 1987; 1998), strives to generate results that can be readily interpreted by policy makers.

The survey approach has provided a wealth of information and done much to advance the field of PUS. However, there are several consistent criticisms. One weakness is the tendency to interpret public understanding based on a respondent's answers to a battery of context-specific questions that are judged against a pre-determined "scientifically correct" answer. This has been termed the "deficit model" because it generally defines the public as cognitively deficient with regard to scientific knowledge (see Michael, 1996). Such surveys may not fully assess one's understanding of science, but rather how widespread one particular notion of science is among the public. Furthermore, the survey method attempts to assess knowledge and understanding out of the context of social interaction, where much meaning is constructed (Wynne, 1995).

The second dominant approach to PUS research draws on cognitive and social psychology and cognitive anthropology, focusing on the identification of mental models such as schemas, which are described as non-conscious cognitive structures instrumental in classification, simplification, prediction, and cognitive stability (Blount & Schwanenflugel, 1993). Mental models guide information organization, selection, and recall, as well as inferences based on that information, and provide a frame of reference for judgment. These cognitive structures give rise to expectancies, and are essential for guiding behavior and facilitating cognitive economy (Ross, Amabile, & Steinmetz, 1977).

The mental model approach in PUS research involves the identification of cognitive structures related to science or particular aspects of technology (e.g., Collins & Gentner, 1987; Gentner & Gentner, 1983; Kempton, 1987). For example, Einsiedel (1994) described multiple, interrelated schemas related to science and associated attitudes among Canadian adults, noting, "cognitions about scientific concepts may trigger more generalized schemas relating to science, the scientific enterprise, and roles associated with scientists, which may evoke some evaluative response" (p. 39). Research from this perspective suggests that multiple models related to the general concept of science operate simultaneously. A consequent dilemma has been defining a domain for which the researcher can reasonably assume a model exists. Critics of this approach contend that the metal models identified in some studies, such as Kempton's (1987) study of "home energy management" models, may be artifacts of the researcher's imposed view, or that such models may be unique to the populations studied. Additionally, there have been some questions about the ability of researchers to "map" mental models independent of social context (Wynne, 1995). Furthermore, there is disagreement among theorists about the stability of mental models, especially with regard to unfamiliar concepts with which people have limited exposure (Michael, 1996).

Despite these limitations, an important contribution of the mental model approach has been to encourage an expanded definition of the PUS problem to include *naïve theories* of science and technology (Anderson & Lindsay, 1998). The direct relevance of this point for my study is that by recognizing naïve theories of science, research has begun to move beyond a deficit model to explicitly allow for subjects to understand science in individualized ways. Furthermore this perspective points research toward an examination of how understandings of science might shape how people act with regard to other issues, such as natural resource policy. Also, the mental models approach tends to assume that the number of different prototypical understandings of science is limited, which is also an assumption in this study.

The third major approach to PUS research is broadly construed as constructivist in theoretical orientation, employing methods of discourse analysis, and is less well circumscribed. This approach has been heavily influenced by critical analyses of science, especially constructivist approaches, the sociology of scientific knowledge (e.g., Collins, 1988, 1999; Latour, 1987), and critical discourse analysis (Fairclough, 1995; Hammersley, 1997). A defining feature of studies in this genre is a commitment to the notion that "problematizing science is a central part of any serious attempt to define the overall research and public policy issues of public understanding of science" (Wynne, 1995, p. 385). That is, constructivist PUS research seeks to avoid predetermined normative prescriptions about science by allowing various constructions of science to emerge from the public rather than gauging understandings against a particular prescribed view. Another important characteristic of the constructivist approach is its focus on the social context of knowledge.

For example, Michael (1996) employed a constructivist approach to PUS to examine the active construction of relationships between individuals and their own ignorance of scientific knowledge and shared understandings with actors from other social worlds. Other research has focused on the importance of trust, relevance, and models of agency (see Wynne, 1995). Yearley (1994) suggests that constructivist research highlights certain aspects of science, such as the role of skilled judgment, interpretation, and trust that are most visible in controversial situations. Based on the advantages of these features – the problematization of science, focus on social context and active construction of meaning, and the usefulness of examining controversy – constructivist discourse analysis is the approach I prefer. Additionally, constructivist discourse analysis is the most appropriate approach for the policy context in this study (congressional hearing). This approach is explored in detail in the next chapter.

Expectations for Salmon Recovery Policy Discourse

Although little PUS research has directly examined understandings of science in natural resource policy specifically, a number of studies have examined PUS issues in such realms as environmental policy (Eden, 1996), biotechnology (Davison, Barns, & Schibeci, 1997; Hagedorn & Allender-Hagedorn, 1997; Hornig Priest, 1995; Irwin, 2001), genetics (Michael & Carter, 2001; Richards, 1996), and climate change (Kempton, Boster, & Hartley, 1995; Weingart, Engels, & Pansegrau, 2000; Zehr, 2000). Furthermore, other studies have addressed understandings or social constructions of related natural resource concepts including salmon (Scarce, 1999, 2000), nature (Dizard, 1994; Hull, Robertson, & Kendra, 2001), environmental quality (Richert, 2001; Seekamp, 2001), and wilderness (Kendra & Hall, 2000). Based on these studies and others discussed below, I expect to find a wide range of understandings of the characteristics of scientists, scientific process, and scientific knowledge expressed in salmon recovery policy discourse.

As most PUS research focuses on scientists and non-scientists or lay citizens, certain expectations arise for these rather broad social categories. I expect those witnesses who self-identify as scientists or who have strong affiliations with scientific organizations (e.g., academic scientists, science advisory board members, etc.) to exhibit traditional or received notions of science in their discourse (e.g., science described as a value-free endeavor conducted by objective scientists that generates incontrovertible knowledge about the natural world). This expectation is based in part on examination of policy discourse in other environmental and natural resource settings, where scientists have tended to portray themselves as possessing exclusive knowledge whereas the public is considered ignorant, irrational, or emotional (e.g., Huenneke, 1995; Magill, 1988; Pouyat, 1999). Although I expect this traditional view of science to be prevalent among scientists, I also expect to find among some a sense that scientific knowledge (at least in the case of salmon recovery) can be uncertain, tentative, and subject to refinement.

Furthermore, based on Yearley's (1992; 1996) studies of environmental organizations, I expect that representatives of conservation organizations will be ambivalent about the validity of scientific knowledge or the objectivity of scientists. This ambivalence is expected because of the unique relationship between environmental organizations and science. On one hand, environmental organizations increasingly use scientific credentials to make claims to legal-rational social authority and many environmental groups have historic ties to scientific organizations, most notably natural history sciences. Yearley (1992) suggests that the environmental movement is "doubly bound to science, by epistemological affinity and common descent" (p. 514). However, environmental organizations' relationship to science is not straightforward as one might expect, for many individuals and organizations blame science and technology for creating the ecological problems currently facing society.

Among those stakeholders who do not closely align themselves with science, I expect that a diversity of understandings will be expressed in discourse, in part due to the variety of perspectives present in this study that might be classified as non-scientists or lay citizens (e.g., Idaho Farm Bureau representative, Director of Orofino Chamber of Commerce, and Director of Northwest Marine Trade Association). As previously noted, one of the objectives of this study is to better understand and document this complexity. My expectations for these actors are based on in part on Michael's (1996) findings that lay people employ "discourses of ignorance" by describing themselves as not scientifically minded and science as unfathomable. Michael (1992) also found that lay understandings of "science-in-general" differed from understandings of "science-in-particular." That is, although a traditional conceptualization of science is likely to be present in non-scientists' discourse, it is also possible that lay witnesses will question the validity of scientific knowledge and the objectivity of scientists in specific circumstances. Furthermore, research has shown that citizens' trust in the validity scientific and technical knowledge may differ based on the source of the science (e.g., industry vs. government) (Peters, Covello, & McCallum, 1997; Soden, 1995).

While public understanding of science research provides some general guidelines about the range of understandings that may be encountered in recovery policy discourse, the collection of sociological studies discussed below informed my expectations for how stakeholders distinguish science from other social endeavors, such as policy, management, economics, or law.

Boundaries of Science

How the boundaries of science are delineated to distinguish science from non-science is an important topic for this study because scientists and scientific knowledge have historically been prominent in natural resource policy. Because of the prominence of scientific knowledge as a decision-making tool and the influence that science has had on decision processes, stakeholders often (understandably) seek to characterize their knowledge as scientific, and their positions as scientifically supported. From the sociological perspective, the analytic challenge is not determining whose knowledge is scientific and whose claims are scientifically valid, but rather how stakeholders' understandings of the boundaries of science are expressed in policy discourse. This perspective is relevant because labeling claims as scientific serves to legitimate and empower certain actors. Today this is especially relevant, as salmon policy is becoming more and more “scientized” (Mann & Plummer, 2000).

Within sociological research, the boundaries of science have been examined through the theoretical framework of “boundary work” (Gieryn, 1983, 1995, 1999; Guston, 1999; Jasanoff, 1987, 1990, 1995). Boundary work research expands on earlier work on demarcation, which focused on identifying “unique and essential characteristics of science that distinguish it from other kinds of intellectual activities” (Gieryn, 1983, p. 781). Defining the essential characteristics of science has long been a topic for philosophy of science. However, the boundary work perspective from the sociology of science denies the analytical and practical usefulness of sharp conceptual distinctions between science and non-science that characterized much early philosophical thought. Boundary work studies relocate the demarcation issue to practical grounds, examining the rhetorical tactics actors use to construct a boundary between science and non-science, and highlighting the consequences that arise from the location of that boundary:

> Characteristics of science are examined not as inherent or possibly unique, but as part of ideological efforts *by scientists* to distinguish their work and its products from non-scientific intellectual activities. The focus is on *boundary work* of scientists: their attribution of selected characteristics to the institution of science (i.e., to its practitioners, methods, stock of knowledge, values and work organization) for purposes of construction a social boundary that distinguishes some intellectual activities as “non-science.” (Gieryn, 1983, p. 781-782, emphasis in original)

Boundary work involves drawing upon an available repertoire of characteristics to describe science and scientists to construct a social boundary. A key point is that these attributions are selectively made based on the social context and the characteristics of the object of comparison. That is, “the boundaries of science are ambiguous, flexible, historically changing, contextually variable, internally inconsistent, and sometimes disputed” (Gieryn, 1983, p. 792). The rhetorical style and characteristics attributed to science may differ based on the goal of the boundary work, which might be monopolization of professional authority and resources, expansion of professional authority or expertise, expulsion of illegitimate professional members, or protection of professional autonomy.

The constructivist notion of boundary work, which is related to work in the sociology of professions, symbolic interactionism, anthropological studies of cultural classification, and feminist theories of knowledge, holds that essentialist characteristics of science, such as Popper's (1959) falsifiability, Merton's (1973) norms, and Kuhn's (1962) paradigmatic consensus, along with other representations, simply provide scientists with a "*repertoire* of characteristics available for selective attributions" (Gieryn, 1995, p. 406, emphasis in original). Constructivists highlight science's malleability, its emptiness as a cultural space that can be strategically filled with selective qualities that helps to explain science's success in acquiring, expanding, and maintaining intellectual authority.

The notion of boundary work has proven useful for identifying the rhetorical practices that scientists use to distinguish science from non-science, but it is also relevant for describing how other actors understand the boundaries of science. Furthermore, examining how actors delineate science's boundaries sheds light the other dimensions of their understandings of science, including the role of science in policy.

Expectations for Salmon Recovery Policy Discourse

Boundary studies have focused on the rhetorical practices of scientists, and thus I expect to find this type of discourse in the testimony of expert witnesses. For example, I anticipate that some scientists will retain the traditional notion of science as a process that leads to objective facts, but distinguish science from policy by suggesting that values come into play when scientific facts are deployed in policy decisions. Although this conceptualization restricts the domain of science, it retains a crucial role for science in the policy process and does not fundamentally challenge the notion of the process of science. The "experimental process, and thus scientific knowledge, remains value-free" (Kerr, Cunningham-Burley, & Amos, 1997, p. 280). This view is one that hinges on the belief that one can separate facts from values, and has been documented in other natural resource contexts. For example, Behan (1997) makes such a case when he asserts in reference to forestry, "science can tell us what is right, not what is good" (p. 415).

However, for most stakeholders, it is unclear what discursive practices will be identified that illustrate the boundary work theme. One possibility is that citizens will differentiate scientific knowledge from their own first-hand or local knowledge. The boundary between science and non-science may be affected by perceived consistency between scientific knowledge and citizens' own local knowledge (Abraham & Shepard, 1997; Michael, 1992). Local knowledge tends to be less abstract and generalized than the expert knowledge of scientists. Local knowledge tends to be place-specific and historically-embedded (Harrison et al., 1998). When there is inconsistency, those with local knowledge may point out that scientists lack real first-hand experience of the particular circumstances and may simply deny the validity of the science (Harrison et al., 1998; Wynne, 1996).

Role of Science in Salmon Recovery Policy

Natural resource policy disputes are often marked by discussion of the role of science and scientists in decision-making. This informational, persuasive, and rhetorical dialogue illustrates actors' conceptualizations of the various roles available to science and scientists in decision-making, as well as providing insight into individuals' normative judgments about which roles are most appropriate, ethical, effective, or legitimate. A reflexive examination of this discourse can facilitate shared understandings of the types of discretionary judgments involved in scientific and technical policy issues, including the type and amount of information necessary, which data collection and analysis techniques are appropriate, how to deal with uncertainty, and what possible effects the institutional affiliation and disciplinary training of experts may have on findings (Ozawa, 1996). When these issues are openly discussed, "stakeholders contending to dominate the decision process are less inclined to posture behind admittedly disputed technical argumentation, as they do in more adversarial procedures" (Ozawa, 1996, p. 227).

An illuminating example of the debate about the role of science and scientists in natural resource policy comes from a recent issue of *Canadian Journal of Fisheries and Aquatic Science* (Healey, 1997; Hutchings, Haedrich, & Walters, 1997a; Hutchings, Walters, & Haedrich, 1997b). Hutchings et al. (1997b) lament the non-scientific influences on the conduct of fisheries research regarding Canadian Atlantic cod and Pacific salmon stocks. These authors draw a sharp boundary between science and policy; the former should be concerned with developing information, the latter implementing rational regulations based on that information. They argue that scientific information explaining the decline of cod and salmon stocks did not properly inform regulations because of nonscientific governmental influences. Specifically, officials with the Canadian Department of Fisheries and Oceans (DFO) were accused of presenting an inaccurate account of scientific consensus, denouncing independent scientific studies, misrepresenting alternative hypotheses, interfering with scientists' interpretations of data, inappropriately disciplining an agency scientist for speaking out against the government's conclusions, and misrepresenting the scientific basis of government reports and decisions. Hutchings et al. (1997b) conclude that "bureaucratic intervention has deleteriously influenced the ability of scientists to contribute effectively to fisheries management" (p. 1206). Based on this understanding of the nature and boundaries of science, these authors propose an independent, publicly funded scientific institution be created that would operate free from political influence.

This analysis and subsequent recommendations were countered (Healey, 1997) on the basis of several allegedly flawed assumptions in the proposal to institutionally separate science from policy. Notably, Healey challenged the assumptions that science is an unbiased endeavor uninfluenced by social forces, and that an independent scientific board would choose to conduct managerially relevant research. Healey suggests that the assumption that independent or better science would inevitably lead to better decisions is naïve and empirically unsupported.

In another example of how members of the policy community debate the role of science in natural resource policy, the Idaho Chapter of the American Fisheries Society (AFS) (1995) asked the question, "Why isn't science saving salmon?". This group of professional fisheries scientists suggested that consensus exists among scientists about the causes of salmon decline and the actions necessary for recovery, but that proponents of the status quo strategically employ claims of bad science or insufficient data to stall decisions. The Idaho chapter of AFS argues that no part of the policy community has the ability to *know* that their preferred policy solution will be effective, but the Idaho AFS is an *unbiased* think tank that is able to provide *unbiased* consensus of opinion. The implied answer to the question, "why isn't science saving salmon?" is that the weight of scientific consensus is too easily disrupted by competing counter- or pseudo-scientific claims. To reinforce this point, an analogy is offered that compares the salmon policy debate to the tobacco regulation debate. Just as the tobacco industry can generate science that contradicts objective medical research, so too can salmon recovery policy actors who disagree with AFS' policy position generate their own science.

Policy analysts have documented such use of counter-science and counter-expertise by increasingly sophisticated non-governmental organizations and industries to challenge policy decisions and exacerbate controversy (Eden, 1996). Counter-science claims can be employed to exploit uncertainty and gaps in scientific knowledge in a strategic manner to stall decisions (Jasanoff, 1990; Laird, 1993; Mitchell, Mertig, & Dunlap, 1991). Thus, according to some, involving science and scientists in policy decisions does not lead to better decisions because scientists' involvement furthers the political polarization of controversies, leads to the deconstruction of expert knowledge, and reduces scientists' credibility because their involvement is seen as ritualistic or manipulative (Limoges, 1993).

Weingart (1999) has pointed out that, paradoxically, the use of science in policy may ultimately be de-legitimating and destructive. As more and more science and counter-science are employed in policy-making, especially in areas with significant levels of uncertainty and lack of consensus, one result is competition for the most recent, and presumably the most accurate research. This process,

> drives the recruitment of expertise far beyond the realm of consensual knowledge right up to the research frontier where knowledge claims are uncertain, contested and open to challenge... the competition between political adversaries for legitimating knowledge pushes the demand for expertise in the direction of yet uncertified knowledge, that is, controversy. (Weingart, 1999, p. 158)

Despite this potentially de-legitimizing outcome of using science in policy, the coupling of the two social processes is solidly institutionalized, and most policy actors agree that science is an indispensable decision tool and the most authoritative source of knowledge in recovery planning. Indeed, it seems that each time there is a failure that stakeholders call for more and better science. Therefore, it is critical for analysts and actors alike to further examine understandings of the roles of science in salmon recovery policy in hopes that such deliberation will help actors to realize the implications of explicit (or tacit) adoption of one or another perspective on the role of science.

Expectations for Salmon Recovery Policy Discourse

I expect salmon recovery policy discourse to be replete with examples of stakeholders expressing their views about the role of science in policy. Furthermore, I anticipate a wide range of perspectives on this issue between different segments of the policy community. For example, natural resource scientists, especially in the fields of conservation biology and ecology, have engaged in a wide-ranging debate about the question of what scientists can or should decide, with little apparent consensus (e.g., Brussard, Murphy, & Tracy, 1995; Franklin, 1995; Lackey, 2000; Meffee, 1998; Noss, 1994; Schmidt, Webb, Valdez, Marzolf, & Stevens, 1998; Wolok, 1995; Woolley, 1997).

Science's role in policy may be a topic of discourse on several levels. For example, the issue may be discussed along a temporal decision-making scale. That is, stakeholders may talk about the role of science in identifying policy problems, creating policy alternatives, selecting among different alternatives, legitimating selected alternatives, or evaluating the effectiveness of selected alternatives. I also expect to find understandings related to science's role in decision-making at different geographical or spatial scales (e.g., local watershed, ecosystem, or region) as well as political scale (e.g., county government, state government, or national government).

From a critical or conflict perspective, it might be expected that some policy actors' understandings of the role of science in policy would be affected by whether or not the science in question supports their interest or policy position. Prior research suggests that having a vested interest, or a perception of significant personal consequence, affects attitudes towards policy issues (Boninger, Krosnick, & Berent, 1995; Crano, 1983; Diekmann, Samuels, Ross, & Bazerman, 1997; Wolpert & Gimpel, 1998; Young, Thomsen, Borgida, Sullivan, & Aldrich, 1991). For some members of the policy community, interests will be largely economic, as is the case with commercial fishers affected by salmon recovery. Others may have vested interests of a different sort, based on perceived environmental consequences or attachment to place (Williams et al., 1999).

One additional consideration regarding the role of science in policy is the general consensus among the policy community that recovery efforts to this point have been ineffective. If stakeholders believe that science and scientists have directed recovery policy in the past, there may be cynicism about the role of science. That is, people may point out past failures caused by science (Harrison et al., 1998). In the Pacific Northwest, for example, scientists once argued that streams should be *cleaned* of debris to help fish; today such practices are viewed as detrimental, and scientists promote precisely the opposite. This inconsistency has been used to question whether today's scientists have a similarly tenuous perspective on the truth and thus argue that their role in decision-making should be limited.

Summary

This chapter established the complexity of salmon recovery as a policy problem and reviewed relevant areas of research that are influential in framing the topics of study and research questions. Public understanding of science research, sociological studies of boundaries of science, and debate about science's role provided insights into the range of understandings of science that may be encountered in salmon recovery policy discourse.

CHAPTER III: THEORETICAL AND METHODOLOGICAL APPROACH

Introduction

This study was conducted within the theoretical and methodological traditions of discourse analysis, which has been specifically recommended as a useful framework for new work within the field of public understanding of science (Wynne, 1995). Following this introduction, Chapter III has four main parts and a summary. The first section is an explanation of the theory and method of discourse analysis and a justification of its applicability as a framework for this study. I situate discourse analysis within a broader context by reviewing developments within a number of social science disciplines. The second section of this chapter includes a review of the prominent approaches to discourse analysis as well as an explanation of the particular adaptation of discourse analysis that I employed in this study. The third section details my rationale for choosing the empirical material analyzed in the study (transcripts of oral testimony given by witnesses to Congressional committee and subcommittee hearings dealing with salmon recovery policy during the period of 1998 to 2000). In the final section I describe the three-phase process used for analyzing the textual data, which involved stages of data reduction, data display, and conclusion drawing and verification.

Situating Discourse Analysis

Although discourse analysis is becoming increasingly popular in public understanding of science and other social science research, there are numerous variations of discourse analysis and myriad definitions of key concepts:

> Perhaps the only thing all commentators agree on in this area is that terminological confusions abound. The problem arises because developments have been happening concurrently in a number of different disciplines (psychology, sociology, linguistics, anthropology, literary studies, philosophy, media and communication studies), using a panoply of theoretical perspectives... It is a field in which it is perfectly possible to have two books on discourse analysis with no overlap in content at all. (Potter & Wetherell, 1987)

In light of the many uses of the terms discourse and discourse analysis in social science research, and the associated theoretical and methodological implications, it is important to clearly define my interpretation these multifaceted and nuanced concepts. The next section highlights the developments in social research collectively termed the linguistic turn, which have given rise to discourse analysis.

The Linguistic Turn in Social Research

The emergence of discourse analysis has been situated within the broader context of the so-called turn to language, or linguistic turn, in twentieth-century philosophy and social science (Alvesson, 2000; Hammersley, 1997; Parker, 1990). The linguistic turn is a phrase that summarizes complex philosophical and analytical developments within varied sociological, anthropological and psychological disciplines, especially cultural anthropology and ethnomethodology (Atkinson, 1990; Clifford & Marcus, 1986; Garfinkel, 1967; Geertz, 1988), conversation analysis (Sacks & Jefferson, 1992; Silverman, 1993), semiology (semiotics) (Barthes, 1972; de Saussure, Bally, Sechehaye, & Riedlinger, 1974), and post-structuralism and postmodernism (Deetz, 1992; Derrida, 1976; Foucault, 1972; Foucault & Gordon, 1980; Haraway, 1991; Lyotard, 1984).

According to Alvesson (2000), this linguistic turn in social research is manifested in three significant ways that are germane to the development of discourse analysis. First, the linguistic turn caused researchers to focus on “language itself, its very nature, and the possibilities and impossibilities that it brings with it” (p. 141). For some researchers, this focus has inspired a nearly complete rejection of the received conception of language as a transparent vehicle to meaning. That is, some analysts wholly deny that language can be treated as a surrogate or proxy for some other phenomenon of interest, such as a cognitive structure, attitude, mental model, schema, or inner representation. This perspective on language is generally inspired by some form of social constructivism (e.g., Potter, 1996, especially Chapter 4). Such analysts tend to treat language as ambiguous, metaphorical, context-dependent, and active.

For others, including myself, the linguistic turn has not inspired such dramatic shifts in epistemology. Like most discourse analysts, I am skeptical about assuming an invariant representational capacity of language (i.e., the correspondence between a person’s language and his or her attitude, for example). However, this does not mean there is no relationship. The major way that the linguistic turn has influenced this study is that stakeholders' understandings of science are investigated through the study of language, rather than through the study of attitudes as measured by psychometric instruments (c.f., Aikenhead & Ryan, 1992). In other words, I agree that language can no longer be naïvely accepted as a window to the levels of meaning and subjectivity, but must be evaluated critically and cautiously, taking context into account. However, with this caveat in mind, my own analysis treats language as fairly unambiguous within a given context. So, examining a policy actor's language within a particular policy setting (Congressional hearing) sheds light on how science is represented in that particular policy problem (salmon recovery), but generalizations made from this study must be carefully constrained to similar settings and issues.

The second way in which the linguistic turn has affected social research is by encouraging an interest in language in use. Inasmuch as social research is an empirical practice, and discourse analysts are critical to some degree of the representational capacity of language, "then the study of language use is what is left as robust and reliably replicated empirical phenomena" (Alvesson, 2000, p. 141). In particular, discourse analysts are often interested specifically in language use in real world or naturally occurring settings. For example, Macnaghten (1991) examined social constructions of nature through an analysis of discourse where the real world context was a public inquiry concerning the application of a permit for a landfill site. This study focused on how understandings of nature were employed by proponents and opponents of the landfill in their argumentative discourse. In another example, Potter et al. (1991) examined the discursive use of quantification rhetoric in a television program about the success of charity giving to cancer research. These authors defined quantification rhetoric as the way numerical and non-numerical quantity formulations were deployed as tactics in argumentative discourse to construct arguments as factual and undermine opposing viewpoints. In that case, the naturally occurring setting was a television program. What these studies have in common with my own is that the locus of inquiry was a discursive setting that was not primarily an artifact of the research process (e.g., an interview). The policy actors engaged in the congressional hearings process irrespective of research studies, and thus the discourse that occurs can be viewed as part of a naturally occurring social practice.

A third significant influence of the linguistic turn on social research has been an enhanced reflexivity on the part of researchers, especially regarding their own language and written texts: "The writing of a research report is no longer a routine dispassionate account, for the construction of a credible text is viewed as an extremely complex enterprise. As such, it stands in an ambiguous relationship with any observations or experiences of the social reality as perceived by the researcher" (Alvesson, 2000, p. 141). Because of the linguistic turn, researchers' explanations of social phenomenon are increasingly viewed as stylized, rhetorical, and (sometimes) self-consciously constructed accounts, as opposed to transparent windows on social reality.

In summary, the linguistic turn in social research has inspired a focus on language, especially the empirical examination of language used in naturally occurring settings, and an enhanced reflexivity on the part of the analyst. These developments have sparked an interest in discourse analysis as a way to provide a richer, more sophisticated understanding of how individuals with independent agency and subjectivity function within a social and cultural context. In the next sections, the prominent approaches to discourse analysis are summarized and my own adaptation is further developed.

Approaches to Discourse Analysis

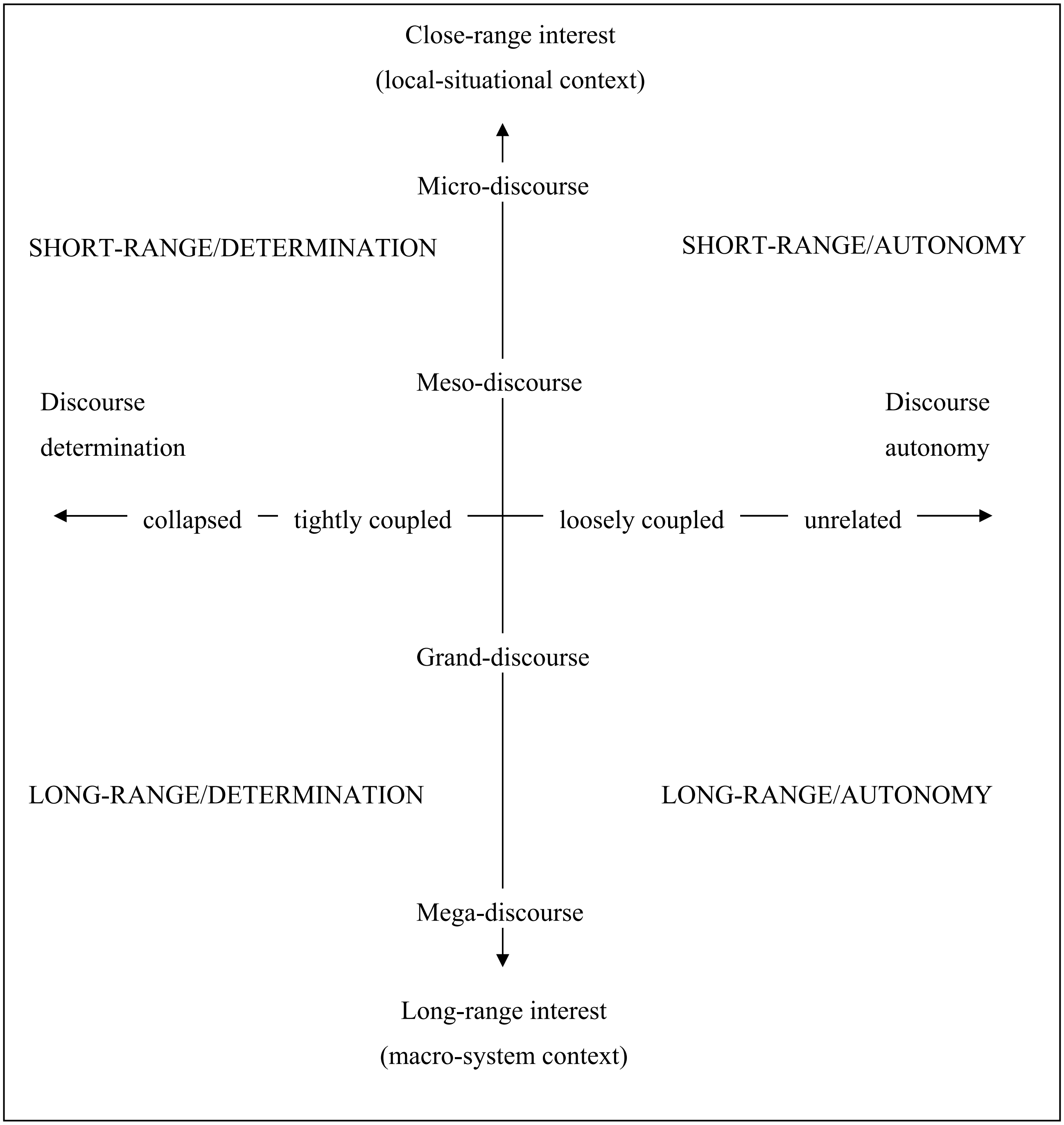
As discourse analysis has gained prominence within social research, a number of approaches have emerged. However, as noted before, these approaches have arisen from an array of analytical and philosophical traditions, and subsequently, there is a lack of fully consensual agreement on key issues. For example, there are different theoretical and methodological interpretations of what constitutes discourse, what practices are appropriate forms of analysis, and how the relationship between language, meaning, and practice should be addressed. These issues are discussed below in order to illustrate the adaptation of discourse analysis employed in this study.

Alvesson and Karreman (2000) provide a useful framework for categorizing the various approaches to discourse analysis along two key dimensions (Figure 1):

> The first is the connection between discourse and meaning (broadly defined): does discourse precede cultural meaning and subjectivity or is it best understood as referring to the level of talk (and other forms of social texts) loosely coupled to the level of meaning? The second is the formative range of discourse: is discourse best understood as a highly local, context-dependent phenomenon to be studied in detail or does it mean an interest in understanding broader, more generalized vocabularies/ ways of structuring the social world. (Alvesson & Karreman, 2000, p. 1129)

The first key dimension of this framework addresses the relationship between discourse and meaning. The analyst may take a position toward the pole of discourse determination, whereby discourse and meaning are assumed to be essentially collapsed, or tightly coupled. Discourse and meaning are collapsed if one views language as *muscular* in that it fully constitutes subjectivity. That is, language would be understood to construct an individual's sense of self, including emotions and cognitions. Or, language and meaning may be viewed as tightly coupled, whereby language frames meaning, but there is room for investigation of meaning-related phenomena outside of the realm of discourse.

Figure 1 Core dimensions and positions in discourse analysis (Alvesson & Karreman, 2000)



On the other hand, the analyst may proceed from the perspective of discourse autonomy; that is discourse and meaning may be considered to be unrelated or loosely coupled. Rejecting the notion that discourse constitutes or forcefully constrains subjectivity, discourse may stand on its own, uncoupled from meaning and relatively independent of meaning. This theoretical perspective suggests a method whereby discourse is analyzed to examine the actions that languages accomplishes, without regard for other levels of meaning. This calls into question the psychological study of verbal expressions of attitudes. People may say something and you can analyze it, but there is question about whether or not people's words map onto any stable cognitive structure: "Talking in certain ways or reproducing a specific vocabulary does not imply any specific cognition, feelings or practices...Addressing what may go on in people's heads and hearts is another issue, disrupting discourse analysis, and may only be carried out in a speculative manner" (Alvesson & Karreman, 2000, p. 1132). Viewing discourse and meaning as loosely coupled allows that discourse has some effect on (vs. reflecting) the level of meaning, but those effects may be considered somewhat fragile and limited to specific contexts.

My own perspective on the relationship between the levels of language and meaning is that they are tightly coupled. That is, I do not assume language to determine or constitute meaning and subjectivity. Although discourse serves to frame or affect meaning, non-linguistic elements, such as emotion and cognition, also play a role in constituting subjectivity.

Alvesson and Karreman's (2000) second key dimension of discourse studies concerns the formative range of discourse. Here the different perspectives relate to the analyst's interest in the scale of discourse. Analysts operating at the close range pole of the formative dimension take an interest in the local and specific situational context of language use. For example, an interest in micro-discourse implies a detailed analysis of language use in a specific context, perhaps even a few short phrases. This seems to be the perspective of analysts the tradition of Potter, Wetherell and colleagues discussed below. Moving along this dimension, it is possible for analysts to examine meso-discourse in context, but also looking for patterns and themes that may be relatively independent of micro-context and transferable to similar contexts (Zehr, 2000).

For analysts with a long-range interest, Grand Discourses or Mega Discourses may occupy their attention. Grand Discourses are conceptualized as compilations of discourses presented as an organized framework. Mega Discourses describe culturally standardized ways of talking about a phenomenon. Examples of Mega Discourses include modernization, globalization, and distinction (Bourdieu, 1984), broad cultural themes or orientations within which individuals' daily lives and actions can be understood. Adopting a long-range interest does not necessarily deny local variation in language use, but rather, the analyst is focused on identifying broad discursive categorizations and themes that are more often applied in and that shape situational context.

Regarding the formative range of discourse, my particular interest is at the level of meso-discourse. Thus, my approach is to be aware of language use in a specific context, and to study a particular context empirically with sensitivity to how discourse is used in that context, but also to be attentive to the emergence of patterns of language use that may be transferable to other, similar contexts: "A *meso-discourse* analysis would be somewhat more inclined to look for slightly broader and more general themes while still being careful to avoid gross categorizations" (Alvesson & Karreman, 2000, p. 1141, emphasis in original).

Based on the preceding discussion, it is possible to characterize two major approaches to discourse analysis that are available for investigating public understanding of science issues. One approach, which can be termed Foucaultian because it is primarily associated with the work of Michel Foucault, emerged from the varied traditions of post-structuralism and postmodernism (e.g., Deetz, 1992; Derrida, 1976; Foucault, 1972; Foucault & Gordon, 1980; Haraway, 1991; Lyotard, 1984). Analysts in this tradition treat discourse as sets of linguistic and other cultural texts that inform and powerfully shape social worlds. Essentially, culture is primarily made up of discourses that constrain and shape individual agency. From this perspective, discourses do not simply describe social reality, but discourses function to constitute social worlds: "Language, put together as discourses, arranges and naturalizes the social world in a specific way and thus informs social practices" (Alvesson & Karreman, 2000, p. 1128). In terms of the relationship between language and meaning dimensions discussed above, Foucaultian analysis would be classified toward the determination end of the spectrum on the first of Alvesson & Karreman's

(2000) key dimensions (i.e., language and meaning are tightly coupled/collapsed and language is muscular in that it constitutes subjectivity). With respect to the formative dimension, this type of analysis generally takes a long-range interest (i.e., examining Grand Discourses or Mega Discourses within a macro system context). Thus, Foucaultian analysis would be placed in the lower left quadrant of Figure 1.

Another influential perspective on discourse analysis has been developed by Jonathan Potter, Margaret Wetherell and colleagues (e.g., Edwards & Potter, 1992; Gilbert & Mulkay, 1984; Potter, 1996; Potter & Wetherell, 1987; Wetherell & Potter, 1988). This approach focuses on the close empirical examination of specific language in naturally occurring contexts, with the aim of illustrating the actions that language accomplishes as part of social practice in social contexts. Here, discourse is interpreted broadly to include, "all forms of spoken interaction, formal and informal, and written texts of all kinds. So when we talk of 'discourse analysis' we mean analysis of any of these forms of discourse" (Potter & Wetherell, 1987, p. 7). This version of analysis would be located in the upper right quadrant of Figure 1 because discourse is treated as loosely coupled or unrelated to issues of meaning and there is a close range interest on local-situational context.

Researchers interested in the social functions of discourse tend to focus on the context-dependency and variability of language. In order to identify social function in language, the analyst relies on the identification of variability associated with changes in context. Variation within and between descriptions is said to be a consequence of the function that a particular description is oriented to achieve, and therefore identifying variation provides information about function. The practice of discourse analysis according to the method developed by Potter, Wetherell and colleagues entails the detailed scrutiny of talk and texts to identify linguistic patterns and discursive variability that point to the intended or unintended social functions of language. To accomplish this, these analysts identify interpretive repertoires, which are statements, often constructed from culturally available metaphors, which are deployed in a particular context; "Any particular repertoire is constituted out of a restricted range of terms used in a specific stylistic and grammatical fashion" (Wetherell & Potter, 1988, p. 172).

For example, in one discourse analytic study representative of the interpretive repertoire approach, Roth & Lucas (1997) identified nine repertoires that high school physics students employed in their discussions about science. Students used these repertoires to support ontological, epistemological, and sociological claims about the nature of scientific inquiry. For instance, some students employed a “rational” repertoire to describe science as reasoned, valid, and logical, drawing on “construction” metaphors, such as “the building blocks” of knowledge. Other discursive resources employed by students included the “intuitive” repertoire, describing science as innate, instinctive knowledge, and the “religious” repertoire, describing humans as having a privileged role as discoverers (through science) of God’s natural laws. Over the course of the study, individual students had access to, and employed numerous different repertoires, and often would use the same repertoire to support conflicting epistemological claims.

As stated above, the adaptation of discourse analysis employed in this study treated language and meaning as tightly coupled and focused on the level of meso-discourse. Therefore, my approach would be placed in the upper left quadrant of Figure 1. The implications of this theoretical and methodological approach for this study are twofold. Firstly, because my view is that language is tightly coupled with the level of meaning, I think that there are non-discursive elements of the understandings of science that are expressed in policy debate, (e.g., cognitions, values). However, I am not able to make inferences about these dimensions in this study because I do not have access to the individuals’ cognitions or affect. (Of course, it is not clear whether the individuals could reflect on and articulate the cognitive and affective dimensions of the understandings of science they express in policy discourse, even if I had the opportunity to query them.) In any case, the implication of my stance on the relationship between discourse and meaning is that this study focuses on one instance of social text (i.e., one occurrence of testimony) from each individual, rather than having multiple units from difference contexts. Secondly, examining discourse at the meso level means that I chose to include a relatively large sample of individuals to look for broader patterns and themes.

The preceding discussion of discourse analysis as a theoretical and methodological approach to investigating stakeholders’ understandings of science in salmon recovery policy debates is followed here by an explanation of the specific empirical material that is the target of analysis, and why this material is appropriate for the aims of the analysis.

The Empirical Material: Transcripts of Congressional Committee Hearings

The empirical material in this study consisted of transcripts of testimony given during hearings before United States Congressional committees dealing with threatened and endangered salmon recovery policy in the Pacific Northwest. More specifically, the analysis included records from following hearings conducted between 1998 and 2000:

1. Decision-making Processes and Interagency Cooperation of the National Marine Fisheries Service Northwest Region. Hearings before the Subcommittee on Fisheries, Wildlife, Conservation and Oceans, Committee on Resources, House of Representatives, One-hundred Fifth Congress, First Session, July 24th and August 15th, 1997, Washington, DC.
2. National Marine Fisheries Service's Implementation of the Endangered Species Act. Field hearings before the Committee on Resources, House of Representatives, One-hundred Fifth Congress, Second Session, September 2, 1998, Pasco, Washington, and September 3, 1998, Boise, Idaho.
3. Salmon Recovery on the Columbia and Snake Rivers. Hearing before Subcommittee on Drinking Water, Fisheries and Wildlife, Committee on Environment and Public Works, United States Senate, One-hundred Fifth Congress, Second Session, October 8, 1999, Washington, DC.
4. Northwest Salmon Recovery. Joint hearing before the Subcommittee on Interior and Related Agencies, Committee on Appropriations, United States Senate, and the Subcommittee on Interior, Committee on Appropriations, House of Representatives, One-hundred Sixth Congress, First Session, April 7, 1999, Seattle, Washington.
5. Salmon in the Columbia River Basin: Review of the Proposed Recovery Plan. Hearing before Subcommittee on Fisheries, Wildlife and Drinking Water, Committee on Environment and Public Works, United States Senate, One-hundred Sixth Congress, First Session, June 23, 1999, Washington, DC.

6. How to Prevent Salmon Species from Extinction or Disruption. Hearing before the Subcommittee on Interior and Related Agencies, Committee on Appropriations, United States Senate, One-hundred Sixth Congress, Second Session, April 20, 2000, Redmond, Washington.

These hearings were conducted as part of the policy development process for recovery of threatened and endangered salmon species in the Pacific Northwest. Congressional testimony is an important form of discourse in policy development, and was selected for this analysis for several reasons. First, the hearings captured the viewpoints of a wide spectrum of stakeholders, which supports the objective of this study to identify a broad range of understandings of science and to look for themes at the meso-discourse level. More than one hundred separate witnesses testified before Congress during these hearings, representing a diversity of viewpoints and interests, and these individuals comprise a convenience sample for this study (Appendix A). Witnesses self-identified and spoke as representatives of organizations or positions, and thus my subsequent categorizations of stakeholder groups were informed by the individuals' own identification and stated allegiances (see below). Secondly, these Congressional hearings are an example of naturally occurring language use regarding salmon recovery policy development. Thirdly, Congressional testimony is public, accessible and costs are low compared to other types of data.

The transcripts were accessed through the U.S. Government Printing Office (GPO) through GPO Online Access (U.S. Government Printing Office, 2001), downloaded to text files, and imported into the qualitative data analysis software program QSR N5 (Non-numerical unstructured data indexing, sorting and theorizing, version 5). After omitting the written materials that some witnesses submitted, the texts subject to analysis contained 17,269 text units or single-space lines. Single-space lines were chosen as the text unit to provide the most flexibility in the coding process (see below). Single-space lines are the smallest unit within the N5 software (i.e., single words cannot be used as a text unit). However, during the coding process, I eventually decided to code at the paragraph level because in the transcriptions paragraphs were used very effectively to separate the witnesses' testimony.

Organization of Witnesses into Social Groups

The individual witnesses who testified before Congress during the salmon recovery hearings were categorized into social groups (the groups and number of witnesses from each group are listed below). These groupings are based on the self-identified social role that each witness declared in the introductory remarks of his or her testimony; that is, their interests, positions, and institutional affiliations. While all individuals in a complex society occupy a variety of different social statuses and roles – a role-set (Inciardi & Rothman, 1990) – it is assumed for the purposes of classifying the individuals into social groups that each witness prefaced his or her testimony by claiming his or her master status – the person's most important and defining social identity. Some might debate whether the stated status accurately reflects the individual's master status, but at least during the hearing, each witness claims to be speaking from that particular status for the time being. Thus, although a witness claiming the status of academic scientist might also be a sport-fishing enthusiast, it is assumed that academic scientist is the defining social identity and the most appropriate role for this specific context. Furthermore, because behaviors and discourses are socially expected based on a persons status and social role, those claiming a similar status are likely to be more similar than different in their discursive patterns, and thus were considered part of a collective social group in this study.

As evident from this list, there are several important differences among actors, particularly in terms of power relations and affiliation with science. Some witnesses (e.g., academic scientists, Fish and Wildlife Service representatives) are expected to have substantial scientific training and therefore access to better articulated discourses of science. As Magill (1988), Brunson (1992), and others have pointed out, scientific training cultivates (and/or selects for) particular views on the role of science, primarily those views that privilege scientific knowledge and expertise.

In contrast, many witnesses are elected political representatives. Such witnesses are expected to be especially sensitive to issues of equity, process, and democracy – as these values are prominent in political discourse. Other witnesses are private citizens, and the use of science discourse in their testimony is likely to vary. Although there is relatively little guidance in the literature pertaining to this type of resource issue, previous research suggests that scientific discourse, even if poorly formulated, will emerge in citizens' testimony. Thus, the witnesses in this study are expected, by virtue of the selection and socialization into specific roles, to employ discourses of science in different ways and at different levels of elaboration and articulation.

1. Academic Scientists (6)
2. Agriculture and Irrigation (10)
3. Army Corps of Engineers (2)
4. Bonneville Power Administration (2)
5. Bureau of Reclamation (2)
6. Chamber of Commerce (1)
7. City Government – Washington (2)
8. Columbia Intertribal Fish Commission (1)
9. Commercial Fisheries (1)
10. Council on Environmental Quality (1)
11. County Government – Idaho (1)
12. County Government – Washington (5)
13. Environmental Lawyer (1)
14. Forestry and Forest Products (3)
15. Grazing
16. Homebuilding (1)
17. Hydropower (1)
18. Mining (2)
19. Municipal Planner (1)
20. National Marine Fisheries Service (4)
21. Native American Tribe (5)
22. Nongovernmental Conservation Organization (18)
23. Northwest Power Planning Council (2)
24. Private Property Lawyer (1)
25. Recreational Motor Boating (1)
26. Resource Manager (4)
27. Sport-fishing (2)
28. State Legislator – Idaho (4)
29. State Legislator – Oregon (1)
30. State Legislator – Washington (4)
31. Transportation (4)
32. U.S. Fish and Wildlife Service (2)

The social groups constructed for this study are meant to reflect meso-social organization. That is, groups might be classified at different levels of social organization, from micro- to macro-social. For example, at a more macro-social level, all witnesses from the Fish and Wildlife Service, Forest Service, and Environmental Protection Agency might be considered "federal government representatives." However, this classification dilutes significant social and institutional differences between these organizations and their representatives. On the other hand, micro-social categorizations that highlight the individuality of the witnesses' perspectives would severely limit the potential to recognize patterns in the discourse. Thus, the classifications used are intended to strike a balance between these two extremes. These social groupings are consistent with my interest in identifying and describing meso-discursive patterns.

Analytical Procedures

To implement the discourse analysis, I employed a three-stage procedure including phases of data reduction, data display, and conclusion drawing and verification (Miles & Huberman, 1994). These phases of analysis were interrelated and recursive – they occurred concurrently and shaped one another. The first phase, data reduction, "refers to the process of selecting, focusing, simplifying, abstracting, and transforming the data that appear in written up field notes or transcriptions" (Miles & Huberman, 1994, p. 10). The main tools of data reduction were document summaries, memos, and coding. After each transcript was read several times to gain a broad understanding of its content, a document summary form was created containing general information about the content and significance of the transcript regarding each research question, and any reflective commentary. These forms provided for quick retrieval of information and cross-referencing to facilitate coding. Memos contained my written ideas about documents and codes, amplified with conceptual elaboration that guided future analytic direction (Glaser, 1978).

Coding involved assigning descriptive and inferential tags or labels to segments of text that were analytically related. The coding process began with a provisional start list of codes suggested by the conceptual framework, the research reviewed in Chapter II, and the research questions. In this case, codes were developed that anticipated discourses related to stakeholders' understandings of the nature of science, the boundaries of science, and the roles of science in decision-making, as well as discourses used to represent recovery actors and actions. The start list included broad analytic categories that form the initial coding tree structure in the N5 software. For example, the broad analytic categories for understandings of the nature of science include understandings of scientific process, understandings of scientific knowledge, and understandings of scientists.

The start list was augmented by codes created during the initial development of the codebook, which facilitated "team-based qualitative analysis" (MacQueen, McLellan, Kay, & Milstein, 1998) and promoted inter-coder reliability. To develop the codebook, two coders each independently read through a randomly selected subset of the transcripts (approximately 10% of all individuals providing testimony) and developed primary analytic categories, and analytic sub-categories and dimensions to capture emergent themes within the broad analytic categories. For example, within the broad analytic category of understandings of scientific process, one analytic category was "relation to theory," with dimensions of "based on theory" or "not based on theory." After discussion and resolution of discrepancies, the coders again independently read a different subset of randomly selected transcripts representing another 10% of individuals. The result of this process was the final codebook (Appendix B).

During the development process I conducted several rounds of inter-coder reliability verifications (ICRV) with my committee chair using N5 software and the N5 merge utility (Bourdon, 2000). To accomplish this task I created two identical copies of the main N5 master project with all tree nodes in each project subsumed under a parent node that corresponded to one of the two coders. Then, after each coder coded his or her project independently, the two projects were merged together for ICRV using the N5 merge utility. In the new merged project the two parent nodes were different, but there were two identical coding structures. At this point, I used the mail merge facility in Microsoft Word to create a command file to instruct the N5 software to carry out a procedure whereby a new index search node was created for each coding disagreement, as recommended by Bourdon (2000). Next, I used the N5 software's Index Search System (ISS) operators to make node-by-node comparisons between the two structures.

Then a document report was created in N5 containing the index search nodes comparing the two sets of coding and exported to Microsoft Word where a simple search and replace function allowed me to determine the number of references to text units (RTUs) agreed upon and disagreed upon. Finally, I calculated the ICRV by assessing the total proportional agreement between coders for all coding judgments, which was calculated by dividing the number of pairwise inter-coder agreements by the total number of pairwise judgments. This value can range from 0 to 1 (Rust & Cooil, 1994). "Given that no coder has priority over the other, agreement will be assumed if both coders have coded or have omitted coding a text unit at a particular code. What is to be flagged, then, are units that are coded by one coder and not by the other" (Bourdon, 2000, p. 3).

Initially, the ICRV process yielded proportional agreement in the area of 20% at the lowest level of analysis, depending upon coding category, with significantly higher levels of agreement for higher order categories. These results illustrate the major difficulty of using this type of coding process for natural language. That is, if we developed a coding scheme for an interview study, for example, then each parent node would likely correspond to a certain interview question that addressed a certain topic. Then, the respondent's answer would be coded into specific categories under that parent node, limiting the possible categories that a response could be coded into, and providing a structure for the coding process. However, in this study, a witness might discuss roles of science in one statement and boundaries in the next, and might never express understandings of the nature of science in his or her testimony. Furthermore, the ICRV was extremely challenging due to the volume of text unrelated to the research questions. However, after multiple iterations and adjustments to the coding scheme, we achieved an acceptable proportional agreement in the area of 80% depending upon coding category. This improvement from 20% to 80% agreement reflects advances in operational definition of the coding categories, clarification of the rules for applying specific codes, and progressive elimination of text deemed irrelevant to the analysis.

Subsequently, I coded all transcripts in N5, which allowed me to explore instances of codes, and link those that were internally related (i.e., intersecting or overlapping codes) to form "families of codes," which were organized into broad analytic categories, primary analytic categories, and analytic sub-categories. These relationships were explored further through the second phase of analysis, data display.

In data display, information distilled from the coded transcripts was presented systematically in a visual format (Miles & Huberman, 1994). In Chapters IV and V, I present "discourse analytic summary tables" that contain the broad analytic categories, primary analytic categories, subcategories. A second set of data displays that I present in Chapters IV and V are role-ordered summary tables, which include the categories, subcategories, and dimensions, and my interpretations of the presence, distribution, frequency of expression of the understandings across the stakeholder groups.

The main point of data displays is to allow the analyst and the reader to review and assimilate large amounts of information to recognize patterns in the data. The data displays are organized by concept (i.e., understanding) and by role (i.e., social group). Along with transcriptions, data displays should make the data more accessible to the reader, who can then evaluate my claims and interpretations for him or herself.

The data displays are especially useful in summarizing the presence, distribution, and frequency of expression of the understandings of science and representational strategies across the different stakeholder groups (see Chapters IV and V). To determine which understandings and representational strategies were employed by which group, and to what degree, I first generated a series of reports within the N5 software that calculated the number of text units (i.e., lines of text) that were coded for each of the primary analytic categories for each of the social groups. Next, I used N5 to determine the percentage of text units coded for a particular primary analytic category for each group out of total text units coded for that group for the broad analytic category. This gives a measure of the frequency of expression a particular understanding relative to the amount of testimony provided deemed relevant for the broad theme (parent code). Such a frequency measure is better than using absolute counts, due to differences in the amount of text across the different social roles. For the purposes of comparing the use of different discourses, three ordinal categories were used: low – less than 30% of the testimony given by that social group was coded at that primary category within the broad category; moderate – 30% to 60% of the testimony given by that social group was coded at that primary category within the broad category; and high – greater than 60% of the testimony given by that social group was coded at that primary category within the broad category.

In the final phase of analysis, conclusions were drawn and verified through measures of trustworthiness. The quality of these conclusions were evaluated against the four trustworthiness criteria: confirmability, credibility, dependability, and transferability (Guba & Lincoln, 1994; Lincoln & Guba, 1985). Confirmability relates to the research's relative freedom from bias, or "explicitness about the inevitable biases that exist" (Miles & Huberman, 1994, p. 278). Confirmability was addressed in this study by providing a full disclosure of the assumptions that guided the inquiry, by keeping a detailed description of the study's methods and procedures, and by explicitly considering rival interpretations. For example, in Chapter II, I detailed my assumptions about the content and distribution of understandings across stakeholder groups in salmon policy discourse. Also, in this chapter, I earlier detailed my assumptions about the relationships between language, meaning, and practice, and how these assumptions affect my chosen method of discourse analysis.

Credibility addresses the central truth value of the research, and will be demonstrated if my findings are communicated to readers in a manner that is affirmed by them (Erlandson, Harris, Skipper, & Allen, 1993). The strategies I used to promote credibility were triangulation among researchers and context-rich description. While I do not claim absolute objectivity, by using multiple coders I hoped to achieve a level of inter-subjectivity among my self and committee chair, with the assumption that other researchers operating under similar assumptions and using similar theoretical and methodological approaches would reach similar conclusions. Furthermore, the findings chapters include a wealth of excerpts from the testimony that illustrate the analytic themes so that the reader can review my line of reasoning.

Dependability measures the study's consistency of operation across time, researchers, and methods. To address this criterion, it was essential that research questions were clearly defined and consistent with the chosen design, that periodic audits were made between researchers to ensure that comparable data analysis procedures were being used, that intra- and inter-coder reliability indices were regularly calculated where appropriate, and that peer review was utilized.

The final criterion for judging the quality of research, transferability, refers to the degree to which the findings may be analytically generalized to a broader theory (Yin, 1994), or carefully applied to other situations that exhibit similar context. To facilitate transferability, a rich contextual description of the study was provided so that readers may make interpretations about the relevance of my findings to other similar contexts (Miles & Huberman, 1994).

Summary

In this chapter I outlined the theoretical and methodological traditions of discourse analysis and justified its applicability as a framework for this study. I situated discourse analysis within a broader context and reviewed the prominent approaches. I laid out my assumptions and placed my particular adaptation of discourse analysis along two key dimensions of a theoretical model. Finally, I presented the three-phase process used for analyzing the textual data and reviewed the procedures used to promote trustworthiness in the study.

CHAPTER IV: UNDERSTANDINGS OF SCIENCE EXPRESSED IN SALMON RECOVERY POLICY

Introduction

This chapter presents the findings of the discourse analysis that address research questions one through three (i.e., understandings of the nature, boundaries, and roles of science in salmon recovery policy). Throughout this chapter and the next, excerpts from stakeholders' congressional testimony are interspersed with the narrative to illustrate the analytic themes. The congressional hearing transcripts were obtained from the Government Printing Office via GPO Online Access (U.S. Government Printing Office, 2001), and all documents analyzed for this study are within the public domain. Thus, the hearing witnesses have no expectation of confidentiality or anonymity. Rather, witness identities and statements are public information. Therefore, no effort has been made to conceal the identity any of individual or organization.

Following each of the excerpts is a numeric code. The reader can reference Appendix A to determine the speaker's identity, his or her self-described affiliation or interest, and assigned stakeholder group. Also, after each excerpt the reader will find date(s) of the hearing, the legislative branch that convened the hearing and the N5-assigned line numbers from the annotated hearing transcripts. For example, the code (1 74; House 9.2.98 & 9.3.98: 1358 – 1362) indicates the testimony was provided by Wille Stelle, National Marine Fisheries Service Northwest Regional Administrator, during a field hearing of the full House Committee on Resources conducted on September 2, 1998 in Pasco, Washington, and September 3, 1998 in Boise, Idaho, and that testimony is located at lines 1358 – 1362 of the transcripts.

Each of the three major sections of the chapter (understandings of the nature of science, understandings of the boundaries of science, and understandings of the roles of science in decision-making) includes a series of data displays. The discourse analytic summary tables present the understandings that were identified in the text and the relationships between the broad analytic categories, primary analytic categories, and analytic subcategories. The role-ordered summary tables present the presence, distribution, and frequency of expression of the various understandings across the stakeholder groups. Frequency is presented through ordinal categories of low, moderate, and high. As noted in the previous chapter, frequency was measured by calculating the number of text units coded for each category for each stakeholder group, which are noted in parentheses in the cells. The data displays are meant to provide a reasonable measure of the presence, distribution, and frequency of expression of understandings across the social categories in this study.

Understandings of the Nature of Science

In the first section I present understandings of the nature of science, organized according to the broad analytic categories: understandings of scientific process, understandings of scientific knowledge, and understandings of scientists. These broad themes were suggested by the research reviewed in Chapter II and evaluated throughout the analysis for practicality and consistency with the empirical material. That is, I began with the broad analytic themes as a provisional start list of coding categories for research question one. Then, during the data reduction phase I collaborated with my committee chair on numerous iterations of the coding scheme to develop primary analytic categories, subcategories, and dimensions. We designed the coding scheme to capture the variation and nuance of the hearing transcripts. The reader may wish to review Chapter III, where the codebook development process is explained in more detail.

Understandings of Scientific Process

Discourses of scientific process were interpreted by analyzing stakeholders' descriptions of the various methods, practices, or techniques of assorted field studies, research projects, or experiments dealing with salmon recovery. These descriptions were organized into categories dealing with concepts such as hypotheses, theory, peer review, empiricism, openness, transparency, modeling, quantification, paradigmatic change, technicality, consensus, certainty, progress, experimentalism, and practicality (Table 1). Descriptions of scientific process were further organized within these categories along a dimensional continuum. That is, a description might be interpreted to deal with an actor's understanding of scientific process (broad analytic category), and then interpreted as related to certainty of science (analytic subcategory), and finally classified as uncertain and tentative (dimension; i.e., as opposed to certain). The categories were not mutually exclusive, so that one description might be interpreted to express multiple subcategories (theoretical, technical, and hypothesis-driven). These subcategories were grouped into primary analytic categories if they were interpreted to form an analytically related "family" of codes. It is important to note that it was the representation of scientific process that mattered to me, not simply the presence or absence of specific words or grammatical constructions. This distinction differentiates my approach from traditional content analysis.

Table 1 Discourse analytic summary table of understandings of scientific process

Analytic Categories		
Broad analytic category	**Primary analytic category**	**Analytic sub-categories**
Scientific Process	Ideal science	Theoretical Hypotheses Rigorous Peer review Modeling Quantification
	Building consensus and certainty	Consensus Certainty
	Peer review	Peer review
	Changing paradigms	Changing paradigms

Ideal Science

One set of discourses that was identified in the text was interpreted to express an understanding labeled ideal science. Descriptions of ideal science were consistent with archetypal notions of scientific process as a theoretical and hypothesis-driven empirical practice that relies on independent peer review to ensure impartiality and limit bias. The ideal understanding was located in the discourse of academic scientists, representatives of sport-fishing, forestry and hydropower interests, NMFS administrators, conservation advocates, and tribal leaders. Academic scientists used this discourse most frequently. This may be because scientists are more likely to be exposed to, and adopt, a traditional or ideal vision of science because of their educational training and institutional socialization (Vaughan & Seifert, 1992).

The extract below demonstrates how the Chief of Fisheries for the Oregon Department of Fish and Wildlife described science according to such an ideal understanding:

> We commend the National Marine Fisheries Service for the role it has played in establishing a regional analytical forum called PATH, a Plan for Analysis – yes – a Plan for Analysis and Testing of Hypotheses… This forum involves scientists from the Pacific Northwest and from throughout the region and is charged with describing and testing the various hypotheses put forth concerning salmon restoration. It is a scientifically rigorous process that includes independent peer review of analyses by outside experts and it has played a significant role in evaluating the scientific merit of competing hypotheses and setting the stage for well-informed decisions about the long-term course of action. We urge NMFS and the other Federal agencies to stay the course in their commitment to supporting and using that process to support decisions. (1 21; House 7.24.97 & 8.15.97: 2816 - 2830)

This witness referenced a number of characteristics of scientific process consistent with an ideal understanding by describing science as hypothesis-driven, theoretical, rigorous, and peer reviewed.

Another attribute of scientific process identified in stakeholders' discourse consistent with an ideal understanding was the use of modeling to estimate or predict. For example, an academic scientist from Oregon State University described a scientific study designed to simulate the effects of predation on salmon populations:

> We used a bioenergetics model to estimate the numbers of juvenile salmonids consumed by the Rice Island Caspian tern colony in 1997. We estimated that between 6 and 25 million juvenile salmonids were consumed by Caspian terns, or approximately 6 to 25 percent of the estimated 100,000,000 out-migrating smolts that reached the estuary in 1997. In addition, estimates of the number of juvenile salmonids lost to cormorants and gulls in the estuary were in the millions. (1 64; Senate 10.8.98: 641 – 649)

The modeling theme was also present the testimony of the President of the Hood Canal Regional Fisheries Enhancement Group, as he described a survey involving computer simulation of salmon behavior:

> In addition, we are making a detailed scientific habitat survey and gridding of each river… All of this data becomes a part of our Global Information System, the GIS, which we have started with the help of Naval Undersea Warfare Center and DNR. In four years--I repeat; in four years--we will be able to demonstrate visually the trip that a pair of wild salmon take returning to spawn up any Hood Canal river, including all the physical features like ripples, large woody debris, fish passage, salmon gravel, and much more. (1 73; Joint 4.7.99: 1348 – 1432)

Some stakeholders conceptualized ideal science as a process of quantification, as exemplified by the following two passages. In the first example, an academic scientist from the University of Washington criticized the science supporting NMFS' implementation of the Endangered Species Act because the agency failed to quantify costs and benefits:

> What I really wanted to discuss is NMFS flow [the amount of water released from dams] and water policies, and I want to discuss that in terms of what it's done for how science is used. Simply put, what NMFS has done, is try to justify benefits in a qualitative sense, without putting numbers on the benefits. And I think that what this does is produce an unrealistic expectation for some of the actions. It's critical that we put numbers on things so we know the cost and the benefits. And I want to use the flow as an example of how we have been misled inadvertently in many cases... And these issues and these numbers need to be brought forward so that people have realistic expectations for the impacts of flow. (1 1; House; 9.2.98 & 9.3.98: 1220 – 1230)

Commenting on the proposed recovery plan before the Senate, a representative of the Columbia River Inter-Tribal Fish Commission described science as a process of quantification when he declared that the best available science used by the Commission's recovery plan included quantitative goals and objectives and quantitative assessment:

> Over 4 years ago, the Commission and its member tribes published "Wy-Kan-Ush-Mi Wa-Kish-Wit" (The Spirit of the Salmon) plan. The plan encompasses the 4-H [harvest, habitat, hydropower, hatcheries] and includes quantitative goals and objectives. It uses the best available science and provides for monitoring, evaluation, and adaptive management. I believe it is still the only plan for Columbia River Basin salmon

> restoration that quantitatively assesses the measures recommended against the adopted goals and objectives and addresses all four H's in a manner consistent with applicable laws. (1 50; Senate 6.23.99: 777 – 786)

Consensus and (Un)certainty

Academic scientists and representatives of conservation groups, tribes, and motor boating and mining interests described science as a process of building consensus and certainty. These individuals described uncertainty as an inherent feature of scientific process. However, this perspective was often tied to the idea that the scientific process leads to the eventual development of consensus, and the systematic reduction of uncertainty. For example, consider the following excerpt from the testimony of an academic scientist and Chair of both the Independent Scientific Advisory Board (ISAB) and the Independent Scientific Review Panel (ISRP):

> The Northwest Power Planning Council and the National Marine Fisheries Service created the ISAB in 1996 to provide scientific advice on salmon recovery issues to the Pacific Northwest. The ISRP was formed in early 1997 as a result of a Congressional amendment to the Northwest Power Act. The ISRP assists the Power Council in peer review of its fish and wildlife program and of specific projects. The 14 members of the two science groups are all senior scientists from the United States and Canada with wide expertise in fisheries, ecology, statistics and economics. We differ from other groups of scientists in the basin due to our independent nature, our non-representational status and a consensus mode of operation... To a great degree, salmon recovery actions within the region have been forestalled by a continuing intractable debate that centers unnecessarily on scientific uncertainty or a perception of disagreement among scientists. The focus of the debate needs to shift to implementation of recovery actions in areas where scientific consensus exists and to the design of specific research projects that resolve issues where disagreement or uncertainty exist. Recent reviews of the salmon problem by the ISAB, a National Research Council panel and others identify substantial areas of scientific consensus where the region could move forward on effective restoration actions. (1 80; House 7.24.97 & 8.15.97: 2640-2652; 2672-2683)

The statement above is particularly interesting because the speaker employed the description of scientific uncertainty as a justification for scientific judgment as a decision-making strategy. The use of science to justify claims is developed in the next chapter. A related description of scientific process as uncertain was identified in the testimony of the NMFS Northwest Regional Coordinator:

> Some of those challenges are, first and foremost, scientific uncertainty. I would love, and I can't tell you how much I would love, to be able to point to clear, unequivocal and convincing evidence on some of the important issues we face here in this region. The fact of life is, is that there is not crystal clear science on any one particular factor. The ability to isolate one factor as the silver bullet is very limited. The ability to eliminate the noise in the system, so to speak, from a scientific perspective is, is limited, and we therefore don't have absolutely clear-cut scientific certainties. We must acknowledge that, and we must design strategies that build decisions based upon on the best scientific judgment available to us, and we do so. (1 74; House 7.24.97 & 8.15.97: 2672 - 2679)

Science as a Process of Peer Review

Academic scientists, NMFS representatives, and sport-fishing, conservation, and forestry interests expressed an understanding of scientific process labeled science as process of peer review. For example, the Northwest Regional Director for NMFS prefaced his testimony to the House Committee on Resources with the declaration that NMFS science was open and subjected to scrutiny:

> First and foremost, we have a commitment to pursue the best science available. Unequaled. It is an unequivocal commitment. Our science is open. Our science is transparent. Our science is continually submitted to peer reviews, and our decisions are based upon it. Point No. 1. (1 74; House 9.2.98 & 9.3.98: 1358 - 1362)

The peer review understanding was also identified in the following statement about the so-called Forest and Fish agreement made by the Director of Forest Management for the Washington Forest Protection Association, an organization that represents private forest landowners:

> The public agency that writes the forest practices rules, the State Forest Practices Board, they're in charge. A work team made up of stakeholder scientists will follow the research priority set by the board and gets the monitoring and scientific study work done. There's a stakeholders group that's responsible for reviewing the results of the monitoring and scientific study and making recommendations to the board. There's an independent scientific review panel to peer review the work of the stakeholder scientists. And there are management functions to keep everything running and to ensure that the board receives timely and accurate communications about the progress of the studies. (1 37; Senate 4.20.2000: 1448 - 1460)

Speaking to a Subcommittee of the House Committee on Resources, a representative from the Northwest Sport-fishing Association criticized the National Marine Fisheries Service's scientific credibility because NMFS' science was not peer reviewed. This statement was interpreted to mean that credible and complete science includes peer review:

> National Marine Fisheries Service's scientific credibility is very low. An example of the apparent misuse and premature information release occurred this year with the preliminary results of the 1995 PIT-tag study. A PIT-tag is a tag that is put into the fish that is an interactive transponder. The study is incomplete. The data has not been peer reviewed by State, Federal, tribal managers, and it is just one study amongst many that the National Marine Fisheries Service is doing right now. Yet, high NMFS officials are publicly releasing preliminary data to the media and to Congress claiming that it shows fish barging worked in 1995. (1 65; House 7.24.97 & 8.15.97: 1029 - 1039)

Changing Paradigms

One witness representing a conservation group expressed an understanding of scientific process labeled changing paradigms that was distinct to that witness. This uncommon and atypical understanding was located in the testimony of the Policy Director from Save our Wild Salmon, as he criticized salmon recovery efforts for not adapting to changing scientific paradigms. This description indicates an understanding of science as a process that is based on knowledge and assumptions that are subject to change over time:

> I think a bigger problem though is that our Biological Opinions have been inconsistent, they haven't been coordinated, they haven't been enforced. During this whole process the science has changed. The scientific paradigm that we're working on is different than it was in 1980, different even than it was in 1991. Fish need rivers, they need watershed processes. We need to use technology to work with those issues. (1 91: Senate 6.23.99: 1149 – 1155)

In summary, within the broad analytic category of understandings of scientific process, my analysis uncovered four distinct understandings labeled ideal science, building consensus and certainty, peer review, and changing paradigms. The ideal science understanding was the most elaborate and complex, and, although it was most commonly identified in academic scientists' discourse, a variety of other stakeholders also described science in this manner. Witnesses also described science as a process of systematically building consensus and certainty through peer review. Finally, one individual remarked about the need for salmon recovery policy to be more responsive to the changing paradigms of science. Table 2 summarizes the presence, distribution, and frequency of expression of the understandings of scientific process across stakeholder groups.

Table 2 Role-ordered summary table of understandings of scientific process

ANALYTIC CATEGORIES			FREQUENCY OF EXPRESSION		
Broad analytic category	**Primary analytic category**	**Analytic sub-categories**	**Low (<30)**	**Moderate (30-60)**	**High (>60)**
Scientific Process	Ideal science	Theoretical Hypotheses Rigorous Peer review Modeling Quantification	NMFS Conservation Tribal	Sport-fishing Forestry Hydro	Academic scientists
	Building consensus and certainty	Consensus Certainty	Tribal Mining Motor boating	Conservation	Academic scientists
	Peer review	Peer review	NMFS Conservation Forestry	Academic scientists Sport-fishing	
	Changing paradigms	Changing paradigms	Conservation		

Understandings of Scientific Knowledge

The second way that I interpreted stakeholders' understandings of the nature of science was by analyzing discourse for descriptions of science's products; that is, the knowledge, information, data, facts, or truth generated by science. Stakeholders rarely referred to scientific knowledge per se. Rather, their understandings were interpreted by identifying discursive elements and grammatical constructions such as "the facts are certain" or "the science is undeniable." I organized these descriptions according to the speakers' position relative to conceptual categories such as value orientation, certitude, representativeness, quantitative nature, and predictive or explanatory ability (Table 3). Again, the categories were not mutually exclusive and descriptions were further organized along a dimensional continuum, so that a stakeholders' understanding of scientific knowledge might be interpreted as value free, certain, and predictive.

Table 3 Discourse analytic summary table of understandings of scientific knowledge

Analytic Categories		
Broad analytic category	**Primary analytic category**	**Analytic sub-categories**
Scientific Knowledge	Scientific knowledge as truth	Certain Predictive Value free Representative Explanatory
	Scientific knowledge as “today’s” truth	Certain Conclusive Predictive Tentative

Scientific Knowledge as Truth

One prototypical understanding of scientific knowledge that I located in the transcripts was labeled scientific knowledge as truth. This understanding was identified by descriptions of knowledge as certain, predictive, value free, representative, and explanatory. This description was most likely to be found in the discourse of academic scientists and conservation group spokespersons, but NMFS delegates, tribal leaders, and mining interest representatives also expressed the scientific knowledge as truth understanding.

The following passage from the testimony of the Fisheries Policy Representative for the Shoshone-Bannock Tribes illustrates the scientific knowledge as truth discourse. Note how the speaker described recent studies and data as predictive, certain, and explanatory:

> Recent studies indicate a positive probability of recovery with breaching of the dams would occur, but NMFS continues to maintain status quo and the continued expenditures to maintain the studies, approve construction of unproven methods on the very problems that continue to destroy the runs and the dams... The data clearly shows that about 57 percent of the salmon that enter the Columbia River were destined for the Snake River. NMFS allowed harvest grades for downriver fisheries in 1997 that could not be maintained by the Shoshone-Bannock Tribes. (1 8; House 7.24.97 & 8.15.97: 852 – 862)

Scientific knowledge was described in similar terms as certain by the Associate Director of Public Policy from Save our Wild Salmon, a nonprofit conservation organization advocating for the removal of the Snake River Dams:

> The science is now conclusive. PATH process scientists now agree that retiring the four dams on the lower Snake will recover the fish with 99 to 100 percent certainty. Now, nothing would please me more than to have Secretary Babbitt in charge of removing these dams on the lower Snake. But I can't believe that is what is really being offered by this legislation. (1 76; House 9.2.98 & 9.3.98: 3423 – 3428)

The next quotation was taken as an example of science as truth because the speaker, the Board President of Idaho Rivers United, cited the findings of a report as certain, definitive evidence able to predict the future outcomes of salmon recovery efforts:

> An extensive report by NMFS's own independent scientific advisory board cautioned NMFS against its continued use of widespread, large-scale barging of juvenile fish. This report stated that there has never been any evidence that the practice of barging fish will lead to the eventual recovery of the salmon. (1 36; House 7.24.97 & 8.15.97: 1338 – 1343)

Scientific Knowledge as Today's Truth

A distinct but closely related understanding was labeled scientific knowledge as "today's" truth. Stakeholders who expressed this understanding described scientific knowledge as incontrovertible and irrefutable evidence, but with certain limitations. Usually, scientific knowledge was described as certain, conclusive, and predictive of future events, but this understanding differed from science as truth because of the presence of caveats or elements of caution. That is, the speaker recognized, either explicitly or implicitly, that scientific knowledge's truth-status was conditional and subject to refinement. Therefore, I interpreted this discourse to indicate that scientific knowledge was accepted as truth within a specific context, but that truth was subject to refutation, if only by more science or future science.

For example, a fisheries scientist from the University of Washington who testified before the House Committee on Resources described research results as certain, conclusive, and definitive. In this testimony, scientific knowledge was said to decisively answer the question of whether augmenting Columbia River flow with additional reservoir water would increase juvenile salmon survival enough to achieve recovery targets:

> That simply is not true [a direct relationship between increased flow and increased juvenile salmon survival]. The research that we now have shows that instead of having the thousand percent increase that would be needed to return the runs, we get about a 1 percent increase by increasing the flows. So there is – the idea of a strong flow relationship simply [doesn't] exist; a strong relationship between survival and throw. There was not, this type of information has not been used in developing the flow objectives and the flow targets. (1 1; House 9.2.98 & 9.3.98:1235 – 1242)

Clearly, the speaker considers the research results to be certain; however, I interpreted this passage to indicate an understanding of scientific knowledge as "today's" truth because of the implication that knowledge that "we now have" is knowledge that "we did not have" previously. Thus, it is implied that we may have knowledge in the future that we do not have today.

In summary, I identified two closely related but distinct understandings of scientific knowledge in the text. In the first, actors described scientific knowledge as accurately reflecting the natural reality, whereas in the second speakers hedged slightly by implying that knowledge might change over time. One interesting observation is that no witnesses described scientific facts as entirely uncertain or tentative. Furthermore, the understanding of scientific knowledge as socially constructed that pervades academic discussions in sociology of scientific knowledge was entirely absent from this text. Table 4 summarizes the presence, distribution, and frequency of expression of the understandings of scientific knowledge across stakeholder groups.

Table 4 Role ordered summary table of understandings of scientific knowledge

Analytic Categories			Intensity		
Broad analytic category	**Primary analytic category**	**Analytic sub-categories**	**Low (<30)**	**Moderate (30-60)**	**High (>60)**
Scientific Knowledge	Scientific knowledge as truth	Certain Predictive Value free Representative Explanatory		NMFS Tribal Mining	Academic scientists Conservation
	Scientific knowledge as “today’s” truth	Certain Conclusive Predictive Tentative			Academic scientists Conservation

Understandings of Scientists

The third component of the investigation of stakeholders’ understandings of the nature of science involved analyzing policy discourse for descriptions of scientists. I organized these descriptions into to primary categories such as independence, objectivity, rationality, bias, and community (Table 5). I then located the descriptions along a dimensional continuum within each category, interpreting the text to draw conclusions about the prototypical understandings of scientists expressed and patterns in the discourse within and between social groups.

Table 5 Discourse analytic summary table of understandings of scientists

Analytic Categories		
Scientists	Scientists as independent advisors	Independent Objective Unbiased
	Captured Scientists	Subjective Biased Interest-driven

Representation of Independence

Undoubtedly, the most prominent set of discourses identified in the text dealt with scientists’ independence, objectivity, and bias. I labeled two noteworthy understandings associated these categories scientists as independent advisors and captured scientists. Witnesses who expressed the former understanding described scientists as independent, objective, and unbiased advisors to the policy community, whereas witnesses who exhibited the latter described scientists as subjective, biased, or interest-driven. The critical analytical distinction between the two understandings was the discursive construction of independence; that is, the ways in which witnesses distinguished between independence and partiality. Usually, this distinction hinged upon institutional affiliation, with academic scientists and members of science advisory boards described as independent advisors and scientists affiliated with resource management agencies or hydropower interests described as captured.

The Lead Facilitator of the Hatchery Scientific Review Group described the members of a science advisory board as independent and praised their expertise and input into the salmon recovery efforts:

> The third thing you did, and I think perhaps the most important in the long-term, was to create an independent scientific review group, made up of nine scientists, who have been charged to come [up] with an approach for how we will bring science to bear on making these decisions in the long-term. It's been my honor as part of a facilitation team through Long Live the Kings to work with this group of scientists, and I have been absolutely impressed with the quality of their background and their judgment and their focus on having an impact on these issues and having an impact in a very short period of time. (1 79; Senate, 4.20.2000: 1809 – 1819)

While the passage above illustrates the independence theme, the next two excerpts are prototypical examples of both the scientists as independent advisors and the captured scientists understandings. The first passage is from the testimony of the Director of Biological Services for Marine Technology, a private firm. However it should also be noted that this individual reminded the panel in his introduction that he served a seven-year term as Chief of Salmon Management for the State of Washington. Note how the distinction between of independent and captured scientists is achieved by highlighting institutional affiliation:

> In my opinion, this is a true, blue ribbon scientific panel. There are nine members. Five of those members are independent; they do not work for the local agencies. And they were provided by a list provided by the past presidents of the American Fisheries Society. So they went through and decided who met the criteria and who were the top ranked folks, so five people were selected from that group. (1 6; Senate, 4.20.2000: 1934 – 1940)

The Policy Director for Save Our Wild Salmon also expressed understandings of scientists as independent advisors and captured scientists during a critique of the National Marine Fisheries Service. In this description he portrayed members of science advisory boards as independent and scientists with agency affiliations as interest-driven. In this case, the speaker singled out scientists from the NMFS barging program as captured:

> And, fourth, the authoritative, scientific views of the National Marine Fisheries Service's own independent scientific advisory board need to be given more credence by NMFS itself and by the Administration. This is the best science available, and they are ignoring it. Rather, NMFS relies far too much on the decidedly unindependent scientists that are in charge of its own fish barging program to create their future policy. (1 36; House, 9.2.98 & 9.3.98: 2024 – 2027)

In the preceding section I presented two divergent understandings of scientists that were distinguished by constructions of independence and partiality. Conservation advocates and academic scientists were most likely to describe scientists as independent advisors while witnesses from the same conservation groups and the Bonneville Power Administration described scientists as captured. Witnesses generally used institutional affiliation as an indication of independence and objectivity. Table 6 summarizes the presence, distribution, and frequency of expression of the understandings of scientists across stakeholder groups.

Table 6 Role ordered summary table of understandings of scientists

Analytic Categories			**Intensity**		
Broad analytic category	**Primary analytic category**	**Analytic sub-categories**	**Low (<30)**	**Moderate (30-60)**	**High (>60)**
Scientists	Scientists as independent advisors	Independent Objective Unbiased	NMFS Tribal Forestry	Academic scientists	Conservation
	Captured Scientists	Subjective Biased Interest-driven	Conservation	BPA	

Understandings of the Boundaries of Science

In this section, I discuss how stakeholders' discourse expressed understandings of the boundaries between science and non-science. In order to interpret the discourse for understandings, I categorized stakeholders' descriptions according to the broad analytic categories of boundaries of science and politics and boundaries of science and management (Table 7).

Table 7 Discourse analytic summary table of understandings of boundaries of science

Analytic Categories		
Broad analytic category	**Primary analytic category**	**Analytic sub-categories**
Boundary of Science and Politics	Science and politics as separate and unequal	Incompatible cultures of science and politics Science and politics separate
	Science and politics as reluctant (and unequal) partners	Science and politics separate
Boundary of Science and Management	Science as management's caretaker	Science and management separate

Science and Politics: Separate and Unequal

As witnesses debated salmon recovery policy during the congressional hearings, they established conceptual boundaries between science and politics. One prominent discourse was interpreted to exemplify an understanding of science and politics as separate and unequal. Stakeholders who employed this discourse not only expressed an understanding of science and policy as separate, but also privileged science's epistemic authority and lamented the politicization of salmon recovery decisions, which should be based on science.

For some, the boundary between science and politics should be forcefully patrolled to limit political incursions into scientific realms. For example, a private farm owner from Oregon expressed frustration with political interference into NMFS' permitting process, which should be a science-based decision:

> You can imagine our frustration, then, when NMFS announced in June 1998 that it had entered into a Habitat Conservation Plan with two public utilities in the Mid-Columbia. Why will NMFS reach an HCP agreement with public utilities, a no jeopardy opinion for the Federal hydro system [the dams do not significantly contribute to salmon decline], and a no jeopardy opinion for the sport and commercial fish harvests, allowing them to directly kill fish, while they will not allow a farmer to move an irrigation diversion point that will have no measurable impact on the flows and fish survival. Inland believes that the biological opinion was issued for political purposes to pacify environmental organizations, not because of scientific justification... In our [four] year effort to permit this farm, with the assistance of four regional law firms, three wildlife habitat consulting firms, two salmon recovery consulting firms, two engineering firms, and a Project Manager, we have spent nearly one million dollars and we still cannot proceed. A fisheries biologist for the Corps' Portland office said it best, when he interrupted me during a technical presentation I was making and said, excuse me, Bob, this isn't about science and biology, this is about politics. (1 35; House 9.2.98 & 9.3.98: 1880 – 1891, 1900 – 1908)

Note how in the passage above the speaker first described his own experience, and his perception that politics invaded a decision-making process that should be under the command of science, and then reinforced his point with an anecdote where another stakeholder – a scientist – expressed a similar sentiment.

The separate and unequal understanding was also identified in the following passage from the Northwest Regional Director of Friends of the Earth. Here, a representative of the nonprofit conservation interest was responding to a statement made two months earlier by NMFS Northwest Regional Director, Will Stelle, who suggested that science cannot provide absolute answers for salmon recovery. The Friends of the Earth representative replies that while absolute certainty may be outside of the boundary of science, such certainty is nearer the realm of science than that of politics:

> We would offer three specific suggestions. The first, as Mr. Stelle says, science does not provide absolute answers, but it tends to provide better answers than a pure political process. And we are concerned that more often than not politics is being substituted for science on many decisions. And we would point to a number of documents that highlight what can work and what cannot work or at least have more indications. Particularly the ISAB, the Independent Science Advisory Board, their return to the river, while not a blueprint for detailed restoration, I think is the direction I would urge the Committee to try to make sure the Federal agencies follow. (1 12; House 9.2.98 & 9.3.98: 4016 – 4028)

In his statement, the speaker above indicated that science and politics are separate realms, and the explicit claim is made that science's answers are superior to those generated by pure politics. The speaker highlighted the contrast by comparing archetypes; that is, a rhetorical strategy is used whereby pure politics is contrasted with science, thus emphasizing the essential qualities of each and heightening the contrast.

In the same hearing, the Speaker of the House of the Oregon State Legislature characterized the Endangered Species Act as bad public policy because the law is based on politics, not science:

> First, I want to make a statement, that a flawed law cannot be administered as good public policy. The Endangered Species Act does not provide effective mechanisms for species recovery as we have already heard. And I think there is one main reason for that. And that is it is not based on science but rather it is too much based on politics. (1 51; House 9.2.98 & 9.3.98: 886 – 891)

A subtle variation on the theme discussed above was interpreted as science and politics as reluctant (and unequal) partners. What distinguishes this understanding is the assertion that the boundary between science and politics must be breached by scientists and policymakers for salmon recovery to be successful. The Director of Forest Management for Washington Forest Protection Association exhibited this understanding in his testimony before the Senate Appropriation Committee's Subcommittee on Interior and Related Agencies:

> This system must operate in a collaborative atmosphere that includes not only the participants of the Forest and Fish agreement but other stakeholders if they choose to join in. To further complicate the mission, scientists and policymakers are forced to work under the same roof, respecting each other's responsibilities but ultimately accepting the realities and limitations of both disciplines. To overcome this, the scientists must take a disciplined approach that follow scientific method and statistical protocols. Policymakers must have confidence in and respect the values of the technical information. (1 37; Senate 4.20.00: 1420 – 1430)

After the representative of the forest products industry made an initial concession about the limitations of both approaches, he went on to privilege science in his discourse. This was where the speaker calls for scientists to be disciplined (i.e., stay true to science) and policymakers to respect (i.e., follow) the scientists' input.

Science and Management

In order to capture the full range of understandings of the boundaries of science, I sought to examine how stakeholders compared science with other sources of knowledge and other recovery concerns, such as resource management. Looking at multiple comparisons is important because, as Gieryn (1983; 1995; 1999) has demonstrated convincingly, the characteristics attributed to science may differ based on the object of comparison.

In the salmon recovery policy debate, hatchery operations provided one context for boundary negotiations between science and management. In one understanding, labeled science as management's caretaker, the distinction between science and management was less sharply drawn, but the contrast still cast science in a favorable light. This understanding is illustrated by the following passage from the testimony of a stakeholder with strong educational and institutional ties to science. In this particular description the speaker suggested that hatchery management was not been based on science and that decisions were not objective. An interesting rhetorical technique is employed here whereby the speaker impugns hatcheries by associating them with an emotional public:

> I mentioned that the goals have to change, and I want to emphasize something that Jim brought up. And I want to say, very poignantly, the real problem with hatchery management in the past has been that the decisions were not based on science. I mean, some were, but by and large, they were not objective. And I think for those who have familiarity with hatcheries in the past, they realize that the public supported hatcheries just emotionally, and to the point where if you wanted to close a hatchery somewhere, you had some real problems. So essentially what I'm saying – and it's not just what I'm saying; it's what our group said… you know, these hatcheries just have not been evaluated. They're simply running fundamentally on emotion, and that's got to change. (1 6; Senate, 4.20.00: 1904 – 1918)

I interpreted this discourse to illustrate an understanding of science as management's caretaker because management was characterized as subject to outside pressures, such a public that may oppose hatchery reform out of misplaced emotion and self-interest, and science's responsibility is to oversee the management process and ensure decisions are made objectively.

In an examination of the role of science advisory boards in environmental regulation, Jasanoff (1987) discussed the "trans-science" scheme of boundary work, whereby science is distinguished from policy on the basis of the types of questions being asked. According to this discourse, trans-scientific questions cannot be answered empirically, and therefore should be left to policymakers to decide. I identified a similar discourse in this study that hinged upon the separation of values from science. The Director of the Floodplains Program for American Rivers, a nonprofit conservation organization, summarized his experience dealing with river management in the Midwest, and offered suggestions for the Pacific Northwest during a Senate hearing:

> But in the Midwest, we have pursued a different course that you might consider in the Pacific Northwest. We persuaded the Corps and other Federal agencies to develop a wide range of science-based management alternatives and then simply ask the public to decide the fate of our rivers. On the Upper Mississippi River, for example, which stretches from St. Paul to St. Louis, the Corps worked with American Rivers and Mark 2000, which

> represents waterway users and farmers, to create the Upper Mississippi River Summit, which is an annual forum of farmers, conservation groups, and waterway users, and asked them to set management goals for the river together. Rather than having States or the Corps run that process, I run that process with my colleague who represents the navigation industry. On the Missouri River, the Corps held public workshops on a wide range of management alternatives that were selected in part by the public, and then asked river stakeholders to seek consensus on how the river's dams should be managed. In both cases, the Corps provided sound science-based information and then got out of the way and asked the public to make the tough calls. (1 27; Senate, 6.23.99: 857 – 877)

Note how the speaker above drew a line between science and management based on the exclusion of values from science. The Corps of Engineers' scientists provided "science-based information and then got out of the way" so that the public could "make the tough calls." As with the previous discourse, science was represented as objective and value-neutral, and management is represented as subjective and value-laden. However, this discourse differs from the science as management's caretaker because values (and the public from which the values are derived) are described as legitimately within the boundaries of management.

To review the previous section, I analyzed stakeholders' discourse to determine the understandings of the boundaries of science that were expressed in policy discourse. Within the broad analytic category of boundaries of science and politics, I described two understandings labeled science and politics as separate and unequal and science and politics as reluctant (and unequal) partners. I located the first understanding in the discourse of irrigation and agricultural interest representatives, as well as conservation advocates and state legislators. The second understanding appeared in a limited fashion in the testimony of a forest products association spokesperson. Academic scientists and conservation advocates described the boundaries of science and management in a way that cast science as management's caretaker. This analysis is summarized in Table 8. Additional broad analytic themes that were anticipated based on previous research, such as boundaries of science and culture, economics, media, and law were not encountered in the material analyzed for this study.

Table 8 Role ordered summary table of understandings of boundaries of science

Analytic Categories			Intensity		
Broad analytic category	**Primary analytic category**	**Analytic sub-categories**	**Low (<30)**	**Moderate (30-60)**	**High (>60)**
Boundary of Science and Politics	Science and politics as separate and unequal	Incompatible cultures of science and politics Science and politics separate		Legislator (Oregon)	Irrigation/ agriculture Conservation
	Science and politics as reluctant (and unequal) partners	Science and politics separate		Forestry	
Boundary of Science and Management	Science as management's caretaker	Science and management separate			Academic scientists Conservation

Understandings of the Roles of Science in Decision-making

Research question number three asked, what understandings of the roles of science in decision-making are present in stakeholders' discourse about Northwest salmon policy? To address this question, I analyzed congressional witnesses' descriptions of the functions, responsibilities, or duties of science and scientists. I began the data reduction phase of this analysis by organizing the descriptions into conceptual categories, including the role of science in creating and selecting decision alternatives, and evaluating and legitimating selected alternatives. Next, I organized descriptions according to salient themes and dimensions within each category. For example, science was described as essential for creating alternatives by defining the problem to be solved. Data displays facilitated the identification and interpretation of discourses and the distribution of discourses within and between social groups.

Creating Decision-making Alternatives

Witnesses constructed a role for science in creating decision-making alternatives during their testimony. This role included functions of identifying problems, identifying alternatives, and filling in knowledge gaps (Table 9). Members of the following groups or interests described this role for science: academic scientists, NMFS, conservation, forestry, and motor boating.

Table 9 Discourse analytic summary table of understandings of the roles of science in creating decision-making alternatives

Analytic Categories		
Broad analytic category	**Primary analytic category**	**Analytic sub-categories**
Roles of science creating decision-making alternatives	Science creates decision-making alternatives	Identifies problems; Identifies alternatives; Fills in knowledge gaps

During the congressional hearings, stakeholders described the role of science in discovering or framing the problems that salmon recovery policy should address. The former chair of a science advisory board praised the activities of another group of scientists for their efforts in problem identification:

> Anyway, these folks are hard at work. Once again, I'm repeating a little bit of what Jim says, but I'll say it. They've been defining the problems, what are the problems, they've been generating workplans, and they've been determining what science is needed, what science we should jump on and learn about. (1 6; Senate 4.20.00: 1958 – 1963)

The previous passage illustrates an understanding labeled science identifies problems to be solved. The analysis also uncovered a related discourse labeled science identifies alternatives where witnesses defined science as crucial for developing decision choices. For example, the Chairman of the Northwest Power Planning Council discussed studies and tests that generated alternatives for managing the Columbia and Snake Rivers to recover salmon:

> One of the other things we're working on is the multi-species framework, which is a series of studies and tests that have come out now with various alternatives for the

> Columbia-Snake system, and this document is sort of a primer on that, and I'll leave it for you. But it talks about seven alternatives with regard to changes that can occur on the Columbia-Snake Basin, including four alternatives that deal with breaching [dams] and what happens to them.(1 14; Senate 4.20.00: 2469 – 2476)

Actors who suggested that science fills in knowledge gaps said one function of science and scientists is to reduce decision-making uncertainty. The NMFS official with primary responsibility for Pacific Northwest salmon recovery testified that continuing research was necessary to reduce uncertainty about salmon mortality associated with the hydropower system:

> Secondly, there remain, obviously, deep divisions within the region on how to fix the dams, ranging from leaving them alone to taking out at least five of them. We have developed a strategy which was contained in the 1995 biological opinion for the hydro power system for resolving this dilemma which has three facets. A set of interim operations, given the current configuration of the dams, to improve survivals, continuing research on where precisely we are losing the fish through very robust evaluations of mortalities associated with each of the four Snake dams, and a thorough evaluation of the different options for fixing the system and the biological and economic impacts of each option. (1 74; House 7.24.97 & 8.15.97: 3114 – 3125)

Table 10 summarizes the presence, distribution, and frequency of expression of the understandings of science's role in creating decision alternatives across stakeholder groups.

Table 10 Role ordered summary table of understandings of the roles of science in creating decision alternatives

Analytic Categories			Distribution		
Broad analytic category	**Primary analytic category**	**Analytic sub-categories**	**Low (<30)**	**Moderate (30-60)**	**High (>60)**
Roles of science creating decision-making alternatives	Science creates decision-making alternatives	Identifies problems; Identifies alternatives; Fills in knowledge gaps	Motor boating	NMFS Conservation Forestry	Academic scientists

Selecting among Decision-making Alternatives

While the previous section discussed science's role in creating decision-making alternatives, this section presents the discourse analysis of stakeholders' understandings of science's role in selecting among alternatives (Table 11).

Table 11 Discourse analytic summary table of understandings of roles of science in selecting among decision-making alternatives

Analytic Categories		
Broad analytic category	**Primary analytic category**	**Analytic sub-categories**
Roles of science in selecting among decision-making alternatives	Science as decision-making instrument	Identifies decision priorities; Identifies risks and benefits

One understanding labeled science as decision-making instrument was especially prominent in the discourse of those with strong scientific affiliations, including academic scientists, and resource management agency scientists. Other groups whose representatives expressed this widespread understanding included conservation, forestry, outfitter/guides, tribal, agriculture, motor boating, and BPA representatives. This understanding was identified by metaphorical descriptions of science as a “tool,” a “rudder,” or a “light in the darkness.” Often, the descriptions were vague, symbolic, and nonspecific. Take the following statement from the Chair of the Independent Science Advisory Board and the Independent Science Review Panel for example:

> A recovery plan based on the best available science, backed by the support of all regional constituents, and implemented with rigorous monitoring and evaluation, would be a powerful force for salmon recovery. The architecture for such a recovery program is in place. Scientific and technical groups such as the ISAB, the ISRP and PATH have already identified and can continue to identify the best scientific information and analyses to aid and guide salmon recovery efforts. (1 80; House 7.24.97 & 8.15.97: 2711 – 2718)

Throughout this testimony before the House Resource Committee’s Subcommittee on Fisheries, Wildlife and Oceans, this scientist described science as a tool to “guide program development for salmon recovery” and lauded NMFS because the science advisory boards’ reports “are influencing their program emphasis and direction.”

The science as decision-making instrument theme was pervasive in the discourse of the federal resource management agency representatives as well, especially the NMFS Northwest Regional Administrator, who testified regularly before the various committees. This speaker routinely prefaced his statements with a declaration of allegiance to pursue science-based decision-making “whatever way it leads”:

> NOAA Fisheries is dedicated to using the best scientific information available when making its decisions on implementing the Endangered Species program here in the basin. Science-based [decision-making] is perhaps the single most important principle we have. Given the deep divisions that exist and the stakes involved, we must stick to the science. If we do not, we will be rudderless, adrift without direction, and lost. (1 74; House 7.24.97 & 8.15.97 :3090 – 3096)

> Given the winds of controversy that buffet this subject almost daily, consistency and a commitment to a clearly articulated pathway based on good science is absolutely vital. (House 7.24.97 & 8.15.97: 3228 – 3241)

> First and foremost, we have a commitment to pursue the best science available. Unequaled. It is an unequivocal commitment. Our science is open. Our science is transparent. Our science is continually submitted to peer reviews, and our decisions are based upon it. Point No. 1. (1 74; House 9.2.98 & 9.3.98: 1358 – 1362)
>
> Some of the fundamentals of the approach that we are bringing to salmon restoration: First, and foremost, a commitment to good science to pursue good science, whatever way it leads us. It is an absolute rock-hard commitment. (1 74; House 9.2.98 & 9.3.98: 3876 – 3879)

Just as the NMFS Regional Director proclaimed that his agency follows the science, the Wildlife Director for the Bonneville Power Administration stated that BPA's salmon restoration funding decisions are heavily influenced by the recommendations of a science advisory board:

> Senator Gorton has helped enormously with that process by creating an independent science review panel. That group, the ISRP, reviews each of the proposals. The agencies and tribes also do that. This wealth of recommendation comes together in the Northwest Power Planning Council, and they issue their recommendations to us. Generally speaking, we follow them to the letter. (1 99; Joint, 4.7.99: 3605 – 3611)

The preceding passages were identified and categorized by the presence of metaphors and specific rhetorical constructions. However, this discourse was interpreted as indicating an understanding of science as an instrument not simply based on the presence of certain grammatical elements, but rather because the speaker indicates that science can, and should, be used to choose between competing alternatives.

Although the science as decision-making instrument discourse was common among scientists, it was certainly not limited to that group. Another sector of the policy community, representatives from the nonprofit conservation organizations, also routinely described science's role in such instrumental terms. The Northwest Salmon Campaign Coordinator for the Sierra Club constructed a role for the independent scientific advisory board" and its independent biology in deciding among alternatives:

> And fourth, follow the independent biology, such as the independent scientific advisory board. The best available science is telling us that the salmon need river ecosystem restoration, not more techno-fixes. (1 3; House; 9.2.98 & 9.3.98: 2024 – 2027)

In the second example, the Board President for Idaho Rivers United employed a similar discourse when he stated that removing the Snake River dams is the correct policy choice based on the declaration that "scientists agree" and the "science is now clear":

> The science is now conclusive. PATH process scientists now agree that retiring the four dams on the lower Snake will recover the fish with 99 to 100 percent certainty. Now, nothing would please me more than to have Secretary Babbitt in charge of removing these dams on the lower Snake. But I can't believe that is what is really being offered by this legislation. Both of our organizations, I should point out to you, along with national organizations like Trout Unlimited, the National Wildlife Federation, America Rivers and others, have already endorsed the retirement of four unnecessary dams on the lower Snake River to restore Idaho salmon. We believe that the science is now clear. (1 76; House, 9.2.98 & 9.3.98: 3423 – 3428, 3334 – 3339)

In the third example from the conservation community, a representative of Save our Wild Salmon proclaimed that the policy community must "follow the science":

> One is, we need to follow the science. And the science is going to take us down some painful paths, but it's going to define what tracks we must react under. We cannot use science as a weapon for delay, or a weapon to divide. We need to use science to pull us together... Let's follow the science, stop the harm, enforce the law. (1 91; Joint; 4.7.99: 2274 – 2278, 2318)

Other policy actors, including representatives of the tribes, forest products industry, recreational outfitters and guides, and the recreational boating industry made statements indicating an understanding of science as instrument for decision-making. Below, the Executive Director of Northwest Marine Trade Association, a recreational boating industry trade group exhibits the instrumental understanding:

> We and the tribes share a common goal that harvest decisions must be made on a biological and scientific basis. If there is any question of adequate escapement of wild

Chinook, then fisheries must be curtailed. However, if in some terminal areas, such as Elliott Bay, the returning salmon are well above escapement goals, then limited harvest should be allowed for both tribal and nontribal fishers, as long as the fisheries permit escapement goals are met. (1 85; Joint, 4.7.99: 1570 – 1577)

Table 12 summarizes the presence, distribution, and frequency of expression of the understandings of the roles of science in selecting among decision alternatives across stakeholder groups.

Table 12 Role ordered summary table of understandings of roles of science in selecting among decision alternatives

Broad analytic category	Primary analytic category	Analytic sub-categories	Low (<30)	Moderate (30-60)	High (>60)
Roles of science in selecting among decision-making alternatives	Science as decision-making instrument	Identifies decision priorities; Identifies risks and benefits	Agriculture Motor boating BPA	Tribal Forestry Outfitters/ guides	Academic scientists NMFS Conservation

Evaluating and Legitimating Selected Alternatives

Based on the prominence with which hearing witnesses promoted science's role in identifying and selecting decision-making alternatives, it should not be surprising that the analysis also uncovered understandings related to science's role in evaluating and legitimizing decisions (Table 13). Although most stakeholders described science as an important decision-making instrument in similar, albeit vague terms, the discourses of evaluating and legitimating decisions were divergent and usually more specific. That is, the results of the discourse analysis and interpretation revealed two closely related, but distinct and disparate discourses of science's role in evaluation and legitimization.

Table 13 Discourse analytic summary table of understandings of science in evaluating among decision alternatives

Analytic Categories		
Broad analytic category	**Primary analytic category**	**Analytic sub-categories**
Roles of science in evaluating and legitimating selected alternatives	Science evaluates and legitimates selected alternatives	Decisions supported by: best available science; best available data; external peer review; science advisory board Limits political conflict
		Decisions not supported by: best available science; best available data; external peer review; science advisory board Decisions based on: selective or opportunistic use of data; anecdotes; vested interest

The first understanding was characterized by favorable descriptions of science's ability to evaluate effectiveness in achieving desired outcomes and provide instrumental and political legitimization to decision-making based on the best available science, the best available data, external peer review, and science advisory boards. The opposing discourse was associated with criticisms of decision-making as illegitimate based on a lack of support because decisions were not supported by the best available science, the best available data, external peer review, and science advisory boards. Although these two discourses were divergent in that the stakeholders employed one or another to support or oppose decisions, the two discourses were interpreted as illustrating a single understanding – that science and scientists can and should evaluate and legitimate decisions in salmon recovery.

Below are three examples of the discourse of science as a source of instrumental and political legitimization. In the first excerpt, the Chief of Fisheries for the Oregon Department of Fisheries and Wildlife asserted that decision-making accountability and credibility are enhanced by support from technical and scientific analysis:

> In our opinion, the Federal Government, through NMFS leadership, has improved accountability for the decisions that they make. However, the Federal Government must better explain what information influenced their decisions and how that information was weighted and used to make decisions. Likewise, the Federal Government must explain what alternatives it considered and equally important why at times it has rejected alternatives put forward by State and tribal resource managers. The Federal Government can improve the credibility of its decisions, we believe, by supporting them with regionally accepted technical and scientific analysis. (1 21; House 7.24.97 & 8.15.97: 2805 – 2815)

In the next passage, a representative of private forest landowners and the forest products industry implied that the information and knowledge generated though adaptive management is necessary to bring controversies to a close:

> Forest and Fish is working, and with adaptive management we'll continue to work. The alternative is to demand less information and to make decisions without adequate knowledge. And, of course, if we do that, ultimately the questions will remain and the conflicts will not be settled. (1 37; Senate, 4.20.00: 1478 – 1482)

The third example is from the testimony of the ranking NMFS official in the Northwest, who reviewed the process that led to the decision on how to apportion the juvenile steelhead migration between in-river and barge transportation. Note how the speaker justified the decision not only with "professional judgment," but also by "the best available scientific information" and the recommendations of numerous science advisory boards:

> In 1997, Idaho proposed its steelhead plan which called for leaving two-thirds of the juvenile steelhead in the river rather than transporting them down around the eight downstream dams. After considerable review and discussion among the salmon managers at various levels, I decided that we could only accommodate the Idaho plan up to a certain point reflecting the, quote, spread-the-risk strategy which we adopted last year in consultation with the salmon managers and reflecting a similar strategy called for in the Northwest Power Planning Council's fish and wildlife program. I made this judgment

> based upon my best professional judgment that placing more fish in this river would only subject them to a higher rate of mortality, an outcome that is not consistent with our obligations under the Endangered Species Act. The above decision reflects, in my judgment, the best scientific information available. It is consistent with the findings and recommendations of the Snake River Recovery Team, the National Academy of Sciences and the recent report of the Independent Scientific Advisory Board. It is a situation where, unfortunately, the best science is not always the most popular. We must stick with the science. (1 74; House 7.24.97 & 8.15.97, 3163 – 3183)

I interpreted these and similar passages to illustrate an understanding that science functions to limit or reduce conflict between stakeholders by justifying or substantiating claims and decisions.

The second understanding of the role of science in evaluating and legitimating decisions was identified by descriptions of decision-making as based on selective or opportunistic use of data, anecdotes or casual observation, or vested interest. Although speakers employing this discourse were usually criticizing a decision-making process or a particular decision, this discourse was also interpreted to indicate an understanding that science can and should be used to evaluate and legitimate decisions. In effect, it was the absence of scientific justification that generally prompted the employment of the critical discourse.

To summarize the final section of this chapter, policy actors construct a variety of roles for science in salmon recovery decision-making. Three broad analytic categories were presented in this analysis: roles of science in creating decision-making alternatives, roles of science in selecting among decision-making alternatives, and roles of science in evaluating and legitimating alternatives. Stakeholders' descriptions of science's role in creating decision-making alternatives were interpreted to express understandings of roles of science in problem identification, alternative identification, and filling in knowledge gaps. A descriptively complex and elaborate understanding of the role of science in selecting among decision-making alternatives was labeled science as decision-making instrument. According to this understanding, science is used instrumentally and rationally to identify decision priorities and identify risks and benefits of various alternatives. Finally, two divergent discourses were interpreted to express a unified understanding affirming a role for science in evaluating and legitimating selected alternatives. Table 14 summarizes the presence, distribution, and frequency of expression of the understandings of the roles of science in evaluating alternatives across stakeholder groups.

Table 14 Role ordered summary table of understandings of science in evaluating decision alternatives

Analytic Categories			Intensity		
Broad analytic category	**Primary analytic category**	**Analytic sub-categories**	**Low (<30)**	**Moderate (30-60)**	**High (>60)**
Roles of science in evaluating and legitimating selected alternatives	Science evaluates and legitimates selected alternatives (positive)	Decisions supported by: best available science; best available data; external peer review; science advisory board Limits political conflict	Conservation Tribal Forestry BPA NWPPC	Academic scientists NMFS	
	Science evaluates and legitimates selected alternatives (negative)	Decisions not supported by: best available science; best available data; external peer review; science advisory board Decisions based on: selective or opportunistic use of data; anecdotes; vested interest	Academic scientists Sport-fishing Mining Transportation	Conservation Outfitters/ guides	Tribal Agriculture/ irrigation

Summary

In this chapter I presented the understandings of the nature, boundaries, and roles of science in salmon recovery expressed by stakeholders during the congressional hearings. Within the category of understandings of scientific process, my analysis uncovered four distinct understandings labeled ideal science, building consensus and certainty, peer review, and changing paradigms. I identified two closely related but distinct understandings of scientific knowledge in the text. In the first, actors described scientific knowledge as accurately reflecting the natural reality, whereas in the second speakers hedged slightly by implying that knowledge might change over time. I also presented two divergent understandings of scientists that were distinguished by constructions of independence and partiality. Within the broad analytic category of boundaries of science and politics, I described two understandings labeled science and politics as separate and unequal and science and politics as reluctant (and unequal) partners. Additional broad analytic themes that were anticipated based on previous research, such as boundaries of science and: culture, economics, media, and law were not encountered to in the material analyzed for this study. Finally I described stakeholders' understandings of the roles of science in creating decision-making alternatives, selecting among decision-making alternatives, and evaluating and legitimating alternatives.

CHAPTER V: REPRESENTATIONS OF RECOVERY

Introduction

This chapter presents the findings related to research question number four: How do stakeholders represent recovery actions and actors in their discourse about Pacific Northwest salmon policy? To address this question, I conducted an analysis of stakeholders' discourse to interpret the strategies that witnesses used to justify their own claims and undermine the claims of others. This analysis involved categorizing representations according to 1) the content of the representation (i.e., the actor or action being described); 2) the alignment of the speaker (i.e., the speaker's degree of support or opposition); and 3) the basis for advancing or refuting the representation (i.e., the justification for support or opposition). Additionally, I identified differences between stakeholder groups in the methods they employed.

In this section of the analysis, there was a greater emphasis on the rhetorical aspects of the policy discourse. That is, the focus shifted from identifying understandings of science to determining how science and other justifications were employed in persuasive and argumentative discourse. Consistent with this aim, I incorporated the perspective on discourse analysis associated with Potter, Wetherell and colleagues (Gilbert & Mulkay, 1984; Potter, 1996, 1997; Potter & Mulkay, 1985; Potter & Wetherell, 1987; Potter et al., 1991; Wetherell & Potter, 1988) to a greater extent (See Chapter II). This perspective proved useful for examining how people establish descriptions as factual and undermine others' accounts. However, this does not represent a theoretical or methodological shift away from the basic assumptions about the relationship between the levels of language and meaning or the study's focus on the level of meso-discourse (See Chapter II). Rather, Potter and colleagues' studies of micro-discourse in social practice simply provide a useful framework for identifying specific constructions present in stakeholders discourse that serve to justify claims. Furthermore, using this framework facilitates the potential to discuss relations between the various levels of discourse, or "climb the ladder" from micro-discourse to meso-discourse and beyond (Alvesson & Karreman, 2000).

In this analysis of the representations of recovery, two broad categories of discourses that stakeholders use to support or oppose claims are discussed. One group includes strategies that rely on understandings of science for legitimization, whereas the second group makes no such recourse to science. Although this dichotomy separates the discourses (in practice a stakeholder may employ both types), the discourses are arranged in this manner to conform to the study's focus on exploring understandings of science in policy discourse.

Science-based Discourses

Science-based discourses provided justification to stakeholders' representations by invoking specific understandings of science that imbue descriptions with social and cognitive authority. The science-based discourses are summarized in Table 15 and then explained in detail below. In general, science-based discourses were associated with understandings of an ideal science, a decision-making tool that is separate from and superior to other policy inputs. Science-based discourses were prevalent in the policy debate, undoubtedly due to the nearly universal positive regard for science among stakeholders. Furthermore, science-based discourses were used to support as well as refute representations; the same discourse can be employed by different actors to support disparate positions.

Table 15 Discourse analytic summary table of science-based justifications

Broad analytic category	Primary analytic category	Analytic sub-categories
Science-based discourses	Externalizing devices	Attribution of agency to data or studies Construction of impersonality
		Dispute agency of data Dispute quality of data
	Scientific consensus and corroboration	Peer review Science advisory boards
	Category entitlement	Scientist
	Extreme case formulation	Quantification rhetoric

Externalizing Devices

The first set of strategies available to congressional witnesses were labeled "externalizing devices" (Potter, 1996; Woolgar, 1988). In the context of the congressional hearings, externalizing devices served to simultaneously build up a description's status and also limit the witness' responsibility for the description. That is, the function of these devices is to "draw attention away from concerns with the producer's *stake* in the description – what they might gain or lose – and their *accountability*, or responsibility for it" (Potter, 1996, p. 150, emphasis in original). This type of justification was identified in a study of scientists' discourse by Giblert and Mulkay (1984), who described one externalizing device, the "empiricist repertoire," as a collection of grammatical constructions and styles that minimized the involvement of the scientists, and transferred agency to data. Potter (1996) summarized the effect of the empiricist repertoire: "The scientist becomes passive, virtually a bystander, or evaporates altogether; while simultaneously the data take on a life of their own. They become rhetorically live actors, who can do suggesting, pointing, showing, and implying" (p. 153). Although the fully developed empiricist repertoire is best exemplified in formal scientific texts, such as method sections of journal articles, externalizing devices are not limited to such formal scientific discourse (e.g., Yearley, 1985). The discussion below illustrates that externalizing devices are routinely employed in salmon recovery policy discourse as well.

Attribution of Agency to Data or Studies

During congressional hearings, witnesses employed discourses consistent with an empiricist repertoire to support their claims and undermine the claims of other stakeholders. One available strategy involved attribution of agency to data or studies. This discourse was located in the text by grammatical constructions that shifted the responsibility for the speaker's description away from the individual or group and onto data or studies. The effect was to support the description by limiting the role of human interpretation of such data or studies: "The support is built up by constructing the facts, the record, the evidence, as having its own agency" (Potter, 1996, p. 158). This discourse was most prominent in the testimony of academic scientists, NMFS representatives, conservation advocates, tribal leaders, and representatives of agriculture interests. Spokespersons for mining, transportation, grazing and forestry interests, as well as outfitters and guides and the Bonneville Power Administration also used this discourse, but to a lesser degree.

This attributing agency to data or studies discourse was identified in this testimony of the Fisheries Policy Representative for Shoshone-Bannock Tribes as the speaker expressed support for breaching the Lower Snake River dams:

> Recent studies indicate a positive probability of recovery with breaching of the dams would occur, but NMFS continues to maintain status quo and the continued expenditures to maintain the studies, approve construction of unproven methods on the very problems that continue to destroy the runs and the dams. (1 8; House 7.24.97 & 8.15.97: 852 – 856)

Note that studies are externalized as authoritative, while NMFS is personalized and attacked.

A representative of Save Our Wild Salmon similarly supported dam breaching by attributing agency to science:

> Fourthly, we need to keep our options open. Dam removal is an uncomfortable thing to advocate. But the science says it makes some sense. What we can't do is take any option off the table right now. We have to send them through the same scientific and economic filter. (1 91; Senate 6.23.99: 1244 – 1248)

The argumentative strategy here is to bolster a policy position, supporting dam breaching in these examples, through a discursive construction where "studies" are "indicating" or "science" is "saying" that dam removal is the preferred recovery alternative. This discourse invests a representation with the cognitive authority of science, and is preferred by stakeholders' who advocate recovery alternatives such as dam breaching, which enjoy little political support. Note also what the speakers did *not* say. For example, in the previous quote the speaker did not say "university scientists say," but rather the global "science" is used.

However, the attribution of agency to data or studies discourse was employed to oppose as well as support, especially by agricultural and forestry spokespersons. For example, the Executive Director for the Payette Water Users Association opposed NMFS' proposal to augment Snake River flows with water from Idaho reservoirs by investing "current studies" with agency:

> Currently, however, the United States Bureau of Reclamation, under the direction of the Corps of Engineers and NMFS, is studying adding an additional million acre-feet of water from Idaho to augment flows in that reach. However, there are very little biological

> benefits that support this misuse of Idaho water. Target flows on the lower Snake River are artificially set too high, in my opinion. Current studies indicate that hydrologically those flows cannot be met with all the water that is taken during average or dry years. But yet, NMFS still studies recovery methods that require Idaho water. (1 48; House 9.2.98 & 9.3.98: 3149 – 3159)

This example illustrates that, in addition to supporting politically unpopular positions, externalizing devices were employed when a stakeholder's interests were clearly linked to the policy position (e.g., a water users association opposes a decision that would restrict water use). Also, in this case too, the speaker did not say who is doing the "current studies," creating a hegemony of science.

Scientific Consensus and Corroboration

Another externalizing device that was employed in salmon policy debate was the discursive construction of scientific consensus and corroboration. With this strategy, stakeholders sought to build up agreement among independent actors to advance or refute representations. In the context of salmon recovery, stakeholders focused on working up consensus among scientists to support claims and draw upon the widely shared understandings of science as a source of instrumental justification and political legitimization. Agricultural representatives, academic scientists, NMFS administrators, and conservation advocates were most likely to employ this discourse.

In this testimony, the Western Conservation Director for Trout Unlimited enlisted "grassroots members throughout the nation" and the Independent Science Advisory Board to construct consensus and corroborate the claim that salmon recovery requires breaching four Lower Snake River dams:

> Several weeks ago, at our national meeting, our National Resource Board made up of grassroots members throughout the Nation endorsed proposals to retire the dams on the lower Snake River. We recognize this is a dramatic proposal. But after 20 years of failed experiments to engineer salmon recovery, we believe like the independent Science Advisory Board, that the time has come to look at returning portions of the river to

> conditions more closely approximating the conditions in which the salmon evolved. (1 20; House 9.2.98 & 9.3.98: 1561 – 1570)

The persuasive power of the previous statement would not be as great if the consensus were constructed only among Trout Unlimited's "grassroots members throughout the nation" because the policy position is clearly linked to the group's interests. Thus, to enhance the truth-status of the statement, the speaker corroborated the consensus with support of an "independent" and science-based group.

An alternative usage of the consensus and corroboration discourse was to denigrate a stakeholder group, the National Marine Fisheries Service in the next example, by representing the group as outside of the sphere of scientific consensus:

> The Shoshone-Bannock Tribes had a biological analysis of the Shoshone-Bannock Tribes' proposed harvest of salmon presented to NMFS since early spring. This was approved by them, but when the Shoshone-Bannock Tribes were preparing their tribal regulations, NMFS all of a sudden had a problem. We had to scramble and go through the process to have a technical review by the Technical Advisory Committee. The Technical Advisory Committee did not see any conflict with our proposal but NMFS did; consequently, no consensus. (1 8; House 7.24.97 & 8.15.97: 863 – 871)

By rhetorically placing NMFS outside of a consensus that is corroborated by the "Technical Advisory Committee," the agency's decision-making was characterized as arbitrary, unpredictable, and not science-based.

Category Entitlement

Discourses that invoke category entitlement advanced or refuted a representation based upon the status of an actor's social role. That is, "certain categories of people, in certain contexts, are treated as knowledgeable" (Potter, 1996, p. 133). In the context of the congressional hearings, the category of scientist was constructed to bolster claims and this discourse was located only in the testimony of academic scientists and NMFS scientists. The most obvious strategy for claiming the category of scientist, and the associated entitlement, was to declare membership:

> As a scientist, I must say that I believe that hatcheries, if they assume a reformed role of producing fish with more natural life history traits, can play an important role in the recovery of wild fish. In the Snake River Basin, hatcheries are already being employed to save the last remaining gene pools of listed sockeye and Chinook from extinction through the use of captive breeding. I also believe that we can, during recovery of Chinook and summer chum salmon in the Puget Sound Basin, maintain some semblance of a fishery sustained primarily by hatchery fish. However, it will require that we do business differently than in the past, and that these hatcheries function in ways which reflect the latest scientific information and conservation practices. (1 92; Joint 4.7.99: 2423 – 2436)

The interpretation here is that the speaker, a research scientist for NMFS, introduced his policy advice with the preface "As a scientist" to explicitly claim membership in the scientist category and thus invoke the privilege that is associated with that role in this particular context. The effect is to imbue the subsequent policy advice with the full weight of science and head off efforts to undermine the recommendations for hatchery reform.

Extreme Case Formulation

A common and potent persuasive strategy in many forms of discourse is the use of extreme case formulations (Pomerantz, 1986). One tactic is the use of modifying terms to argue or justify claims and strengthen the case. For example, when asked to plead to murder charges, O.J. Simpson did not respond "not guilty," but rather, "Absolutely, one hundred percent not guilty." Potter and colleagues (Potter, 1996; Potter et al., 1991) described a particular type of extreme case formulation that relies on the use of quantification to maximize and minimize. Quantification rhetoric is conceptualized as the way numerical quantity formulations are deployed as tactics in argumentative discourse. These authors documented this practice through a discourse analysis of a television program about the success of charity giving to cancer research. They described how quantification rhetoric was used to support the factual status of descriptions and paint a version of events as independent of the speaker and therefore more legitimate: "instead of thinking of quantification accounts as more or less accurate renditions of some putative reality, we should view them as designed for their robustness in an argumentative arena" (Potter et al., 1991, p. 337).

The scientific and technical aspects of salmon policy discourse create a suitable arena for the use of extreme case formulation, especially quantification rhetoric, as an argumentative strategy. Quantification rhetoric is evident in the following statement from the Chairman of the Eastern Oregon Irrigation Association, who opposed flow augmentation, which would reduce the amount of water available for irrigation:

> In other words, we have been and we are committed in salmon recovery for long time. We irrigate some 200,000 acres of irrigated land in Eastern Oregon. Almost all of our products are processed locally and values are added. Annually over 80 percent of our products are valued between $8 to $900 million annually, exported out of our region, and most overseas market through one of the most efficient and economical Columbia River barge transportation system. Over 8,000 people in our sparsely populated area are employed in agriculture and other food related industries. We do all of these with the use of only three-tenths of 1 percent of Columbia River water. And that's about all of the water the state of Oregon uses in the whole state, three-tenths of 1 percent. Let me make one thing very clear. Columbia River system, which is the second largest river in the country, is not an over-appropriated river as some may want you to believe. The total of only 7 percent of the Columbia River water is utilized for agricultural, municipal and industrial use in Oregon, Washington, Idaho, Montana and British Columbia combined. Only 7 percent. Ninety three percent of all the water is untouched and is used for fish and hydro. Our farmers are a vital part of providing food for our citizens at home and hungry world abroad. And we are very proud of these achievements. As the world population are expected to reach over 10 [b]illion people in the coming decades, our ability to produce high quality and affordable food supplies become even more vital. (1 83; House 9.2.98 & 9.3.98: 2056 – 2085)

There are several elements of quantification rhetoric in this passage. First, extreme case numerical formulations were employed to describe the contribution of irrigated agriculture to society (e.g., economic impact is estimated in the hundreds of millions). Second, the argument was supported by the strategic and repeated contrast of quantity formulations. For example, the number of people supported by agriculture was given as 8,000, an "objective" measurement that is "enhanced" when modified by the description of the area as "sparsely populated." Then, in a sophisticated construction of quantification discourse, the extreme “maximized” cases (200,000 acres, 80 percent, $900 million, 8,000 people) were contrasted with an extreme “minimized” formulation: “three-tenths of one percent” of the Columbia River’s flow. The purpose of this discourse was to justify the Irrigation Association’s opposition to flow augmentation by representing irrigation’s positive impacts with maximized quantity formulations while representing irrigation’s negative impacts with minimized quantity formulations.

This type of quantification rhetoric, mixing absolute quantities ($800 million) with relational qualities (three tenths of one percent) to maximize one item and minimize the other, is entirely consistent with the practice as described by Potter et al. (1991) in their study of cancer statistics. This discourse is an effective argumentative strategy because “quantification is often thought of as an especially precise and clear-cut form of description which is contrasted to value judgments and vague qualitative assessments” (Potter, 1996, p. 191). Furthermore, as quantification is a discourse associated with the ideal understanding of science, employing extreme case numerical descriptions to support or refute representations links an argument to the widely shared and authoritative ideal version of science.

In summary, this part of the discourse analysis identified a series of science-based justifications that witnesses used to support representations. Witnesses used externalizing devices to build up the status of their representations by shifting the responsibility for away from the speaker and onto science, data, or studies. Other science-based strategies included constructing consensus and corroboration, category entitlement, and extreme case formulation. The representational strategies and differences in presence, distribution, and frequency of expression are presented in Table 16.

Table 16 Role ordered summary table of science-based justifications

Analytic Categories			Intensity		
Broad analytic category	**Primary analytic category**	**Analytic sub-categories**	**Low (<30)**	**Moderate (30-60)**	**High (>60)**
Science-based discourses	Externalizing devices	Attribution of agency to data or studies	Mining Transportation Grazing Forestry Chamber of commerce Outfitters and guides Army Corps		Academic scientists NMFS Conservation Tribal Agriculture
		Dispute agency of data Dispute quality of data	Academic scientists Tribal Sport-fishing Transportation Chamber of commerce Motor boating	Forestry	Agriculture
	Scientific consensus and corroboration	Peer review Science advisory boards	Tribal Sport-fishing Grazing Motor boating NWPPC	Academic scientists NMFS Conservation	Agriculture
	Category entitlement	Scientist	Academic scientists	NMFS	
	Extreme case formulation	Quantification rhetoric	Academic scientists Mining Grazing Chamber of commerce	Tribal	Agriculture Transportation

Non-science Discourses

Although science-based discourses are prevalent and powerful argumentative strategies, other forms of justification are available. Whereas science-based discourses generally support representations through recourse to instrumental rationality and cognitive or social authority, non-science discourses invoke democratic principles, stakeholders' interests, or non-scientific forms of knowledge (Table 17). These discourses reflect a trend in natural resource policy more generally, and salmon recovery in particular, towards increased public participation.

Table 17 Discourse analytic summary table of non-science-based justifications

Broad analytic category	Primary analytic category	Analytic sub-categories
Non-science discourses	Democratic principles	Local control
		Treaty rights
	Interest management	Attributing interest
	Local knowledge	Lay knowledge Local knowledge

Democratic Principles

Clearly, salmon recovery involves not only scientific and technical dimensions, but also social and political dimensions. Conflicts over divergent social values are fundamental to the salmon recovery policy debate. In the most fundamental sense, salmon recovery policy development is the process whereby stakeholders attempt to come to an agreed upon course of action to address the "problem of salmon." Within the congressional hearings, I identified a number of discourses that invoked democratic principles as a powerful argumentative strategy. Discourses of democratic principles employed concepts such as local control, law or policy, and treaty rights to justify claims. The availability of each of these discourses was limited in certain ways to specific categories of social actors. For example, the local control justification was limited to interests who could legitimately claim the Pacific Northwest as their territory.

Local Control

A major concern of natural resource policy communities in the West is decision-making access for local constituencies. The relationships between federal natural resource management agencies and local and regional stakeholders became progressively more contentious during the 1990s as controversies over resource management stimulated the development of social movements to reform federal land management policy and increase local control of public lands. Krannich and Smith (1998) note that "the emergence of the 'Wise Use,' 'country supremacy,' and 'home rule' movements reflects a broadening social conflict over public lands management and growing demand for increased local control over resource management decisions" (p. 677).

Columbia River Basin salmon recovery policy exemplifies the broader social conflict over local versus federal control of public natural resource policy that Krannich and Smith (1998) describe. The salmon recovery policy community includes a number of stakeholder groups that use discourses of local control to legitimate claims on the basis of republican principles of democratic governance, especially an opposition to the concentration of decision-making power in the hands of centralized federal government. This discourse can be invoked to support or oppose a range of representations. In practice, local control can support conflicting policy positions because legitimization is based on discursive construction of local rather than other measures of the merit of the policy position. Subsequently, this discourse was limited to stakeholder groups that could construct a credible claim to being local.

One sector of the policy community that employed the local control discourse was governmental representatives from the four affected Northwest states – Washington, Oregon, Idaho, and Montana. The listing of salmon species under the Endangered Species Act injected a significant federal presence into natural resource management and state and local government officials employed the local control discourse to support local recovery efforts and limit federal influence. In this testimony a Washington State Representative from the Olympic Peninsula supported state recovery efforts using the local control discourse:

> Only one issue counts for the State, and that's local control. We must persuade federal authorities that we can handle this problem ourselves. The federal government wants certainty, a clear commitment to salmon restoration, something more than promises. It's not good enough to say that we are--we have agreement with all parties that salmon restoration is important. We recognize the need for action, and this year we're proposing a plan of smart recovery to address the major areas of concern. Last year we passed the Salmon Recovery Act of 1998 which established a framework for recovery efforts based on the principal of putting our resources where they will do the most good, and we're building on those efforts this year. (1 95; 4.7.99: 2766 – 2778)

While state and local government officials regularly employed the local control discourse during congressional hearings, they carefully constructed a prime decision-making role for themselves while simultaneously garnering significant federal funds to carry out recovery efforts.

Agricultural groups and those with water rights interests relied heavily on the local control discourse to justify claims. Flow augmentation to support downstream juvenile salmon migration combined with drought conditions in the Northwest to precipitate a major conflict over water in the West. Columbia River Basin agriculture, especially in the eastern basin, is heavily dependent on the federally operated system of dams for irrigation. The Chairman of the Eastern Oregon Irrigation Association opposed NMFS, dam removal, and flow irrigation based on local control:

> All of these achievements are now in jeopardy through unrealistic dam removals over our dead bodies and excessive flow augmentation proposals by our Federal agencies. We watch with bewilderment how NMFS and an army of Federal agencies have totally abandoned cooperative spirit of working with local officials and the resource users. (1 83; House 9.2.98 & 9.3.98 : 2086 – 2100)

The irrigation representative disparaged others' policy positions and NMFS because the federal agencies have violated republican principles of government.

Opposition to federal authority was echoed by Northwest businesses with largely economic interests. Homebuilders, represented by the Master Builder's Association of King and Snohomish Counties, promoted stakeholder collaboration:

> The Association embraces the Tri-County process because builders felt it was important that the economic and environmental destiny of this region must be determined locally, not by a federal agency. Originally, the Tri-County effort was to emulate the Oregon coastal coho threatened listing model by attempting to avert listing of the Chinook through creating preservation and restoration plans which NMFS could endorse as not requiring listing of the species. That goal was abandoned after the court struck down the Oregon plan. However, the philosophy of the original goal should not be lost. (1 89; Joint, 4.7.99: 2042 – 2052)

Again, the central feature of this discourse is the construction of local control and the rhetorical representation of the federal agencies as outside of the sphere of the local space.

The following quotation, from a representative of Private and Municipal Planning Services, is a prototypical example of the local control discourse:

> I believe these difficulties arise chiefly from the lack of early commitment by the agencies in establishing a meaningful, institutional, financial and regulatory relationships with the local community that are needed to make ESA requirements workable and understood. Failure to provide this coordination has caused harm to the citizens, increased resentment towards government and yielded little benefit to the listed species. Further, the lack of coordinated interaction between the agencies has, more often than not, stifled expeditious implementation of good solution. (1 45; Senate, 4.20.00: 1129 – 1139)

In the passage above, the speaker first established the local control discourse as a justification for opposing NMFS and subsequently went on to "illustrate the point" with specific examples.

Treaty Rights

Other discourses that rely on democratic principles to justify claims invoked existing law or policy, such as the Endangered Species Act, congressional intent, or Indian treaty rights. Not surprisingly, treaty rights were primarily employed to support representations by tribal representatives, although not exclusively. Representatives of conservation nonprofits also deferred to treaty rights to support preferred policy positions. Also, NMFS relied on treaty rights to support their actions.

Specific treaty obligations were explicitly invoked by Nez Perce and Shoshone-Bannock tribal representatives in the following passages:

> The Nez Perce Tribe's legal basis for its role in salmon restoration efforts stems from the supreme law of the land, our treaty of 1855 with the U.S. Government in which we expressly reserved the right to take fish. The United States also owes a trust or fiduciary duty to the Nez Perce Tribe. (1 59; House 7.24.97 & 8.15.97: 677 – 681)

> I come here today to express my tribes' frustration with the National Marine Fisheries Service's representation of the trust responsibility of the United States to the Shoshone-Bannock Tribes. The lack of equitable management of the Endangered Species Act with my tribes' rights that are guaranteed under provisions of the Fort Bridger Treaty of 1868. The Shoshone-Bannock Tribes have taken the position that the ESA does not apply to our people. To enforce the ESA on tribes would be an abrogation of our treaties unless there was proper consultation leading into an agreement or understanding as to how and what would apply to tribes. Otherwise, the treaty, which is the supreme law of the land, would be enforced. (1 8; House 7.24.97 & 8.15.97: 810 – 822)

In the second passage, the Shoshone-Bannock tribal representative justified the extremely significant policy position that the ESA does apply to the tribe based on reserved treaty rights.

Interest Management

The policy actors who testified before Congress on salmon recovery have significant interests at stake. Actors' interests reflect "important perceived personal consequences" (Crano, 1997, p. 132), which affect their policy positions (Boninger et al., 1995; Crano, 1997; Diekmann et al., 1997; Wolpert & Gimpel, 1998; Young et al., 1991). In salmon recovery, interests can take several forms. For some, interests are largely economic. However, others' interests are based on perceived social or ecological consequences. When advocating for a preferred policy outcome during debate, actors actively "managed" these interests. On one hand, interests provided a degree of legitimization and justification – an entrée into the policy arena. However, on the other hand, actors whose policy stance is represented as entirely interest driven were more easily dismissed if their interests were not widely shared or did not contribute to the public good.

Consequently, interest management was an important discursive practice in policy debate. One strategy that is available for actors to oppose others' policy positions involves attributing interest. Through this discourse, stakeholders sought to undermine their counterparts' positions by representing motivations as self-serving. For example, one target of this discourse was NMFS and the "salmon recovery industry," which was portrayed as an interest-driven juggernaut in this excerpt from the Speaker of the Washington State House of Representatives:

> Unfortunately, the most effective action of NMFS to date is to enhance what is being called a salmon recovery industry, not improving salmon runs. The salmon recovery industry, an army of state, Federal and tribal bureaucrats and their consultants, have simply sought greater political and operational control over the resources and funding. Their objectives are totally self-serving. More control and funding has not created more fish in the river. (1 4; House 9.2.98 & 9.3.98: 815 – 822)

To oppose barging as a recovery strategy, the President of Idaho Steelhead and Salmon Unlimited attributed interest to NMFS:

> In recent years, many millions of dollars have been spent and are proposed to be spent on the fish barging system. We feel this is a mistake and will continue the gold plating of this system, thus giving prejudice to the transportation scenario versus in-river migration when the scheduled decision is ultimately made in 1999. Barging proponents have recently been stating that the barging is more successful than in-river migration based on early PIT-tag studies. Unfortunately, the smolt to adult return ratio of one-half of 1 percent for barged fish is far below the 2 percent ratio that the independent scientific group says is necessary to halt their decline and is not even close to the 4 to 6 percent ratio needed to restore them. (1 9; House 7.24.97 & 8.15.97: 2475 – 2481)

Describing NMFS as "gold plating" the system serves to link the agency's decision-making to economic interests. The attribution of interest was followed in this case by a science-based claim that discounts barging even further.

Local Knowledge

A growing body of work in public understanding of science and public of understanding nature considers the role of local knowledge in natural resource decision-making, often contrasting local knowledge with expert or scientific knowledge (e.g., Bensuade-Vincent, 2001; Carr & Tait, 1991; Clark & Murdoch, 1997; Dizard, 1994; Harrison et al., 1998; Hull et al., 2001; Irwin, 1995; Olsson & Folke, 2001; Wynne, 1996) These studies raise concerns about the credibility gap between scientific knowledge and local knowledge and demonstrate ways in which "the presently 'discounted knowledges'" (Harrison et al., 1998, p. 306) of those outside the scientific community potentially can contribute to natural resource policy. More and more, local knowledge is being recognized as legitimate and useful for natural resource decision-making (Clark & Meidinger, 1998; Eden, 1996).

In salmon policy debate, certain stakeholders employed discourses that invoke first hand, contextual, experiential, historical, or place-based local knowledge to justify representations. This type of discourse is much less common than discourses that appeal to science. Representatives of agriculture, grazing, conservation, and tribal interests appeal to local knowledge in policy debate to counter arguments justified by science-based discourses. Speaking on behalf of agricultural and transportation interests, the Vice President for the Port of Lewiston, Idaho drew on local knowledge to oppose flow augmentation and undermine the science-based justification used to support the augmentation proposal:

> Another thing is on the flow augmentation. As a youth in the 1930's, I used to swim in the Clearwater River. The Clearwater River, they had the log drives in there, the log drives come with the high water and the high water was generally considered a week plus or minus Memorial Day. Now we have got to take water out of the Dworshak to keep the Clearwater River, the lower 30 miles of it, at a much higher level than it ever was before. To me, it is not natural. When I was swimming in the Clearwater River, there was no dams up there. We used to swim at Spalding and it was a major accomplishment of the youth to swim the river. It was not really that far, but it was an accomplishment. Now the water is cold as they draw the winter water out of Dworshak, and as I say, it is higher. It

does not make sense to me--does not make sense to me. (1 81; House 7.24.97 & 8.15.97: 2059 – 2073)

The observation that citizens counter scientific advice with local knowledge when science is inconsistent with personal experience is consistent with previous PUS studies. For example, in one case study of English farmers, Harrison et al. (1998) observe that farmers challenged the advice of conservation scientists based on local knowledge: “The expertise, universalizing prescriptions and practices of professional nature conservationists were very much at odds with their [farmers’] own intense, contextual, specific knowledge and experience of the land” (p. 312).

In summary of this section, my analysis uncovered a series of non-science-based justifications that witnesses used to support their claims and undermine the claims of others. Representatives of number of stakeholder groups, including conservation, agriculture, transportation, and grazing used local control as a strategy. These witnesses usually attempted to construct themselves as belonging to the local category and opposed others by representing them as non-local. Another strategy that relied on democratic principles was referencing treaty rights. Finally, some witnesses employed interest management or invoked local knowledge. These non-science-based strategies and differences between groups are summarized in Table 18.

Table 18 Role ordered summary table of non-science-based justifications

Analytic Categories			Distribution		
Broad analytic category	**Primary analytic category**	**Analytic sub-categories**	**Low (<30)**	**Moderate (30-60)**	**High (>60)**
Non-science discourses	Democratic principles	Local control	NMFS Tribal Sport-fishing Forestry Homebuilding CEQ		Conservation Agriculture Transportation Grazing
		Treaty rights	Conservation Motor boating	NMFS	Tribal
	Interest management	Attributing interest	Agriculture Grazing		Conservation Forestry
	Local knowledge	Lay knowledge Local knowledge	Forestry	Conservation Tribal Transportation	

CHAPTER VI: SUMMARY AND DISCUSSION

Introduction

This chapter begins with a brief summary of the study, followed by a discussion of the implications of this research. Finally, I discuss the significance of the study to public understanding of science research, discourse studies, and natural resource policy.

Summary

In this study I examined issues of stakeholders' understanding of science in the context of salmon recovery policy. Four research questions guided the inquiry: 1) what understandings of the nature of science are expressed in stakeholders' discourse about Pacific Northwest salmon policy; 2) what understandings of the boundaries of science are expressed in stakeholders' discourse about Pacific Northwest salmon policy; 3) what understandings of the roles of science in decision-making are expressed in stakeholders' discourse about Pacific Northwest salmon policy; and 4) how do stakeholders represent recovery actions and actors in discourse about Pacific Northwest salmon policy? The objective of the study was to document the content, range, and distribution of understandings of science and associated representational practices in stakeholders' discourse with the goal of contributing to scholarship in the fields of public understanding of science and discourse studies, and improving the policy process by promoting more meaningful, reflexive, and collaborative natural resource decision-making.

The theoretical and methodological framework of constructivist discourse analysis guided the inquiry. Transcripts of witness testimony from congressional committee and subcommittees hearings provided the empirical material for the discourse analysis. I employed a three-phase qualitative analysis process of data reduction, data display, and conclusion drawing and verification to identify, describe and interpret stakeholders' understandings of science and associated representational practices.

To interpret the understandings of science I analyzed witness testimony for emergent themes, which were initially identified by the location of specific grammatical elements and linguistic structures in the text, but, as stated earlier, it was the interpretation of how the speaker employed understandings of science in discourse that mattered to me, not simply the presence or absence of the grammatical forms. I organized the discourse according to analytic categories and dimensions to identify the range of prototypical understandings of the nature, boundaries, and roles of science and associated representational practices. Furthermore, I documented differences between stakeholder groups in the presence, distribution, and frequency of expression of understandings of science and representational practices expressed in policy discourse.

Study Conclusions

In this section I summarize the conclusions of the study, organized according to the four guiding research questions. In response to the first question regarding what understandings of the nature of science are expressed in salmon recovery policy discourse, I located a set of discourses that were organized into categories of scientific process, scientific knowledge, and scientists.

Regarding scientific process, some stakeholders, especially academic scientists, described science in traditional positivist or received terms as an impartial and ideal process that is rigorous, and based on theory, hypothesis testing, modeling, quantification, and peer-review. Academic scientists and conservation advocates also highlighted the role of developing consensus to reduce uncertainty. Peer-review was an attribute of scientific process mentioned to a moderate degree by sport-fishing advocates and scientists and to a lesser degree by NMFS representatives, conservation group spokespersons, and witnesses from forestry associations. Finally, one witness from a conservation group suggested that scientific process shifts over time as paradigms change.

Scientific knowledge was represented as by scientists and conservation advocates as certain, predictive, value free, representative, and explanatory – in short, as “truth.” However, these same groups also sometimes portrayed scientific knowledge as tentative and subject to refinement and refutation, or, as “today’s truth.” Such inconsistency in descriptions is indicative of how different understandings may be employed based on the context to perform social functions in discourse. Descriptions of scientists focused primarily on the representation of independence. That is, some scientists, especially those affiliated with academic institutions and science advisory boards, were described as by conservation advocates, and scientists as independent advisors. Other scientists, including those from industry and government agencies, were labeled by BPA representatives and conservation groups as subjective, biased, and interest-driven – that is, as captured.

The second research question guided the inquiry to examine the understandings of the boundaries of science expressed in policy discourse. Here I documented stakeholders' discourse that served to construct boundaries between science and politics and science and management. Two understandings of the boundaries of science and politics were identified: science and politics as separate and unequal and science and politics as reluctant (an unequal) partners. With both of these discourses, stakeholders represented science as separate from and superior to politics. Science's superiority was based on its impartiality and instrumental utility for decision-making. However, with the later, witnesses expressed an understanding that science and politics are inexorably linked in salmon recovery and the two processes must be integrated to address the policy problem, but science's superiority was uniformly maintained, at least among those groups that expressed this discourse One understanding of the boundary of science and management was identified in the testimony: science as management' caretaker. With this understanding, scientists and conservation groups defined science as separate from natural resource management but essential for proper management.

The third topic of inquiry was understandings of the roles of science in decision-making. Based on the number of text units coded, understandings of the roles of science in decision-making were the most prevalent discourses of science. This is most likely because the hearings themselves focused primarily on the decision-making processes of the federal action agencies such as NMFS. Also, the role of science and scientists in decision-making is less abstract than the other categories and is easier for stakeholders to discuss. Debating the role of science in has tangible outcomes on the vested interests of the parties involved. Stakeholders' constructed roles for science in creating decision-making alternatives, selecting among alternatives, and evaluating and legitimating the selected alternatives. To create alternatives, stakeholders, especially scientists but also NMFS representatives, conservation and forestry advocates and to a lesser degree motor boating groups, said that science identifies problems, identifies alternatives, and fills in knowledge gaps. To select among alternatives, a host of groups described science in instrumental terms as a tool that identifies decision priorities and risks and benefits. This discourse was expressed to a low degree by those representing agriculture and motor boating interests, to a moderate degree by witnesses from the BPA, Indian tribes, forestry associations, outfitters, and to a high degree by academic scientists, conservation advocates, and NMFS representatives. Science was said to evaluate and legitimate alternatives by supporting the decisions with the best available data, external peer review, and science advisory boards.

The fourth topic that guided this discourse analysis concerned the strategies that stakeholders employ to represent other actors and potential recovery actions. In response to this question, I identified the use of both science-based strategies as well as non-science-based strategies that witnesses used to justify their claims and undermine the claims of others during policy development. With the rhetorical employment of science, actors had powerful cognitive authority, and instrumental and rational justification for claims-making, especially in the construction of facts. Science-based discourses included a series of externalizing devices that functioned to shift the responsibility for a description off the speaker and onto science, data, or studies. This strategy was employed most often by agricultural groups, Indian Tribes, scientists, conservation advocates, and NMFS representatives, but was also present in the testimony of other groups representing these interests: mining, transportation, grazing, forestry, chambers of commerce, outfitters and guides, and the Army Corps of Engineers. Stakeholders also used externalizing devices to undermine the veracity of others' claims by disputing the agency of science, data, or studies. Another science-based discourse identified in the text was the construction of scientific consensus and corroboration through reference to peer-review or science advisory boards. Some expert witnesses, including NMFS scientists and academic scientists, claimed entitlement to the category of scientist to legitimate their claims, while other witnesses employed a form extreme case formulation by using quantification rhetoric.

I also found that non-science-based discourses were used to draw on other sources of legitimization, such as democratic principles, interest, and local knowledge to support claims making. Local control and treaty rights were mentioned as two forms of democratic principles most often by agriculture, transportation, grazing, and conservation groups. Some witnesses “managed” interests by attributing stake to others to undermine their claims, whilst Tribal groups in particular made recourse to local knowledge or lay knowledge to support or oppose policy options.

In addition to addressing the four guiding research questions, another objective of this study was to explore the differences in the presence, distribution, and frequency of expression of the understandings of science and representational practices discussed above. By constructing a quantitative measure of the percentage of total text units coded for each primary analytical coding category for each group out of total text units coded for the broad category that group, I was able to conclude from this analysis that the frequency of expression of the understandings of science and strategies used to represent recovery actors and actions differed between stakeholder groups (See Chapters IV and V and discussion above). While I cannot comment definitively on the reasons for these differences or the relative importance of the influential factors based on the findings of this study alone, my sense is that vested interests and social structural roles significantly influence the discourse. For example, the discourse of individuals who hold positions as of academic scientists might be expected to be consistent with social expectations for that role. Also, descriptions are affected by the expectations of the audience – congressional committee members and other witnesses in this case – that a scientist should express an understanding of science consistent with the socially and historically dominant grand discourse of ideal science.

A related explanation for different understandings of science and representations between groups might be the effects of institutional history and enculturation. For example, the governmental and quasi-governmental institutions involved in salmon recovery such as U.S. Fish and Wildlife Service, National Marine Fisheries Service, Army Corps of Engineers, and Bonneville Power Administration have distinctly different institutional histories and cultures. Reward and promotion structures within these agencies tend to favor individuals whose values, beliefs, *and* language are consistent with the institutional history and culture. Subsequently, a thorough understanding of the relationship between institutions and science would be useful for anticipating the understandings of science expressed by a member of that institution.

Significance and Discussion

The significance of this study relates to research in public understanding of science, discourse studies, and the role of science in natural resource decision-making.

Public Understanding of Science

Much of the existing research in this area has explored public understanding of science through surveys (Miller, 1998; Miller & Prewitt, 1979; National Science Board, 2000; Pion & Lipsey, 1981) or in-depth individual or group interviews (Michael, 1992, 1996; Wynne, 1996; Yearley, 2000). These approaches have certain advantages and are central to the PUS enterprise (see Chapter II). However, actors also express understandings of science in policy settings such as congressional hearings that they may not able to describe in a survey or interview. By examining stakeholders' discourse in the context of congressional hearings, this study responds to calls for PUS research to focus more on naturally occurring discourse and specific controversies where the "differences among the multiple definitions of science are thrown into high relief in and through the iterative back-and-forth parrying of argumentation (as in a sequence of presentations in a hearing or in a courtroom)" (Anonymous Reviewer, 2000).

What emerged from this study was a set of ideal types or prototypical discourses (Michael, 1996) related to public understanding of the nature, boundaries, and roles of science in salmon recovery policy. These prototypes might shape future research in public understanding of science by providing an empirically derived set of categorizations to guide discourse analysis of other natural resource issues with similar contexts. The taxonomy developed in this study might be used to construct theoretical propositions about which understandings of science and representational practices are likely to be used by which actors in which situations. For example, it seems clear from this study that academic scientists, natural resource agency representatives, and conservation organization representatives most frequently employed understandings of science in their policy discourse, and these actors' descriptions appeared more descriptively complex and elaborate than other actors' understandings, and thus perhaps more influential in the policy arena, where science is generally revered.

On a different note, researchers approaching public PUS research from the survey perspective might find the different categories of understandings identified through discourse analysis in this study useful in the construction of multiple-item questions for a survey approach. That is, the understandings could form the basis for an exploratory factor analysis. Along these lines, my interpretations of the presence, distribution, and frequency of expression of discourses across stakeholder groups could prove fruitful. Bearing in mind the limited transferability of these interpretations, other analysts may construct propositions to further explore differences between social groups and construct more robust explanations for those differences. However, because descriptions of science may be constructed in discourse to fit the context, which calls into question the traditional conception of attitudes, such survey-based studies should be explicit and specific about context in the survey instrument. That is, just as attitude-behavior relationships are best measured at the same level of specificity and in the same context; surveys of attitudes toward science should take greater account of context. Finally, by linking understandings of science with rhetorical resources used in argumentation, this study lays the groundwork for future research that examines the practical effectiveness of science-based and non-science-based strategies in influencing actual policy outcomes.

However, there were certain difficulties of using discourse analysis in this study to interpret natural language. One difficulty was the subtlety and ambiguity of natural language, which made identifying the different understandings challenging. For example, it was particularly challenging to analyze the language when science was an implied but not explicit topic of the discourse. Macnaghten (1991) expressed similar frustration in his study of the discourses of nature used in stakeholders' arguments about a landfill site. A related challenge was the development of a reliable coding structure that could be consistently applied to organize the understandings according to analytic categories and dimensions. Despite an extensive codebook development process that included multiple iterations and inter-rater reliability verification exercises, differing interpretations of ambiguous statements were persistent. This would likely be even more of a problem in a naturally occurring language context other than a congressional hearing because in other contexts people's language tends to be less direct and more subtle.

Another challenge was the limited prevalence of discourses of science in the testimony. By one measure (text units coded out of total possible text units), about one-quarter of the oral testimony was deemed relevant for further analysis after unrelated text was bracketed off during the data reduction process. Perhaps the most frustrating challenge was that once text was identified as relevant, I did not have the opportunity to directly query the witnesses with probing questions to explore the understandings. This approach would be useful in another study that explored the relationships between linguistic and non-linguistic elements of the understandings of science identified in this study. That is, by directly questioning individuals, the effects of an individual's thoughts and feelings on the understandings that he or she expressed in the hearing could be explored.

Discourse Studies

Relative to discourse studies, this study makes contributions to the theory and method of constructivist discourse analysis. This study is theoretically relevant as an empirical illustration of an analysis of meso-discourse. This is significant because much of the existing discourse analytic research on the category of science focuses on the levels of micro-discourse (e.g., Edwards & Potter, 1992; Gilbert & Mulkay, 1984; Potter, 1996; Potter & Wetherell, 1987; Roth & Lucas, 1997; Wetherell & Potter, 1988), Grand Discourse, or Mega-discourse. While these studies have done much to advance discourse theory, there is a dearth of research that targets the level of meso-discourse. Meso-discourse studies such as this one are necessary for exploring the theoretical relationships between language, meaning, and practice along the formative dimension of the discourse continuum (Alvesson & Karreman, 2000).

This study advances the method of discourse analysis by illustrating the application of a three-phase process that is well accepted in other domains of qualitative analysis (Miles & Huberman, 1994). This process transparently links research questions, empirical material, analyses, and conclusions, allowing for evaluation of the study's credibility. This is in contrast to many empirical constructivist discourse studies, which routinely lack specificity regarding methods of analysis, but rely instead on compelling narrative to reinforce interpretations and conclusions. Furthermore, this study demonstrates the suitability and capability of the N5 qualitative analysis software for discourse studies.

Natural Resource Policy

This study contributes to an ongoing dialogue among participants and analysts about effective strategies for improving decision-making in natural resource controversies. In the current literature, there seem to be two major thrusts to the recommendations for resolving intractable policy problems such as salmon recovery: strengthening of the role of science and scientists (e.g., Dietz & Stern, 1998; Hutchings et al., 1997b) and consensus-driven multi-party collaborative processes (e.g., DeLeon, 1997; Dryzek, 1990; Fischer, 1993, 1995; Hajer, 1995; Schön & Rein, 1994), and this study speaks to both.

On the surface, the findings of this study seem to support strengthening of the role of science and scientists as an effective strategy for achieving policy goals. As noted in the introduction (Chapter I) and discussion of the salmon policy problem (Chapter II), it is common for stakeholders in natural resource disputes to call for science to guide decision-making. The discourse analyzed for this study is illustrative of this pattern. Overall, stakeholders expressed understandings of the nature, boundaries, and roles of science that privilege science and instrumental rationality. The following expressions of support for science typify the views of many stakeholders:

> Science-based decision-making is perhaps the single most important principle we have. Given the deep divisions that exist and the stakes involved, we must stick to the science. If we do not, we will be rudderless, adrift without direction, and lost. (1 74; House 7.24.97 & 8.15.97 :3092 – 3096)

> We need to follow the science. And the science is going to take us down some painful paths, but it's going to define what tracks we must react under. We cannot use science as a weapon for delay, or a weapon to divide. We need to use science to pull us together... Let's follow the science, stop the harm, enforce the law. (1 91; Joint; 4.7.99: 2274 – 2278, 2318)

Thus, one potential recommendation from this study might be to suggest stakeholders rally around science. Scientists might be promoted as arbiters of difficult policy choices, and it seems that the stakeholders would be eager to accept the recommendations of scientists.

However, a careful examination of the patterns of stakeholders' discourse renders such an interpretation untenable. The key lies in divergence in stakeholders' understandings of science-in-general versus science-in-particular (Michael, 1992). While stakeholders' understandings of science-in-general may be widely shared and reverential (as they were here), divergence and skepticism was apparent regarding the nature, boundaries, and roles of science-in-particular. When discourse focused on science-in-particular, science was not so widely privileged and was no longer accepted as universally credible (Michael, 1992). In this study, the credibility of science-in-particular was sometimes challenged by countering the universalizing prescriptions of scientists based on local knowledge (c.f., Harrison et al., 1998; Wynne, 1996), or by questioning the independence and objectivity of scientists. For example, a conservation organization spokesperson praised a science advisory board while criticizing agency scientists to oppose a specific management action:

> And, fourth, the authoritative, scientific views of the National Marine Fisheries Service's own independent scientific advisory board need to be given more credence by NMFS itself and by the Administration. This is the best science available, and they are ignoring it. NMFS relies far too much on the decidedly unindependent scientists that are in charge of its own fish barging program to create their future policy (1 36; House, 9.2.98 & 9.3.98: 2024 – 2027).

Interestingly, such challenges were mounted without undermining the overall credibility of science-in-general. The precise reasons for this divergence in understandings of science-in-general versus science-in-particular cannot be fully determined from this study. However, two plausible explanations are offered. First, it could be that when discussing the role of science in specific circumstances, the consequences of policy decisions on stakeholders' interests become more salient. If the specific recommendations of scientists are not consistent with their interests, stakeholders may dispute science's credibility in that particular context.

Another explanation might be that the divergence in understandings is related to changes in conceptual and spatial scales and individuals' personal experiences and first-hand knowledge. This interpretation seems to be consistent with other PUS studies, which imply that stakeholders would support a strengthened role for science in general terms and at larger conceptual and spatial scales, but in particular instances and at local scales, scientific expertise may be more critically evaluated and measured against personal experience (Burgess, Harrison, & Maiteny, 1991; Harrison et al., 1998; Michael, 1992; Wynne, 1996). Eden (1996) summarizes the importance of scale and individual experience: "So people look to science for unequivocal 'data' but can adopt their own interpretation through the use of either moral judgments or 'first-hand experience' (as opposed to 'second-hand non-experience') and hold to this where science would contradict it" (p. 192).

Whatever the cause of this divergence in understandings, the upshot for natural resource policy is that a single focus on strengthening the role of science in decision-making is not likely to lead to effective resolution of intractable controversies such as salmon policy. In particular, when specific, local decisions are debated, scientific prescriptions must be considered within the context of stakeholders' interests and personal experiences.

The second thrust of analysts' recommendations for resolving controversial policy problems promotes participatory decision-making among a diversity of stakeholders. One salient theme here is the goal of enhancing communication to promote mutual understanding, social learning, and meaningful participation (e.g., DeLeon, 1997; Dryzek, 1990; Fischer, 1993, 1995; Hajer, 1995; Schön & Rein, 1994). While analysts differ about how to achieve this goal, most perspectives emanate from the Habermasian (1984) ideal of open, honest participatory dialogue leading to consensus, or at least meaningful engagement. For example, Hull and Robertson (2000) demonstrate this perspective when they suggest the need for a language of ecological science that is "accessible enough to support both broad participation and meaningful deliberation in environmental decision-making...We need to develop a language that facilitates effective communication among diverse participants" (p. 113).

One of the central tenets of enhancing communication in multi-party collaborative decision-making is the promotion of reflexive discourse. That is, actors are encouraged to critically examine their own language and the understandings that their language expresses, and reflect on the implications of their discourse for other policy actors and policy alternatives. Along these lines, one recommendation from this study is to improve awareness and open dialogue about the multiple understandings of science expressed in policy discourse and the potential for divergent discourses to exacerbate controversy, especially regarding specific, local-scale decisions.

While such a "discursive democracy" (Dryzek, 1990) is certainly appealing, there is reason for skepticism about the potential for reflexive communication to facilitate effective decision-making, especially in complex cases such as salmon recovery. In Chapter II, the salmon recovery policy was characterized as degenerating into a dialogue of the deaf (van Eeten, 1999), an intractable policy controversy that remains deadlocked despite extensive deliberation and discussion by the policy community. Van Eeten contends that reflexive communication, while a laudable goal, is in itself an inadequate solution for a dialogue of the deaf:

> The extensive deliberation that has already taken place in a dialogue of the deaf often means the aims of procedures like multiple advocacy are already achieved in practice, albeit as an unintended byproduct. The controversial nature of these issues provides strong incentives to stakeholders to develop extensive knowledge of each other's positions, the basic assumptions behind them, the different interpretation of certain facts, etc. Under these conditions, the proposed procedures add little surplus value. (van Eeten, 1999, p. 161)

van Eeten contends that the key to unlocking deadlocks lies in understanding the structural properties of debate (e.g., the configuration of arguments and relationships between arguments and policy positions), building crosswalk positions that bridge gaps in the arguments, and using this information to re-define the problem and define a new policy agenda. He also suggests that discourse analysis is an effective method to facilitate this process. While the type of policy analysis that Van Eeten recommends is beyond the scope of the current study, I plan to extend this research in that direction. In effect, progress has already been made toward mapping the argumentative structures of the policy debate. That is, this study has identified understandings of science and a collection of argumentative justifications that stakeholders use to support or oppose policy positions. To extend this research, a subsequent study might follow van Eeten's approach by more thoroughly mapping this debate, and attempt to develop crosswalk positions and redefine the policy problem to contribute to the disentanglement the current controversy.

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APPENDIX A: CONGRESSIONAL WITNESSES

WITNESS NAME	SELF-IDENTIFIED AFFILIATION(S)	RESEARCHER-ASSIGNED STAKEHOLDER GROUP, INTEREST, OR INSTITION	N5 CODE
Anderson, James	Associate Professor, School of Fisheries, University of Washington	Academic Scientist	(1 1)
Ausman, Lynn	Washington Association of Wheat Growers; Washington Barley Commission	Agriculture and Irrigation	(1 2)
Baker, Jim	Northwest Salmon Campaign Coordinator, Sierra Club	Nongovernmental Conservation Organization	(1 3)
Ballard, Clyde	Speaker of the House, Washington State Legislature	State Legislator (Washington)	(1 4)
Batt, Phillip	Governor, State of Idaho	State Legislator (Idaho)	(1 5)
Bergman, Peter	Director, Biological Services, Northwest Marine Technology	Resource Manager	(1 6)
Bowles, Edward	Anadromous Fish Manager, Idaho Department of Fish and Game	Resource Manager	(1 7)
Boyer, Lionel	Fisheries Policy Representative, Shoshone-Bannock Tribes	Native American Tribe	(1 8)
Bruce, Steven	President, Idaho Steelhead and Salmon Unlimited	Nongovernmental Conservation Organization	(1 9)
Burlingame, Joan	Coordinator, Friends of Rock Creek Valley	Nongovernmental Conservation Organization	(1 10)
Campbell, Scott	Idaho Farm Bureau	Agriculture and Irrigation	(1 11)
Cantrell,	Northwest Regional Director, Friends	Nongovernmental	(1 12)

WITNESS NAME	SELF-IDENTIFIED AFFILIATION(S)	RESEARCHER-ASSIGNED STAKEHOLDER GROUP, INTEREST, OR INSTITION	N5 CODE
Shawn	of the Earth	Conservation Organization	
Casavant, Ken	Council Member, Northwest Power Planning Council	Northwest Power Planning Council	(1 13)
Cassidy, Frank	Chairman, Northwest Power Planning Council	Northwest Power Planning Council	(1 14)
Clark, Jerry E.	Deputy Director for Regional Programs, National Fish and Wildlife Foundation	Nongovernmental Conservation Organization	(1 15)
Cloud, Joseph	Professor of Zoology, Department of Biological Sciences, University of Idaho	Academic Scientist	(1 16)
Consenstein, Danny	Columbia Basin Coordinator, National Marine Fisheries Service	National Marine Fisheries Service	(1 17)
Craig, Larry	U.S. Senator, State of Idaho	State Legislator (Idaho)	(1 19)
Curtis, Jeff	Western Conservation Director, Trout Unlimited	Nongovernmental Conservation Organization	(1 20)
Dehart, Douglas	Chief of Fisheries, Oregon Department of Fish and Wildlife	Resource Manager	(1 21)
Deurloo, Robert	Meridian Gold Company	Mining	(1 22)
Diggs, Daniel	Assistant Regional Director for Fisheries, Pacific Region, U.S. Fish and Wildlife Service	U.S. Fish and Wildlife Service	(1 23)
Doeringsfeld, David	Manager, Port of Lewiston	Transportation	(1 24)

WITNESS NAME	SELF-IDENTIFIED AFFILIATION(S)	RESEARCHER-ASSIGNED STAKEHOLDER GROUP, INTEREST, OR INSTITION	N5 CODE
Dunn, Mark	Director of Government Affairs, J.R. Simplot Company; Chairman of the Government Affairs Committee of the Northwest Food Processors Association	Agriculture and Irrigation	(1 25)
Erickson, Richard	Secretary/Manager, East Columbia Basin Irrigation District	Agriculture and Irrigation	(1 26)
Faber, Scott	Director, Floodplains Program, American Rivers	Nongovernmental Conservation Organization	(1 27)
Ferrioli, Ted	Oregon State Senate	Legislator	(1 28)
Fisher, Richard	Vice President for Technology, Coith Hydro, Inc.	Hydropower	(1 29)
Frampton, George	Acting Chair, Council on Environmental Quality	Council on Environmental Quality	(1 30)
Frank, Billy	Chairman, Northwest Indian Fisheries Commission	Native American Tribe	(1 31)
Givens, John	Executive Director, Port of Kennewick	Transportation	(1 32)
Grace, Stan	Council Member, Northwest Power Planning Council	Northwest Power Planning Council	(1 33)
Grunke, James	Executive Director, Orofino Chamber of Commerce	Chamber of Commerce	(1 34)
Hale, Bob	Hale Farms	Agriculture and Irrigation	(1 35)
Hayes, Justin	Associate Director for Public Policy, American Rivers; Save Our Wild Salmon Coalition;	Nongovernmental Conservation Organization	(1 36)

WITNESS NAME	SELF-IDENTIFIED AFFILIATION(S)	RESEARCHER-ASSIGNED STAKEHOLDER GROUP, INTEREST, OR INSTITION	N5 CODE
Heide, Peter	Director, Forest Management, Washington Forest Protection Association	Forestry and Forest Products	(1 37)
Inslee, Hon. Jay	U.S. Representative, State of Washington	State Legislator (Washington)	(1 38)
James, Olivia	President, The River Company	Nongovernmental Conservation Organization	(1 39)
Kaczynski, Victor	Academic Scientist	Academic Scientist	(1 40)
Kaeding, Jack	Executive Director, Fish First	Nongovernmental Conservation Organization	(1 41)
Kempthorne, Dirk	Governor, State of Idaho	State Legislator (Idaho)	(1 42)
Kerr, Thomas	Commissioner, Balley County, Idaho	County Government (Idaho)	(1 43)
Kilbury, Charles	Mayor, City of Pacso, WA	City Government (Washington)	(1 44)
King, Jim	Consultant, Private and Municipal Planning Services	Municipal Planner	(1 45)
Klemm, Jerry	President, Pulp and Paperworkers Resource Council	Forestry and Forest Products	(1 46)
Koenings, Jeff	Director, Washington Department of Fish and Wildlife	Resource Manager	(1 47)
Limbaugh, Mark	Executive Director, Payette River Water Users Association, Inc.	Agriculture and Irrigation	(1 48)
Little, Jim	Grazing Permitee; Idaho Cattle	Grazing	(1 49)

WITNESS NAME	SELF-IDENTIFIED AFFILIATION(S)	RESEARCHER-ASSIGNED STAKEHOLDER GROUP, INTEREST, OR INSTITION	N5 CODE
	Association		
Lothrop, Robert	Manager for Policy Development and Litigation Support, Columbia River Inter-Tribal Fish Commission	Native American Tribe	(1 50)
Lundquist, Lynn	Speaker of the House, State of Oregon	State Legislator (Oregon)	(1 51)
Mackrow, Paula	Executive Director, North Olympic Salmon Coalition	Nongovernmental Conservation Organization	(1 52)
Martinez, Eluid	Commissioner, Bureau of Reclamation	Bureau of Reclamation	(1 53)
Mastin, Dave	Chairman, House-Senate Executive Branch Task Force on Salmon Recovery, State of Washington	State Legislator (Washington)	(1 54)
Maynard, Robert	Perkins Coie, LLP	Environmental Lawyer	(1 55)
McFarland, Dave	Chairman, Lemhi Riparian Conservation Agreement	Grazing	(1 56)
Morgren, Colonel Eric	Deputy Commander, Northwest Division, Army Corps of Engineers	Army Corps of Engineers	(1 57)
Olsen, Darryl	The Pacific Northwest Project	Agriculture and Irrigation	(1 58)
Penney, Samuel	Chair, Nez Perce Tribal Council	Native American Tribe	(1 59)
Phillips, Rob	Director, Northwest Sport-fishing Industry Association	Sport-fishing	(1 60)
Pollot, Mark	Foundation for Constitutional Law	Private Property Lawyer	(1 61)

WITNESS NAME	SELF-IDENTIFIED AFFILIATION(S)	RESEARCHER-ASSIGNED STAKEHOLDER GROUP, INTEREST, OR INSTITION	N5 CODE
Ray, Charles	Idaho Rivers United	Nongovernmental Conservation Organization	(1 62)
Raybold, Dell	Committee of Nine, Water District 1	Agriculture and Irrigation	(1 63)
Roby, Daniel	Oregon Cooperative Fish and Wildlife Research Unit	Academic Scientist	(1 64)
Rohleder, Joseph	Northwest Sport-fishing Industry Association	Sport-fishing	(1 65)
Ruckelshaus, William	Chairman, Washington State Salmon Recovery Funding Board; Madrona Investment Group	State Legislator (Washington)	(1 66)
Sanchotena, Mitch	Executive Director, Idaho Steelhead and Salmon Unlimited	Nongovernmental Conservation Organization	(1 67)
Semanko, Norman	Twin Falls Canal Company and North Side Canal Company	Transportation	(1 68)
Sims, Ron	County Executive, King County, WA	County Government (Washington)	(1 69)
Smith, Bruce	Rosholt, Robertson & Tucker	Mining	(1 70)
Smith, Gordon	U.S. Senator, State of Oregon	Legislator (Federal)	(1 71)
Squires, Owen	Pulp and Paperworkers Resource Council	Forestry and Forest Products	(1 72)
Adams, Al	President, Hood Canal Fisheries Enhancement Group	Nongovernmental Conservation Organization	(1 73)
Stelle, William	Northwest Regional Administrator, National Marine Fisheries Service	National Marine Fisheries Service	(1 74)
Strong, Ted	Executive Director, Columbia Inter-	Columbia Inter-Tribal Fish	(1 75)

WITNESS NAME	SELF-IDENTIFIED AFFILIATION(S)	RESEARCHER-ASSIGNED STAKEHOLDER GROUP, INTEREST, OR INSTITION	N5 CODE
	Tribal Fish Commission	Commission	
Stuart, Tom	Board President, Idaho Rivers United	Nongovernmental Conservation Organization	(1 76)
Sutherland, Doug	County Executive, Pierce County, WA	County Government (Washington)	(1 77)
Waldo, James	Lead Facilitator, Hatchery Scientific Review Group	Academic Scientist	(1 79)
Williams, Richard	Chairman, Independent Scientific Advisory Board	Academic Scientist	(1 80)
Wilson, Peter	Vice President, Port of Lewiston	Transportation	(1 81)
Yost, Jim	Senior Special Assistant, Idaho Governor's Office	State Legislator (Idaho)	(1 82)
Ziari, Fred	Chairman, Eastern Oregon Irrigation Association	Irrigation and Agriculture	(1 83)
Braden, Roger	Chelan Public Utility District	Hydropower	(1 84)
Sitko, Hank	Executive Director, Northwest Marine Trade Association	Recreational Motor Boating	(1 85)
Owens, ED	Coastal Fisheries Coalition	Commercial Fisheries	(1 86)
Wilkerson, Bill	Washington Forest Protection	Nongovernmental Conservation Organization	(1 87)
Johnson, Linda	Washington State Farm Bureau; Washington Cattlemen's Association	Agriculture and Irrigation	(1 88)
Miller, Mike	President, Pacific Properties	Homebuilding	(1 89)
Kelly, Robert	Nooksack Tribe	Native American Tribe	(1 90)
Stearns, Tim	Save our Wild Salmon	Nongovernmental	(1 91)

WITNESS NAME	SELF-IDENTIFIED AFFILIATION(S)	RESEARCHER-ASSIGNED STAKEHOLDER GROUP, INTEREST, OR INSTITION	N5 CODE
		Conservation Organization	
Mahnken, Conrad	National Marine Fisheries Service	National Marine Fisheries Service	(1 92)
Drewell, Bob	Snohomish County Executive, WA	County Government (Washington)	(1 93)
Hansen, Ed	Mayor of Everett, WA	City Government (Washington)	(1 94)
Buck, Jim	Washington State Legislature	Legislator (Washington)	(1 95)
Thiele, Ed	Commissioner, Okanogan County	County Government (Washington)	(1 96)
Miller, Louise	King County Council	County Government (Washington)	(1 97)
Smitch, Curt	Special Assistant on natural resources to Gary Locke, Governor, State of Oregon	State Government (Oregon)	(1 98)
Lohn, Bob	Bonneville Power Administration	Bonneville Power Administration	(1 99)
Dwyer, Tom	U.S. Fish and Wildlife Service	U.S. Fish and Wildlife Service	(1 100)
Locke, Gary	Governor, State of Washington	State Legislator (Washington)	(1 101)
Darm, Donna	Northwest Assistant Regional Administrator, National Marine Fisheries Service	National Marine Fisheries Service	(1 102)
Anderson,	Fisheries Biologist, Army Corps of	Army Corps of Engineers	(1 103)

WITNESS NAME	SELF-IDENTIFIED AFFILIATION(S)	RESEARCHER-ASSIGNED STAKEHOLDER GROUP, INTEREST, OR INSTITION	N5 CODE
Witt	Engineers		
Wright, Steve	Vice President, Bonneville Power Administration	Bonneville Power Administration	(1 104)
Pedde, Ken	Assistant Regional Director, Bureau of Reclamation	Bureau of Reclamation	(1 105)
Anderson, Robert	President, Mid-sound Fisheries Enhancement Group; Regional Fisheries Citizens Advisory Board; Vice Chair, People for Salmon	Nongovernmental Conservation Organization	(1 106)
Regala, Debbie	Washington State Legislature	State Legislator (Washington)	(1 107)

APPPENDIX B: N5 CODING STRUCTURE

N5 CODE	DESCRIPTION
(3 1)	ROLES OF SCIENCE in managing PNW salmon recovery
(3 1 1)	Role of science in CREATING management alternatives
(3 1 1 1)	PROBLEM DEFINITION
(3 1 1 1 1)	Science DEFINES PROBLEM to be solved
(3 1 1 1 2)	Science DOES NOT DEFINE PROBLEM to be solved
(3 1 1 2)	MIMIC NATURE
(3 1 1 2 1)	Science MIMICS NATURE
(3 1 1 2 2)	Science DOES NOT MIMIC NATURE
(3 1 1 3)	ALTERNATIVE IDENTIFICATION
(3 1 1 3 1)	Science IDENTIFIES ALTERNATIVES
(3 1 1 3 2)	Science DOES NOT IDENTIFIY ALTERNATIVES
(3 1 1 4)	LIMITING FACTORS
(3 1 1 4 1)	Science IDENTIFIES LIMITING FACTORS
(3 1 1 4 2)	Science DOES NOT IDENTIFY LIMITING FACTORS
(3 1 1 5)	KNOWLEDGE GAPS
(3 1 1 5 1)	Science IDENTIFIES KNOWLEDGE GAPS
(3 1 1 5 2)	Science DOES NOT IDENTIFY KNOWLEDGE GAPS
(3 1 1 5 3)	Science FILLS IN KNOWLEDGE GAPS
(3 1 1 5 4)	Science DOES NOT FILL IN KNOWLEDGE GAPS
(3 1 2)	Role of science in SELECTING among management alternatives
(3 1 2 1)	DECISION PRIORITIES
(3 1 2 1 1)	Science IDENTIFIES DECISION PRIORITIES
(3 1 2 1 2)	Science DOES NOT IDENTIFY DECISION PRIORITIES
(3 1 2 2)	RISKS AND BENEFITS
(3 1 2 2 1)	Science IDENTIFIES RISKS AND BENEFITS of decision alternatives
(3 1 2 2 2)	Science DOES NOT IDENTIFY RISKS AND BENEFITS of decision alternatives
(3 1 2 3)	Science as one of several INPUTS in selection among alternatives

N5 CODE	DESCRIPTION
(3 1 2 3 1)	OTHER INPUTS must be considered
(3 1 2 3 1 1)	ECONOMICS
(3 1 2 3 1 2)	TREATY RIGHTS
(3 1 2 3 1 3)	FIRST HAND EXPERIENCE
(3 1 2 3 1 4)	LOCAL KNOWLEDGE
(3 1 2 3 1 5)	VOLUNTEER RECOVERY EFFORTS
(3 1 2 3 1 6)	PROPERTY RIGHTS
(3 1 2 3 1 7)	Traditional WAY OF LIFE
(3 1 2 3 1 8)	COST
(3 1 2 3 1 9)	OTHER
(3 1 3)	Role of science in LEGITIMATING selected alternatives
(3 1 3 1)	Level of support provided by DATA
(3 1 3 1 1)	Decisions SUPPORTED BY DATA
(3 1 3 1 2)	Decisions NOT SUPPORTED BY DATA
(3 1 3 2)	Level of SCIENTIFIC THOROUGHNESS with respect to data
(3 1 3 2 1)	SELECTIVE or opportunistic use of data
(3 1 3 2 2)	Decisions based on ANECDOTES or casual observation
(3 1 3 2 3)	Decisions based on VESTED INTEREST rather than data
(3 1 3 2 4)	Decisions supported the BEST AVAILABLE SCIENTIFIC DATA
(3 1 3 2 5)	Decisions NOT SUPPORTED BY THE BEST AVAILABLE SCIENTIFIC DATA
(3 1 3 3)	Level of EXTERNAL PEER support or justification
(3 1 3 3 1)	Role of EXTERNAL PEER REVIEW
(3 1 3 3 1 1)	Decisions SUPPORTED BY EXTERNAL PEER REVIEW
(3 1 3 3 1 2)	Decisons NOT SUPPORTED BY EXTERNAL PEER REVIEW
(3 1 3 3 2)	Role of SAB
(3 1 3 3 2 1)	Decisions SUPPORTED BY SAB
(3 1 3 3 2 2)	Decisions NOT SUPPORTED BY SAB
(3 1 3 4)	Role of science in POLITICAL LEGITIMACY

N5 CODE	DESCRIPTION
(3 1 3 4 1)	Science LIMITS POLITICAL CONFLICT
(3 1 3 4 2)	Science CREATES POLITICAL CONFLICT
(3 1 3 4 2 1)	Ability to MARSHALL OWN EVIDENCE
(3 1 3 4 2 2)	Science is in CONFLICT WITH POLITICAL IDEALS
(3 1 4)	Role of science in EVALUATING alternatives
(3 1 4 1)	ASSESSES EFFECTIVENESS in achieving desired outcome
(3 1 4 2)	DOES NOT ASSESS EFFECTIVENESS in achieving desired outcome
(3 2)	BOUNDARIES OF SCIENCE in PNW salmon recovery
(3 2 1)	Boundaries of SCIENCES AND MANAGEMENT
(3 2 2)	Boundary of SCIENCE AND POLICY
(3 2 2 1)	INCOMPATIBLE CULTURES of science and policy
(3 2 2 2)	Scientists OUT OF TOUCH with political reality
(3 2 2 3)	FUNDING
(3 2 2 3 1)	Science ABLE TO ADDRESS FUNDING PRIORITIES
(3 2 2 3 2)	Science NOT ABLE TO ADDRESS FUNDING PRIORITIES
(3 2 2 4)	TIMING OF SCIENTIFIC INPUT
(3 2 2 4 1)	Science should PRECEDE POLITICAL INPUT
(3 2 2 4 2)	Science should FOLLOW POLITICAL INPUT
(3 2 2 4 3)	Science should be incorporated AT ALL STAGES OF DECISION-MAKING
(3 2 3)	Boundary of science and culture
(3 2 4)	Boundary of science and media
(3 2 4 1)	Media spins science
(3 2 5)	Boundary of science and economics
(3 2 6)	Boundary of science and law
(3 2 7)	Boundary of science and local knowledge
(3 3)	UNDERSTANDINGS OF SCIENCE in PNW salmon recovery
(3 3 1)	Understandings of scientific PROCESS
(3 3 1 1)	HYPTOTHESES
(3 3 1 1 1)	HYPOTHESIS DRIVEN

N5 CODE	DESCRIPTION
(3 3 1 1 2)	NOT HYPOTHESIS DRIVEN
(3 3 1 2)	RELATION TO THEORY
(3 3 1 2 1)	THEORETICAL
(3 3 1 2 2)	NOT THEORETICAL
(3 3 1 3)	PEER REVIEW
(3 3 1 3 1)	PEER REVIEWED
(3 3 1 3 2)	NOT PEER REVIEWED
(3 3 1 4)	EMPIRICAL
(3 3 1 4 1)	EMPIRICAL
(3 3 1 4 2)	NOT EMPIRICAL
(3 3 1 5)	OPENNESS
(3 3 1 5 1)	OPEN AND TRANSPARENT
(3 3 1 5 2)	NOT OPEN OR TRANSPARENT
(3 3 1 6)	MODELING
(3 3 1 6 1)	BASED ON MODELS
(3 3 1 6 2)	NOT BASED ON MODELS
(3 3 1 7)	PARADIGMS
(3 3 1 7 1)	PARADIGMS CHANGE OVER TIME
(3 3 1 7 2)	PARADIGMS STATIC
(3 3 1 8)	TECHNICALITY
(3 3 1 8 1)	TECHNICAL
(3 3 1 8 2)	NOT TECHNICAL
(3 3 1 9)	CONSENSUS
(3 3 1 9 1)	CONVERGES ON CONSENSUS
(3 3 1 9 2)	DOES NOT CONVERGE ON CONSENSUS
(3 3 1 10)	CERTAINTY
(3 3 1 10 1)	CERTAIN
(3 3 1 10 2)	UNCERTAIN
(3 3 1 11)	PROGRESS

N5 CODE	DESCRIPTION
(3 3 1 11 1)	LEADS TO PROGRESS
(3 3 1 11 2)	DOES NOT LEAD TO PROGRESS
(3 3 1 12)	EXPERIMENTAL
(3 3 1 12 1)	EXPERIMENTAL
(3 3 1 12 2)	NOT EXPERIMENTAL
(3 3 1 13)	PRACTICAL
(3 3 1 13 1)	PRACTICAL
(3 3 1 13 2)	NOT PRACTICAL
(3 3 1 14)	Other
(3 3 2)	Understandings of SCIENTISTS
(3 3 2 1)	SCIENTIFIC COMMUNITY
(3 3 2 1 1)	PART OF SCIENTIFIC COMMUNITY
(3 3 2 1 2)	NOT PART OF SCIENTIFIC COMMUNITY (Maverick)
(3 3 2 2)	INDEPENDENCE
(3 3 2 2 1)	INDEPENDENT
(3 3 2 2 2)	NOT INDEPENDENT
(3 3 2 3)	OBJECTIVITY
(3 3 2 3 1)	OBJECTIVE
(3 3 2 3 2)	NOT OBJECTIVE
(3 3 2 4)	RATIONALITY
(3 3 2 4 1)	RATIONAL
(3 3 2 4 2)	NOT RATIONAL
(3 3 2 5)	BIAS
(3 3 2 5 1)	BIASED
(3 3 2 5 2)	UNBIASED
(3 3 2 6)	OTHER
(3 3 3)	Understandings of scientific KNOWLEDGE
(3 3 3 1)	RIGOR
(3 3 3 1 1)	RIGOUROUS

N5 CODE	DESCRIPTION
(3 3 3 1 2)	NOT RIGOROUS
(3 3 3 2)	EMOTIONAL CHARCHTER
(3 3 3 2 1)	EMOTIONAL
(3 3 3 2 2)	UNEMOTIONAL
(3 3 3 3)	THEORY
(3 3 3 3 1)	THEORETICAL
(3 3 3 3 2)	NOT THEORETICAL
(3 3 3 4)	QUANTITATIVE
(3 3 3 4 1)	QUANTITATIVE
(3 3 3 4 2)	NOT QUANTITATIVE
(3 3 3 5)	PREDICTIVE
(3 3 3 5 1)	PREDICTIVE
(3 3 3 5 2)	NOT PREDICTIVE
(3 3 3 6)	BIAS
(3 3 3 6 1)	UNBIASED
(3 3 3 6 2)	BIASED
(3 3 3 7)	REPRESENTATIVENESS
(3 3 3 7 1)	REPRESENTATIVE
(3 3 3 7 2)	UNREPRESENTATIVE
(3 3 3 8)	VALUE ORIENTATION
(3 3 3 8 1)	VALUE NEUTRAL
(3 3 3 8 2)	VALUE LADEN
(3 3 3 9)	CERTAIN OR TRUE
(3 3 3 9 1)	CERTAIN OR TRUE
(3 3 3 9 2)	UNCERTAIN OR TENTATIVE
(3 3 3 10)	EXPLANATORY
(3 3 3 10 1)	EXPLANATORY
(3 3 3 10 2)	NOT EXPLANATORY
(3 3 3 11)	Other

N5 CODE	DESCRIPTION
(3 4)	REPRESENTATIONS OF RECOVERY ACTIONS and ACTORS
(3 4 1)	CONTENT of representation
(3 4 1 1)	Recovery actors
(3 4 1 1 1)	FEDERAL AGENCY or ENTITY
(3 4 1 1 1 1)	NMFS
(3 4 1 1 1 2)	ARMY CORPS OF ENGINEERS
(3 4 1 1 1 3)	USFWS
(3 4 1 1 1 4)	USFS
(3 4 1 1 1 5)	BPA
(3 4 1 1 2)	STATE
(3 4 1 1 2 1)	Montana
(3 4 1 1 2 2)	Idaho
(3 4 1 1 2 3)	Washington
(3 4 1 1 2 4)	Oregon
(3 4 1 1 3)	NON-GOVERNMENAL ORGANIZATION
(3 4 1 1 4)	INDIAN TRIBE
(3 4 1 1 5)	PATH TEAM
(3 4 1 1 6)	OTHER
(3 4 1 2)	Recovery actions
(3 4 1 2 1)	Restore HABITAT
(3 4 1 2 1 1)	IMPROVE WATER QUALITY
(3 4 1 2 1 2)	STREAMSIDE BUFFERS
(3 4 1 2 1 3)	IMPROVE FISH ACCESS TO STREAMS
(3 4 1 2 1 4)	REDUCE SEDIMENTATION
(3 4 1 2 1 5)	OTHER
(3 4 1 2 2)	Reform HATCHERY system
(3 4 1 2 2 1)	SUPPLEMENT wild populations with hatchery fish
(3 4 1 2 2 2)	OTHER
(3 4 1 2 3)	HARVEST RESTRICTIONS

N5 CODE	DESCRIPTION
(3 4 1 2 3 1)	RESTRICT COMMERCIAL OCEAN HARVEST
(3 4 1 2 3 2)	RESTRICT SPORT-FISHING HARVEST
(3 4 1 2 3 3)	RESTRICT TRIBAL HARVEST
(3 4 1 2 3 4)	OTHER
(3 4 1 2 4)	Reform HYDROPOWER system
(3 4 1 2 4 1)	IMPROVE PASSAGE success
(3 4 1 2 4 2)	BARGING
(3 4 1 2 4 3)	DAM BREACHING
(3 4 1 2 4 4)	OTHER
(3 4 1 2 4 5)	FLOW AUGMENTATION
(3 4 1 2 5)	PREDATOR CONTROL
(3 4 1 2 5 1)	RELOCATE CASPIAN TERN COLONIES
(3 4 1 2 5 2)	REDUCE SEAL LION POPULATIONS
(3 4 1 2 5 3)	OTHER
(3 4 1 2 6)	COORDINATION among actors
(3 4 1 2 6 1)	HABITAT CONSERVATION PLANS
(3 4 1 2 6 2)	US-CANADA TREATY
(3 4 1 2 7)	Reduce mortality in all phases of LIFE CYCLE
(3 4 1 2 8)	Other
(3 4 2)	ALIGNMENT OF SPEAKER
(3 4 2 1)	Close - Speaker supports (praises)
(3 4 2 2)	Far - speaker opposes (denigrates)
(3 4 3)	STATUS OF REPRESENTATION
(3 4 3 3)	BASIS FOR ADVANCING OR REFUTING A REPRESENTATION
(3 4 3 3 1)	EXTERNALIZING DEVICES
(3 4 3 3 1 1)	EMPIRICIST REPERTOIRE
(3 4 3 3 1 1 1)	CONSTRUCTION OF IMPERSONALITY
(3 4 3 3 1 1 2)	ATTRIBUTION OF AGENCY TO DATA OR STUDIES
(3 4 3 3 1 2)	CONSENSUS AND CORROBORATION

N5 CODE	DESCRIPTION
(3 4 3 3 1 2 1)	PEER REVIEW
(3 4 3 3 1 2 2)	SCIENTIFIC ADVISORY BOARD(S)
(3 4 3 3 1 3)	UNDERMINE EMPIRICIST REPERTOIRE
(3 4 3 3 1 3 1)	DISPUTE AGENCY OF DATA
(3 4 3 3 1 3 2)	DISPUTE QUALITY OF DATA
(3 4 3 3 1 3 2 1)	INSUFFICIENT DATA
(3 4 3 3 1 3 2 2)	FLAWED DATA
(3 4 3 3 2)	INTEREST MANAGEMENT
(3 4 3 3 2 1)	STAKE INNOCULATION
(3 4 3 3 2 2)	STAKE CONFESSION
(3 4 3 3 2 3)	ATTRIBUTING STAKE OR INTEREST
(3 4 3 3 3)	CATEGORY ENTITLEMENT
(3 4 3 3 4)	EXTREMATIZATION AND MINIMIZATION
(3 4 3 3 4 1)	EXTREMETIZATION
(3 4 3 3 4 2)	MINIMIMIZATION
(3 4 3 3 5)	NORMALIZATION
(3 4 3 3 6)	DEMOCRATIC PRINCIPLES
(3 4 3 3 6 1)	LOCAL CONTROL
(3 4 3 3 6 2)	CONSENSUS
(3 4 3 3 6 3)	LAW OR POLICY
(3 4 3 3 6 3 1)	TREATY RIGHTS
(3 4 3 3 6 3 2)	ESA
(3 4 3 3 6 4)	CONGRESSIONAL INTENT
(3 4 3 3 6 5)	OTHER
(3 4 3 3 7)	LAY KNOWLEDGE
(3 4 3 3 8)	NO BASIS
(3 4 3 3 9)	OTHER

APPPENDIX C: CURRICULUM VITAE

Department of Recreation Management & Tourism
Arizona State University
Box 874905
Tempe, AZ 85287-4905

Phone: (480) 965-8429
Fax: (480) 965-5664
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PROFESSIONAL BACKGROUD

Education

Ph.D., Forestry (2002)
Virginia Polytechnic Institute and State University, Blacksburg, VA
Dissertation: *A Discourse Analysis of Stakeholders' Understandings of Science in Pacific Northwest Salmon Recovery*

M.S., Resource Recreation and Tourism (1998)
University of Idaho, Moscow, ID
Thesis: *Primal Hypotheses: Relationships Between Naturalness, Solitude, and Human Benefits from Wilderness Experience*

B.A., History (1993)
George Mason University, Fairfax, VA

Academic Appointments

Assistant Professor (2002 – Present)
Department of Recreation Management and Tourism
College of Public Programs
Arizona State University

Lecturer (2001 – 2002)
Department of Recreation Management and Tourism
College of Public Programs
Arizona State University

Graduate Assistant (1998 – 2001)
Department of Forestry
College of Natural Resources
Virginia Polytechnic Institute and State University

Research and Teaching Assistant (1996 – 1998)
Wilderness Research Center
Department of Resource Recreation and Tourism
College of Natural Resources
University of Idaho

Related Professional Experience

Recreation Coordinator (1995 – 1996)
Survival Wilderness Adventure Training
Tucson Parks and Recreation, Tucson, AZ

Recreation Assistant (1994 – 1995)
Cherry Avenue Recreation Center
Tucson Parks and Recreation, Tucson, AZ

TEACHING ACTIVITY

REC 330 – Programming of Recreation Services
REC 370 – Outdoor Recreation Systems
REC 380 – Wilderness and Parks in America
REC 470 – Environmental Interpretation and Education
REC 480 – Natural Resource Tourism

RESEARCH AND SCHOLARLY ACTIVITY

Refereed Articles

Farrell, T., Hall, T. E., & White, D. D. (2001). Wilderness campers' perception and evaluation of campsite impacts. *Journal of Leisure Research, 33*(3), 229-250.

White, D. D., Hall, T. E., & Farrell, T. A. (2001). Influence of ecological impacts and other campsite characteristics on wilderness visitors' campsite choices. *Journal of Park and Recreation Administration (19*)2, 83-97.

White, D. D., & Hendee, J. C. (2000). Primal hypotheses: The relationship between naturalness, solitude and the wilderness experience benefits of development of self (DOS), development of community (DOC) and spiritual development (SD). In Cole, D. N., McCool, S. F., Borrie, W. T. & O'Loughlin, J. (Comps.), *Wilderness science in a time of change conference--Volume 3: Wilderness as a place for scientific inquiry* (pp. 223-228) (Proc RMRS-P-15-VOL-3). Missoula, MT: USDA Forest Service, Rocky Mountain Research Station.

Scholarly Presentations

White, D. D., & Hall, T. E. (2002). *A discourse analysis of stakeholders' understandings of science in Pacific Northwest Salmon Recovery Policy Development.* Paper presented at the 9th International Symposium on Society and Resource Management, Bloomington, IN.

White, D. D. (2001). *Testing assumptions about ROS activity-setting-experience relationships.* Paper presented at the 2001 Southeast Recreation Research Conference, Asheville, NC.

Farrell, T. A., Hall, T. E., & White, D. D. (2000). *Campers' perceptions of site conditions and impacts.* Paper presented at the 8th International Symposium on Society and Resource Management, Bellingham, WA.

Hall, T. E., & White, D. D. (2000). *The "values" of science and scientists in natural resource management*. Paper presented at the 8th International Symposium on Society and Resource Management, Bellingham, WA.

White, D. D., & Hall, T. E. (2000). *Campers' perceptions of ecological impacts in Mt. Jefferson Wilderness*. Paper presented at the 2000 Southeast Recreation Research Conference, Charleston, SC.

White, D. D., & Hall, T. E. (2000). *Stakeholders' understandings of science in biodiversity controversies*. Paper presented at the 2000 Society of American Foresters National Convention, Washington, DC.

White, D. D. (1999). *Short circuiting wilderness values? The use of modern technologies in federal wilderness*. Paper presented at the 1999 Southeast Recreation Research Conference, Gatlinburg, TN.

White, D. D., & Hall, T. E. (1999). *Comparing wilderness and frontcountry users: What makes a good experience?* Paper presented at the 1999 Society of American Foresters National Convention, Portland, OR.

White, D. D. (1995). *Survival Wilderness Adventure Training*. Paper presented at the 1995 Southwestern Youth-at-risk Colloquium, Phoenix, AZ.

Book Reviews

Berkson, J., & White, D. D. (2000). Review: Fishy business: Salmon, biology, and the social construction of nature. *Fisheries, 25*(11), 49-50.

HONORS AND AWARDS

John Hosner Memorial Scholarship, Colonial Agricultural Educational Foundation, Inc. (2001)

MEMBERSHIP IN PROFESSIONAL ORGANIZATIONS

Arizona Parks and Recreation Association
National Park and Recreation Association
Society of American Foresters

PROFESSIONAL SERVICE ACTIVITIES

Professional Association Service Activities

Elected Secretary, Society of American Foresters Wilderness Management Working Group (1999 – Present)
Invited Attendee, Society of American Foresters Leadership Academy, Potosi, MO (2000)
Planning Committee Member, Arizona Parks and Recreation Association, Conference on Open Space (2002)