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Public Understanding of Science in Pacific Northwest Salmon Recovery Policy

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In the arena of salmon recovery policy, stakeholders often propose that science should guide policy, frame their positions in scientific terms, and construct scientific arguments to support their positions. However, there are also appeals to involve citizens more thoroughly in policymaking. An important step in bringing science and citizens together is to investigate how citizens understand the processes, actors, institutions, and knowledge of science. Discourse analysis of the testimony of 51 nonscientist stakeholders to Congressional committees between 1998 and 2000 revealed that 14 used discourses of science. These understandings related to scientific process, scientific knowledge, and scientists as policy actors. Individual citizens employed multiple culturally available discourses based on a traditional, authoritative understanding of science to support their own positions, while others' views were invalidated based on a skeptical-realist understanding. Findings provide mixed comfort for policymakers and resource managers.

Keywords environmental policy, public involvement, science and policy

The arena of natural resource policy is increasingly characterized by inefficiency and paralyzing controversy. Pacific Northwest salmon recovery is one of a class of "contentious, socially wrenching" natural resource policy problems that are distinguished by complexity, polarization among stakeholders, high stakes, delayed consequences, and a divergence between national and regional priorities (Lackey 2000, 91). In the face of such dilemmas, the policy community has struggled with decision making. In the case of salmon recovery, a majority of the public expresses support for restoration, at least in principle (Smith and Steel 1997), and legal mandates such as the Endangered Species Act (ESA) of 1973 are in place to guide recovery, yet only limited progress has taken place. Both society and decision makers appear unwilling to implement the changes necessary to restore wild salmon runs to historic levels. This

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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 stymie the development and implementation of a coordinated policy approach.

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, stakeholders often argue that science should guide policy, frame their policy positions in scientific terms, and construct scientific arguments to support their positions. Many in the policy community, including members of Congress, have advocated basing decisions on more and better scientific input. The assumption is that decisions that are substantiated by science will be more likely to achieve recovery and will be more defensible and acceptable to stakeholders.

However, at the same time that there are calls to increase scientific oversight, there are also appeals to involve the citizens more thoroughly in policymaking (Roth, Dunsby, and Bero 2003). Public involvement in natural resources, which has been steadily expanding over the last four decades (Steel and Lovrich 1997), is mandated by Congress through the National Environmental Policy Act (NEPA) and related environmental laws, and enhances the fundamental democratic goals of society (Fiorino 1990; Laird 1993). Consequently, there have been calls for "extending expertise" (Eden 1996) so that "local knowledge" (Fischer 2000; Hull, Robertson, and Kendra 2001) is accepted along with scientific knowledge as a credible policy input (Clark and Meidinger 1998).

To the extent that those trained in science and members of the general public have different ways of relating to, knowing about, and discussing issues, this presents a challenge (Wynne 1996). Such differences have been widely noted (Abraham and Shepard 1997; Bensuade-Vincent 2001; Flynn, Slovic, and Mertz 1993; Freemuth and Cawley 1998; Petts 1997; Weingart 1999; Yearley 2000). Scientists tend to frame policy issues as matters of systematic, objective empirical data, so that science becomes the "master frame" within which an issue is understood (Roth, Dunsby, and Bero 2003). In so doing, uncertainty or disagreement is "filtered out" (Kajanne and Pirttila-Backman 1999). Citizens, on the other hand, often focus on personal experience as a source of knowledge that challenges scientific opinions (Roth, Dunsby, and Bero 2003; Wynne 1996), on matters of justice or fairness, or on the social processes and interests underlying "scientific" opinions (Brown 1992).

This tension between scientific leadership and democratic process has drawn the attention of many scholars (Abraham and Shepard 1997; Freemuth and Cawley 1998; Irwin 2001; Lach et al. 2003; Pierce 1992; Pierce and Lovrich 1986). In the face of this tension, some scientists argue for an enhanced commitment to scientific objectivity and caution that political advocacy, real or perceived, undermines credibility (Alm 2000). Other scientists have instructed their peers about how to communicate effectively with the public through appreciation of diverse value systems (Rhoads et al. 1999). Still others focus on understanding how and why stakeholders challenge the authority of science (Brown 1992; Roth, Dunsby, and Bero 2003). As Hisschemöller and Midden (1999, 17) note: "Modern society is witnessing an increasing number of issues characterized by scientific and technological complexity.... The problems are perceived in different ways by different people and scientific evidence is not considered equally convincing by all." An important step in bringing science and citizens together is to investigate how citizens understand the processes, actors,

institutions, and knowledge of science. This is the goal of our study. Such an understanding will help policy actors anticipate how players will react to and interact with scientific knowledge and scientists.

Public Understanding of Science

How the public understands and responds to calls for more and better science is complex. Although natural resource policymakers evidently believe that a firmer scientific footing will generate more defensible and acceptable management outcomes, exploration of the literature suggests this is not certain to occur, and, indeed, the reverse might be true. Our reading of public understanding of science (PUS) studies suggests that there are two dominant, and countervailing, perspectives or discourses on science prevalent among the public (Michael 1992). Policymakers' expectations of public trust in science are based on a traditional-idealist conception of science and the nature of resource management problems, but this trust may have been significantly eroded lately by a realist-skeptical view.

The Traditional Discourse

A dominant American conception of science holds that science is objective, rigorous, logical, productive, and unbiased (Ozawa 1996). The authority and credibility of science are widely acknowledged throughout American society, resulting in widespread public belief in the ability of science to solve problems (Brown 1992; Miller 2004). This view is variously described as the "mainstream canon" (Brown 1992), the "traditional-idealist" view (Bauer, Petkova, and Boyadjieva 2000), the "traditional understanding" (Lach et al. 2003), or the "enlightenment model" (Elam and Bertilsson 2003). Even though many studies have shown that public knowledge of the specifics of science and the scientific method (Miller 2004; Zehr 2000) and its explanations of natural phenomena do not conform to those of scientists, nevertheless the public has confidence in science (Miller 2004).

This shared, idealized view of science originates from several factors. Some point to the technological benefits that have arisen from scientific study, which have led to a generalized faith. Even when the creations of science (e.g., genetically modified organisms) are unpopular, it is usually the institution of science that people rely upon to know about and address the problem. Others focus on the social history of scientific institutions that have mystified the source of knowledge, the person who possesses that knowledge, and the scientific community (Kinchy and Kleinman 2003; Petkova and Boyadjieva 1994). These tend to focus on how scientists themselves actively promote such an image, in order to justify and maintain their autonomy and political power (Kinchy and Kleinman 2003). If citizens in resource policy decisions adhere to the traditional view, they might be expected to show deference to scientific opinions. Accordingly, controversy might be alleviated by strengthening the scientific foundations of decisions and explaining these to the public.

The Realist-Skeptical Discourse

Of course, anyone familiar with natural resource management will realize that there is a divergent perspective. In explaining how the public actually engages with science in concrete situations, scholars have uncovered another, more critical discourse.

According to this "realist-skeptical" view (Bauer, Petkova, and Boyadjieva 2000), the public is suspicious of the motives of scientists and untrusting of scientific expertise (Kajanne and Pirttila-Backman 1999). For instance, in their study, Bauer, Petkova, and Boyadjieva (2000) found that 59% of the "educated elite" and 24% of the general public disagreed that "science is policy neutral." Only 45% of the educated elite agreed that "science is rational and objective." In another study, Einsiedel (1994, 39) found that 41% of respondents agreed that "because of their knowledge, scientific researchers have a power that makes them dangerous." In their interviews with 59 people, Kajanne and Pirttila-Backman (1999) found that 27 people cited interest-related reasons such as funding, employment, advertising, and enhancement of reputation as the reasons contributing to controversy among experts. This suggests awareness among citizens of social influences on science that are inconsistent with science's reputation as an objective, neutral institution. Taken together, such studies run counter to the objective, dispassionate stereotype of scientists.

The reasons for public skepticism seem to stem from several sources. First is media exposure of "bad science" (Brown 1992) or of public disagreements among experts that lower the privilege accorded to science (Ziman 1991). This can cause controversy over interpretations of findings, which may exacerbate cynicism among the public. Policy actors also consciously exploit uncertainty and gaps in scientific knowledge in a strategic manner to influence policymaking, most often as a tactic to stall decisions (Jasanoff 1990; Laird 1993; Mitchell, Mertig, and Dunlap 1991). Thus, rather than providing a clear path to a correct decision supported by objective facts, the involvement of science in policy has often exacerbated the political polarization of controversies, led to the deconstruction of expert knowledge, and reduced scientists' credibility because their involvement is seen as ritualistic or manipulative (Limoges 1993).

Another source of skeptical discourse originates within academia. The science and technology studies (STS) movement has provided trenchant critiques of scientific authority and laid blame on science for threats and injuries to society and the environment. STS scholars have deconstructed the practice and rhetoric of science, exposing its contingent, value-laden nature. The important point for natural resource policy is that if scientific facts are socially constructed, they can also be deconstructed by examining the social processes that help create them, which in turn can be used to undermine claims of objective truth (Jasanoff 1995). This deconstruction of scientific facts is precipitated by an adversarial system, such as the courts, an arena all too familiar in natural resources. These debates have become so widespread and heated that they acquired the label "science wars" (Ashman and Baringer 2001; Parsons 2003; Ross 1996; Segerstrêale 2000; Trachtman and Perrucci 2000). This critical attention to the social construction of scientific knowledge has pervaded the realm of public discourse. Many, including scientists, are clearly worried about public skepticism toward scientific leadership. Those who advocate science-based management fear their recommendations will be summarily and wrongly dismissed. For example, Rhoads et al. (1999, 298) worry that "the perception among nonscientists that scientists are insensitive to their values and knowledge may prompt them to ignore scientific information."

A Possible Resolution

The apparent contradiction between a public perspective that sees science as objective and disinterested and another that is skeptical and cautious about science may

turn out to be a product of varying one's analytical focus. That is, the public may know, articulate, and accept the traditional view of science, while at the same time maintaining skepticism about how it is utilized in any given circumstance. Michael (1992, 313) draws the useful distinction between perceptions of "science in general . . . in which science is talked about as a coherent entity and emphasis is placed upon both the form of its activities and its knowledge domain" and perceptions of science-in-particular, in which the focus is on specific examples and actors' identifiable goals.

In his exploratory investigations of public constructions of science, carried out by detailed readings of interviews with members of the public about risks from radon gas, Michael (1992, 317) found considerable evidence of a "traditional" understanding—scientists were seen as specialists who use refined techniques to test hypotheses. Simultaneously, citizens depicted themselves as ignorant of science, thereby distancing science as a "hermetic and exclusive" domain. Such statements appeared to represent views on science-in-general. However, Michael (1992) also found evidence of distrust in talk about science. In these discourses of science-in-particular, science was seen as dismissive of local knowledge, and scientists were seen as pursuing various interests. Different groups of respondents used different discourses of science-in-particular to make different points. Michael (1992, 330) concluded that there is neither wholesale "uptake of science's products or its supposed ethos nor the generalized delegitimization of science . . . . Rather there is a complex interweaving of discourses about science-in-particular, science-in-general and self that constructs and reconstructs science . . . in response to the multiple contexts of people's lives." How actors draw upon these two available perspectives in their negotiations about resource issues is an open question.

The Relevance of PUS to Natural Resource Policy

The range and content of public understandings of science are of paramount importance—not only to salmon recovery policy, but also to natural resource policy in general. If decisions based scientific on input are to be accepted, the process of scientific study and the distribution of power (which would shift to scientists) must be acceptable to the public. Otherwise, decisions will continue to be as controversial as ever. Thus, managers who place their hopes in science-based plans need to know whether these will be greeted with trust or skepticism. If public judgment rests more on personal experience or alternative conceptualizations of the problem than on scientific assertion, conflicts over resource management may continue unchanged.

Based on our readings of PUS literature, we expect to find that lay citizens endorse the validity and utility of scientific information in principle, while maintaining skepticism about the specific role and interests of scientists. Thus, it is important to disentangle public understanding of *science* from public understanding of *scientists*. With this study, we hope 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 and scientists expressed in natural resource policy.

We believe that ambiguity in public views 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. A clear examination of the multiple and varied understandings of science may encourage more meaningful deliberation and successful policy development. 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, studies such as ours may help actors better understand their own and others' positions. Actors may be better able to see instances when they are presenting their values as if they were incontrovertible facts (Rhoads et al. 1999). In such instances, participants may develop a "more nuanced and less polarized view" (Yearley 1994, 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 (e.g., conflicting legislation or divergent agency priorities), 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. As Michael (1992, 315) says: "A profounder reflexivity allows both laypersons and practitioners to detect the efforts of science to legitimate itself."

Background to the Issue

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 precipitously since the middle of the 19th century. Salmon have been extirpated from about 40% of their historic range in the Northwest (National Research Council 1996). Salmon recovery involves myriad individuals, social institutions, and groups that have a stake in the outcomes (Bayer 2004). This policy community engages in debate about salmon recovery in many different settings, from the informal to the formal. The specific policy setting for this study was Congressional hearings about salmon recovery. 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.

At the time of this testimony, two significant policy processes were underway. First, the National Marine Fisheries Service (NMFS) and the Fish and Wildlife Service (FWS) were in formal consultation under the ESA to issue the Federal Columbia River Power System (FCRPS) Biological Opinion, which would set policy for operation of the 29 federal dams on the Columbia and Snake Rivers. Second, the Federal Caucus, comprised of the nine federal agencies with responsibilities for salmon recovery under the ESA, was developing the Draft Basin-Wide Salmon Recovery Strategy, which would set policy to address the causes of decline and guide interagency recovery efforts. Much of the content of the testimony analyzed for our study deals with specific policy and management actions debated as part of these policy processes (e.g., breaching dams on the Lower Snake River).

Methods

Discourse Analysis Approach

Discourse analysis (DA) is a family of techniques commonly used in PUS studies. Although many types of analysis go by the name of discourse analysis (Alvesson

and Karreman 2000), the approach we adopt is most similar to that developed by Potter, Wetherell, and colleagues (Potter 1997; Potter and Mulkay 1985; Potter and Wetherell 1987; Wetherell and 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" (Potter and Wetherell 1987, 7).

The practice of discourse analysis according to this method entails the detailed scrutiny of talk and texts to identify linguistic patterns and variability that expose the social functions of language. All discourses are presumed to accomplish some social outcome; often these are intended by the speaker, but there is no necessity for deliberate intent. For example, a speaker may use the traditional discourse of science deliberately to enhance credibility, but use of such a discourse may affect hearers in ways unanticipated by the speaker. Thus, an important assumption of discourse analysis is that the analyst should focus on the function of the discourse—how repertoires are "deployed." It is not assumed that individuals necessarily adhere to a single, unvarying "understanding" of science; rather, they may use different, culturally available understandings in different contexts to achieve different aims (Potter 1996; Potter and Mulkay 1985).

Discourse analysts identify interpretive repertoires, which are statements, often constructed from culturally available metaphors that 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 and Potter 1988, 172). An important contention in DA is that there are a limited number of repertoires in use (e.g., Zehr 2000). For example, Roth, Dunsby, and Bero (2003) found a small number of ways that tobacco regulation was framed in public discourse. In a DA study representative of the interpretive repertoire approach, Roth and Lucas (1997) identified nine repertoires that high school physics students employed in their discussions about science.

Because of the focus on the use of language, discourse analysts argue that it is most appropriate to study naturally occurring language (Potter, Edwards, and Wetherell 1993). "Naturally-occurring data are especially valuable because they demonstrate people's actual actions, rather than relying on their retrospective accounts of them" (Roth, Dunsby, and Bero 2003, 10). Data obtained through interviews are likely to indicate as much about the interviewees' goals for the interview than about what they would say in other contexts. Our study responds to this call by examining the discourse of people who testified in congressional hearings. We can safely assume that speakers' goals were to influence policy outcomes, and therefore we interpret their speech as displaying their thoughts about science in the policy arena.

The empirical material in this study consisted of transcripts of testimony given during six hearings before United States Congressional committees dealing with threatened and endangered salmon recovery policy in the Pacific Northwest conducted between 1998 and 2000. For this article, we examined the testimony of the 51 "nonscientist" witnesses (i.e., those witnesses representing citizen interests who did not make specific claim to scientific credentials or authority). These individuals identified themselves as representing various citizen interests, such as nonprofit conservation organizations, agricultural communities, forest products industry,

Table 1. Affiliations and number of Congressional witnesses in the sample

Stakeholder group, interest, or institution	*n*
Agriculture and irrigation	10
Chamber of Commerce	1
City government	2
Commercial fisheries	1
Environmental lawyer	1
Forestry and forest products	3
Grazing	2
Homebuilding	1
Mining	2
Municipal planning	1
American Indian tribe	5
Nongovernmental conservation organization	18
Private property lawyer	1
Recreational motor boating	1
Sport-fishing	2
Total	51

and recreation and tourism (see Table 1). 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 programs QSR NUD*IST and QSR NVivo. During the DA process, we conducted several rounds of intercoder reliability (ICR) verifications using the NUD*IST merge utility (Bourdon 2000). After the final iterations and adjustments to the coding scheme, we achieved an acceptable ICR (Rust and Cooil 1994) averaging 80%, depending upon coding category.

Findings

Throughout the results presented in this section, excerpts are used to illustrate the analytic themes. All documents, identities, and statements are public information, so no effort has been made to conceal identities. Of the 51 citizen witnesses, 14 used language in their testimony that explicitly exhibited understandings of scientific knowledge and scientists. Their testimony illustrates that a limited range of understandings of science was expressed in salmon recovery policy discourse. We organize our findings into two broad analytic categories: (a) *understandings of scientific knowledge* and (b) *understandings of scientists*. The following subsections draw on those text elements relevant to our topics.

Understandings of Scientific Knowledge

The first way that we interpreted public understanding of science was by analyzing discourse for descriptions of science's products—that is, the knowledge, information, data, facts, or truth generated by science. Witnesses often made statements providing

evidence of their implicit or explicit understandings of the nature of scientific knowledge. We organized these descriptions according to the speakers' positions relative to conceptual categories such as value orientation, certitude, representativeness, quantitative nature, and predictive or explanatory ability. Three main understandings emerged: (a) *scientific knowledge as certain/true*; (b) *scientific knowledge as consensual*; and (c) *scientific knowledge as privileged.*

Scientific Knowledge as Certain/True

Citizens representing conservation groups, American Indian tribes, and motor-boating and mining interests described scientific knowledge as a matter of certainty in support of their preferred policy positions. Some individuals described uncertainty as intrinsic to existing scientific knowledge. However, implicit in this perspective was the idea that over time the scientific process leads to systematic reduction of uncertainty. In other words, similar to what Zehr (2000) found, uncertainty was presented as manageable within the realm of science. Ten public witnesses made claims illustrating the view of scientific knowledge as certain or incontrovertible.

The testimony of a representative of the Shoshone–Bannock Tribes illustrates the understanding of scientific knowledge as certain and true. Note how the speaker describes recent studies and data as predictive, certain, and explanatory. NMFS comes across as acting irrationally in the face of such evidence:

> 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 fisheries in 1997 that could not be maintained by the Shoshone–Bannock Tribes.

In the next excerpt, 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. The use of linguistic markers of certainty ("*never* been *any* evidence") and emphatic markers ("*extensive* report") frames the behavior of NMFS as especially reprehensible:

> An extensive report by NMFS' 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.

The Associate Director of Public Policy from Save our Wild Salmon, a nonprofit conservation organization, suggests that the science is "99 to 100 percent" certain in advocating for the removal of the Snake River dams:

> The science is now conclusive... 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.

Scientific Knowledge as Consensual

Citizens typically represented scientific knowledge that supported their positions as consensual among a community of scientists. Speakers almost uniformly spoke of scientists—in the plural—advocating a course of action; almost never was a position attributed to a single scientist. This technique depersonalizes and distances science, marshaling a consensus of opinion in support of claims. Some citizens used a variation of this discourse to advance policy positions by denigrating opposing scientific knowledge that had not reached consensus. A representative from the Northwest Sport-fishing Association criticized NMFS's scientific credibility because the scientific (and management) community was not in consensus: "The study is incomplete. The data has not been peer reviewed by State, Federal, tribal managers.... Yet, high NMFS officials are publicly releasing preliminary data to the media and to Congress claiming that it shows fish barging worked."

Scientific Knowledge as Privileged

Although many citizens justified their claims as based on property rights, social justice, or local knowledge, scientific knowledge (and thus scientists) was also routinely afforded a privileged status as an input into the policy process. Typically, this was accomplished by privileging science over politics. For example, the Northwest Director for Friends of the Earth suggested: "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." Similarly, the president of Idaho Steelhead and Salmon Unlimited denigrated NMFS for ignoring science: "It was felt by the scientists that leaving more fish in the river to migrate naturally would result in better returns as adults. Unfortunately, NMFS paid little attention to this plan and went about business as usual." An Oregon farmer told a House Committee that "the biological opinion was issued for political purposes to pacify environmental organizations, not because of scientific justification."

Understandings of Scientists: Representations of Independence/Capture

The second major component of our investigation involved analyzing policy discourse for implicit or explicit descriptions of scientists. We identified two noteworthy understandings of scientists in the text that dealt with scientists' independence, objectivity, and bias: (a) *scientists as independent advisors*, and (b) *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 next three excerpts are prototypical examples of both the scientists as independent advisors and the captured scientists understandings. In the first, the director of a private firm called Biological Services for Marine Technology distinguishes

between independent (explicitly stated) and captured (by inference) scientists 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.

In the next excerpt, the policy director for Save Our Wild Salmon also distinguished between 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:

> 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.

Finally, in the third excerpt the Western Conservation Director for Trout Unlimited justifies his "grass-roots" citizen group's preferred policy option, retiring dams on the Lower Snake River, by aligning their position with the "independent" science advisory board:

> 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.

In each of these cases, 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.

Discussion

Policy advisors in natural resource fields have advocated incorporating more independent scientific input into policy decisions. At the same time, there is recognition

that more extensive and more meaningful public involvement is required to arrive at equitable, acceptable decisions. In the light of this apparent tension, it is important to know how the participants themselves view science and its role in reaching decisions. If the public exhibits widespread deference to science and scientists, those who organize public forums should be attentive to "demystifying" science to ensure that public values are not overridden by values of scientists masquerading as fact. On the other hand, if the public is largely skeptical or distrustful of science/scientists in general, deliberative processes may likewise be in jeopardy. It might be difficult for scientific advisors to establish sufficient trust to be able to move beyond conflict. If the public uses different evidentiary criteria and different frames to understand, interpret, and argue policy, calls for "science-based policy" are falling on deaf, or at best skeptical, ears. It is not a simple or straightforward implication that more science will lead to more acceptance.

Our analysis shows that stakeholders in natural resource controversies employ elements from both the "traditional enlightenment" model of science and the "skeptical-realist" discourse when they testify about the management of salmon. Given existing PUS literature, this finding was not unexpected. Indeed, in arenas where the scientific evidence is so hotly contested—as it is in salmon recovery—both by stakeholders and scientists, speakers will have to acknowledge and negotiate this uncertainty. Speakers can draw on either culturally available discourse to warrant their own claims and discredit those of others. Claims about what should be done can be based on traditional authoritative claims of science, while claims that others' positions are invalid can be based on the skeptical-realist discourse. In this case, positive claims are based on the privileged role of independent scientists, and criticisms are based on the tainted role of captured scientists. There need be no attempt to refute the data—it is guilt by association. Brown (1992) argues that lay participants in policy disputes collect and use scientific information, but they emphasize social structural factors as causes of uncertainty and disagreement. We saw clear evidence of this.

The use of both discourses is similar to what Michael (1992) found in examining discourses of science surrounding risks from radon. In his study, as in ours, the discourse of science-in-general rather unproblematically reflected the traditional view. In certain contexts, many participants used this discourse to establish their relationship to science. However, in discussing specific instances or policy outcomes, participants used discourses of science-in-particular that often challenged the authority of science by exposing its social construction. Ziman (1991, 103) points out that "general attitudes toward science as a whole are poor predictors of specific attitudes on particular science policy issues" and we should therefore be cautious about inferring too much about specific issues from general social attitude studies.

Roth, Dunsby, and Bero (2003) make a particularly insightful observation about people who become involved in proceedings such as testimony on salmon policy: People don't get involved unless they perceive a real or imminent injustice. Justice therefore becomes their frame on the issue. In that case the public rejected scientific recommendations about tobacco regulation, but people "were not 'misunderstanding' the FDA's scientific evidence; they simply refused to grant it the privileged status as a master frame.... The mobilization of significant scientific evidence for a regulation may actually serve as a motive for opponents of the regulation to attempt to redefine the debate in other, non-scientific terms" (Roth, Dunsby, and

Bero 2003, 33). Similarly, in our study, many citizens framed the policy issue as a matter of property rights, economic impacts, or social justice. One implication for scientists who do choose to participate in the policy process is that they must be sensitive to how their input is relevant to these public concerns.

Our findings provide mixed comfort for policymakers and resource managers. On the one hand, citizen stakeholders appeared much more astute about science and its use than is often depicted. Citizens routinely suggested that decisions should be based on scientific knowledge. Of course, this may be a function of the particular context of our study (testimony before Congress), but it does suggest that the public need not always be treated as ignorant or unwilling to attend to scientific evidence. However, this awareness cuts both ways. Citizens appear quite conscious of the ways scientists can be captured by interests, the selective reporting of and attention to findings, and the desire for scientists to further their own careers and influence. Moreover, citizens may simply privilege certain forms of "scientific" evidence (e.g., the economic costs incurred by adopting one position) rather than other forms of scientific evidence (e.g., the effect of the action on salmon). Elam and Bertilson (2003, 236–237), paraphrasing Latour (1998), sum it up this way: Opening up more science "'does not promise to put an end to politics, it only serves to enlarge politics further.'"

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