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THE ROLE OF SCIENTISTS IN THE NATURAL RESOURCE AND ENVIRONMENTAL POLICY PROCESS: A COMPARISON OF CANADIAN AND AMERICAN PUBLICS

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ABSTRACT

Recent "science wars" challenging the primacy of scientific authority in technical decision making, increasingly complex policy problems, and expanding demands for public participation have created tension among both the producers and users of science, especially in the highly visible policy arenas of natural resource management. This article uses survey data collected in 1999 from Oregon, Washington, and British Columbia to investigate public perspectives on these conflicting roles for science and scientists in the natural resource and environmental policy making process in the Canadian and American contexts. Determinants of public support for involving scientists in the policy making process also are characterized and measured. The article concludes that publics in both areas of the Pacific West are likely to approve of Kai Lee's concept of civic science, in which research scientists are more actively integrated into natural resource management processes.

INTRODUCTION

As the United States and Canada emerge as postindustrial societies in the 21st century, a new array of social and political problems is arising that increasingly confounds the ability of our federal agencies to implement effective policy decisions. "Postindustrial" societies have been described as those that are experiencing sustained economic well-being and relative freedom from national threat, expanding education and flow of information, progressively evolving communication technologies across international boundaries, and new social values expressed by individuals raised in these affluent and freedom enhancing conditions [1, 2]. These changes are contributing to policy problems that are highly technical and increasingly scientific in nature and that pose what has been termed the "democracy and technocracy quandary" [3], where the values associated with democratic participation are in opposition to those associated with science-based problem solving.

Managing natural resources, for example, involves multiple complex issues for which substantial amounts of technical and scientific information are critical to decision-making processes. At the same time, however, the United States and Canada are both committed to popular participation in policy making and have experienced noticeable growth in public demands for political involvement in natural resource and environmental management during the past thirty years [4]. In combination, the requirements for democratic participation and technical decision making produce a wide-scale dilemma: How is it possible to increase popular involvement in the policy process, thereby enhancing its democratic character, when many policy problems—such as the management of ecosystems—are scientifically and technically complex? There is fear that the apparently mutually exclusive character of the relationship between participation and scientific expertise will result in the critical erosion of democracy in existing postindustrial societies [3, 5].

Concomitant with the rise of this quandary calls for more science-based natural resource and environmental policy have increased [6]. Many observers have normative expectations that scientists and scientific information can improve the quality of complex natural resource and environmental decisions [7]. Arguably an outgrowth of the philosophy of positivism, the assumption is that where science is relevant to policy issues, scientists can and should facilitate the resolution of management decisions by providing scientific information to policy-makers and the public [8, 9].

There are others, however, who suggest that science is used for other less desirable policy purpose, such as rationalizing and legitimizing decisions made by elites [10]. This latter view has been supported by postmodern perspectives in the sociology of science, which argue that the authority of science and scientific narratives is socially constructed by scientists and users of the scientific information and is not inherent to science *qua* science. In this model, science and

scientists are considered just one of many sources of authority concerning natural resource management issues [10, 11].

The "science wars" challenging the primacy of scientific authority in technical decision making, increasingly complex policy problems, and expanding demands for public participation have created tension among both the producers and users of science, especially in the highly visible policy arenas of natural resource management. This article uses survey data collected in 1999 from Oregon, Washington, and British Columbia to investigate public perspectives on these conflicting roles for science and scientists in the natural resource and environmental policy making process in the Canadian and American contexts. We also examine determinants of public support for involving scientists in the policy making process. We begin by reviewing different theoretical perspectives on the role of scientists in natural resource management; cross-cultural considerations between American and Canadian publics, policies, and politics; and determinants of public support.

SCIENTISTS AND NATURAL RESOURCE MANAGEMENT

There are several theories about the role of science and scientists in policy decision processes. One model, traceable to aspects of the philosophy of positivism, suggests that where science is relevant to public policy issues, scientists should facilitate the resolution of policy decisions by providing scientific "facts" and information to policy-makers and the public. The role of scientists in this model is to provide policy-relevant data and theories that others in the policy process can use to make policy decisions. It is sometimes assumed by scientists themselves that if there is sufficient scientific information provided to decision makers, society and policy-makers will be able to make rational and defensible decisions without the significant intrusion of non-scientific and normative factors that confuse the policy process and cause erroneous decisions to be made. Along with the belief that "rational choice" is available for every decision, reliance on scientific authority is assumed to result in better policy decisions. This view privileges science as objective and factual as opposed to the subjective and normative opinions associated with political processes. When asked, many stakeholders, including scientists themselves, agree with Harmon:

> We in modern society give tremendous prestige and power to our official, publicly validated knowledge system, namely science. It is unique in this position; none of the coexisting knowledge systems—not any system of philosophy or theology, not philosophy or theology as a whole—is in a comparable position [12].

This distinctive valuing of science underlies many of the statutory requirements for resource management decision, including planning, cost-benefit analyses, and

risk assessment, in the United States. Wildavsky has further characterized the importance of science and scientists as follows:

> Scientific evidence does matter. I notice that no mention is made of witchcraft as a rationale for regulation, but rather obeisance is made to science whether or not it is what matters . . . As long as science is the only publicly acceptable rationale, it matters [13].

A second model suggests that scientists and scientific information are only one source of information and authority, among many, in policy decisions. Scientists, policy-makers, and those affected by policy must work together to construct the meaning of the policy *and the science,* ignoring the boundaries of science assumed by scientists. These political processes use science and scientists to characterize and rationalize positions that are supportive of various interests. In this model, the value of information is considered radically contingent on context, and non-scientific, political, personal, and ideological information can override scientific data in policy making (often to scientists' dismay). The emergence of this second model of science has been delineated by Philip Shabecoff:

> In recent decades, science has begun to slip from its lofty pedestal as it has become apparent that it is not adequate either to meet all the needs of humanity or to protect us from the dangers that science and technology themselves create. . . . Increasingly, however, reverence is turning to dismay as we discover that the genie of science and technology is threatening the biological, chemical, and physical systems that support life and evolution [14].

When asked to describe how scientific information is used in policy decisions, experienced stakeholders—including scientists—often report that policy responses are developed through the aid of multiple sources of information, including but not privileging scientific information. Scientific information "disappears" into the mix of information considered by policy-makers. This phenomenon is described by Carol Weiss:

> Researchers need to be aware that the work they do, no matter how applied in intent and how practical in orientation, is not likely to have major influence on the policy decision at which it is purportedly directed. . . . Adherence to all the traditional structures—acceptance of decision-makers' constraints, focus on manipulative variables, timeliness, jargon-free communication, and the like—seems only to increase the application of research results marginally. . . . When competing with other powerful factors, such as officials' concerns with political or bureaucratic advantage, one limited study (and all studies are limited in some way), is likely to have limited impact [15].

Scientists often rue the fact that science is not more authoritative in public policy decisions, since they believe that scientific information can and should settle many policy decisions [16]. However, ecological scientists are generally reluctant to publicly present their normative opinions about natural resource issues

or about the proper uses of scientific information in deciding natural resource management options for fear of loss of authority among their peers or others involved in environmental policy matters. Their scientific objectivity may be questioned and their utility as expert advisors undermined.

Regardless of the model of science utilization, there is surprisingly little empirical research that identifies how ecological information and scientists actually contribute to or participate in collaborative decision processes involving natural resources, and how their scientific and normative judgments affect the policy process. This analysis investigates these questions about the role of science and scientists in natural resource decision making from the perspective of publics in the Pacific West.

CROSS-CULTURAL CONSIDERATIONS

Canada and the United States share a common cultural source in the British Empire and the American revolution [17-20]. Yet, within shared democratic traditions, very different political structures, processes, norms, and values have developed over the past two centuries [21-24]. Canada is seen as having a deferential, organic, communalistic, and particularistic political culture [25-27]. American politics, in contrast, are viewed as reflecting an individualistic, egalitarian, and entrepreneurial political culture.

Both scholarly and journalistic commentators have described distinctive political cultures in Canada and the United States. Seymour Martin Lipset, for example, employs the metaphor of two trains moving down parallel tracks, always remaining different even though they are moving in the very same direction [27]. Fearing cultural submersion into an American sea of diverse cultural tides, persistent calls for maintaining Canada's cultural and political independence from the "Goliath to the South" surface frequently in Canada's political, cultural, and literary commentary [28-30]. Encroaching social values from the United States have been decried as a primary source for disintegration of Canadian cultural distinctiveness. "The Liberal Plan for Canada" argues, for example, that "[a]t a time when globalization and the communications revolution are erasing national borders, Canada needs more than ever to commit itself to cultural development" [31].

However, the emergence of shared "postindustrial" values in America and Canada is revealed in the merging of media markets, increasingly integrated economies, growing alliances in professional entertainment including sports, and the commonality of issues ranking high on policy agendas [32, 33]. In this respect, the Pacific Northwest (Oregon and Washington and the Province of British Columbia) has at times been considered a naturally definable and ecologically distinct geographical region ("Ecotopia" or "Cascadia"). Oregon, Washington, and British Columbia have also been grouped together under the heading of the "Pacific West" area for purposes of political discussion and analysis [34, 35].

The three political units are viewed as sharing a similar population, natural resource-rich environment, and sense of separation and geographic distance from the cultural centers of their respective nations. In addition, all three of these political jurisdictions have been embroiled in many cross-border and controversial natural resource and environmental policy issues including forest and fisheries management and the fate of endangered and threatened species such as Pacific salmon.

Recent research concerning value change and policy preferences in British Columbia and the State of Washington by Pierce et al. [36] suggests that while there are some trends toward value congruence—especially among younger cohorts—there remain important cultural differences between the two countries. In particular, residents of British Columbia were found to be much more trusting of political and social elites when compared to their counterparts in Washington. Based on these and other studies we would expect Canadians to be more trusting and supportive of scientists in the natural resource management process.

DETERMINANTS OF PREFERRED ROLE FOR SCIENTISTS

A number of authors have addressed various aspects of the relationship between social values, science, and attitudes toward natural resource management [37, 38]. These discussions imply that the current debate about the role of science and scientists in natural resource policy in the Pacific West is not only a professional and technological debate, but a debate about political and environmental values. In our judgment, attitudes about the preferred role of scientists in natural resource management are influenced by a variety of factors. Primary influences include sociodemographic characteristics, political and environmental value orientations, interest factors, and contextual factors such as geographical location. How each of these factors may affect preferences about the role of scientific information and scientists in natural resource policy making is discussed briefly below.

Sociodemographic Factors

Group-based social attributes have long been a salient feature of research concerning environmental values [39-42]. Among the most commonly employed measures are sex, age, and education. Age (or for some researchers "political generation") is a widely used variable in evaluating environmental orientation. Citizens in Western democracies born after World War II are considered to be more likely than older persons to focus on environmental concerns [43]. Consequently, age (as an indicator of cohort) is an important background factor in the study of environmental values or practices.

In addition, there may be a relationship between gender and support for scientists in the policy process. Some have argued that differential socialization of

women and men may lead women to be more supportive of multiple voices in the policy processes while men may hold more exclusionary positions [44, 45]. We hypothesize that women will tend to be more supportive of integrating scientists in the management process and less supportive of extreme options where scientists are either totally excluded or are expected to actually make final decisions.

Level of formal educational attainment is included in this analysis because it is broadly associated with commitment to environmental values and interest in such issues [46, 47]. We expect those individuals with higher levels of educational attainment to be more supportive of scientist involvement in the policy process. According to Howell and Laska, this relationship is not surprising because ". . . the evidence on both sides of an environmental issue frequently addresses a very complex etiology of causes comprehended more easily by the better educated" [48].

Value Orientations

Expectations about the role of scientists in the natural resource management process are likely to be influenced by, or are a component of, general political and social values. For example, political ideology may be related to support or opposition for scientist involvement in the natural resource management process. Paul and Anne Ehrlich describe how, for political advantage, those "claiming to represent a scientific viewpoint, misstate scientific findings to support their view that the U.S. government has gone overboard with regulations, especially (but not exclusively) for environmental protection, and that subtle, long-term problems like global warming are nothing to worry about" [7]. Other observers, with left-leaning political values, have also expressed concern about the role of science and scientific experts in the policy process, concerned that the conservative nature of science hinders appropriate environmental policy development [3, 47]. We hypothesize that respondents who describe themselves as ideologically left or right will exhibit concern about a central role for scientists in the policy process, while moderates (including those who are slightly left and right of center) will be more supportive.

Another value dimension relevant to the preferred role of science and scientists in natural resource management concerns postmaterialist values. A number of prominent scholars argue that the advent of the postindustrial society has resulted in systematic changes in values held by many citizens such that "higher order" needs have supplanted more fundamental subsistence and security needs [1, 2]. Some have argued that the rise of postmaterialism has led to "radical egalitarianism" and "elite challenging" politics where increasing numbers of the public distrust established economic and public elites [49, 50]. Based on this previous research, we would expect respondents with postmaterialist values to be less supportive of a dominant role for scientists in the natural resource policy process when compared to others with weaker postmaterialist values.

Interest Factors

Another important factor likely affecting public attitudes concerning the role of scientists in the policy-making process is economic dependence on the natural resource extraction industry (i.e., timber, agriculture, livestock, etc.) or membership in a pro-environmental organization. Some have argued that an individual's orientation toward the role of elite decision makers is influenced by where they stand in relation to the productive arrangements of society [51]. Persons who rely on the natural resource extraction or agricultural industry for their economic well-being may feel threatened by a dominant role for scientists because of fears that scientists may produce research results that question current practices. One example of this is President Clinton's Northwest Forest Plan, where scientists developed a plan for managing northwest forests for endangered species and ultimately brought about a very significant reduction in timber harvests, therefore negatively affecting commodity interests.

Environmentalists may be as concerned about the role of scientists in natural resource management but for different reasons. While modern environmentalism was influenced considerably by scientists such as Aldo Leopold and Rachel Carson, many in the environmental community have become more cynical about science. Lester Milbrath's suggestion that scientists and scientific research is increasingly controlled by those who fund much of the research—large corporations—resonates with many environmentalists [40]. And, arguments made by Paul Ehrlich [52] and Ralph Nader [53], that commercial interests use scientists to produce "junk science" in order to convince the public and politicians that the claims of environmentalists are trivial, increase suspicion of all scientific information and scientists.

Geographical Location

One major goal of this study is to compare the orientations of citizens residing in British Columbia and the American Pacific Northwest regarding their preferred role for scientists in the natural resource management process. As discussed above, many observers have suggested that the political cultures of Canada and the United States—collectivist, quasi-participative, and organic versus individualistic, participative, and pluralistic, respectively—are broadly thought to be reflected in the respective views of who should and shouldn't be involved in the environmental policy process [3, 46, 47]. Canadian political culture tends to produce higher levels of support for elite or expert participation when compared to Americans who are suspicious when government agencies attempt to make important policy decisions.

Yet other research suggests attitudinal, and thus policy convergence, between countries with similar economic, social, and demographic structures [54, 55]. It has been further proposed that similarities will increase as levels of modernization and development increase among nations [56-58]. If this hypothesis is accurate,

then we may well expect attitudinal convergence among Canadian and American citizens concerning the role of science and scientists in the natural resource policy process.

METHODS AND MEASUREMENTS

In order to assess citizen orientations toward the role of scientists in the natural resource management process, a random digit dial telephone survey was conducted in British Columbia, Washington, and Oregon during the period July 12 to September 20, 1999. The overall response rate for the survey was 54 percent, with 559 respondents in British Columbia, 574 respondents in Washington, and 600 respondents in Oregon. Survey design and implementation followed the method recommended by Lavrakas in *Telephone Survey Methods* [59]. Funding for the survey was provided by a Canadian Embassy Faculty Research Grant and the Program for Governmental Research and Education, Oregon State University.

Dependent Variables

Table 1 characterizes five potential roles for scientists in managing natural resources. Each of these categories is an "ideal type" reflecting a complex relationship among, other things, expectations of science, attitudes about resource management, and decision making styles. Through interviews, observations, and previous surveys of scientists and natural resource managers, we

Table 1. Preferred Role for Scientists in Natural Resource Policy

Positions:	
A	Scientists should only report scientific results and leave others to make natural resource management decisions.
B	Scientists should only report scientific results and then actively interpret the results for others involved in natural resource management decisions.
C	Scientists should work closely with managers and others to integrate scientific results in management decisions.
D	Scientists should actively advocate for specific natural resource management decisions they prefer.
E	Scientists should make natural resource management decisions.

Note: The response categories were 1 = strongly disagree to 5 = strongly agree.

have found that these descriptions accurately describe distinct preferences for the role of scientists in natural resource policy. While the categories reflect levels of preference for scientist involvement ranging from a minimal role (i.e., "scientist should only report scientific results and leave others to make natural resource management decisions) to a dominant role (i.e., "scientists should make natural resource management decisions"), they also distinguish between "science as an activity separate from other, non-scientific, activities" and "science as an activity integrated with management and other non-scientific activities."

The two extreme positions described above (a minimal or dominant role for scientists) essentially maintain that it is possible for scientific activities, results, and scientists themselves to remain separate from non-scientific considerations such as politics, economics, or social dynamics. In the minimal case, the role for scientists is to conduct research, publish results, and then exit all non-scientific processes altogether, trusting that science will be used appropriately but taking no action to ensure such proper use. In the dominant case, the scientists' role is to make resource decisions that reflect scientific findings, with the normative expectation that any decision thus made will be completely rational in its sophisticated consideration of scientific and technical information.

Three additional categories describe a preference for scientists becoming involved in management and policy decisions to varying degrees, and for integrating scientific results with other types of non-scientific information when making decisions. These categories include scientists "reporting scientific results and interpreting results for others," " working closely with managers and others to integrate scientific results," and "actively advocating for specific natural resource actions." These three roles reflect an interest in utilizing scientists (and scientific information) in more democratic decision processes, where the scientific voice is welcomed in the negotiations involved in training and finding solutions for natural resource policy issues.

Independent Variables

Three sets of independent variables are used to assess variation in responses to public forest management—sociodemographic, value orientation, and geographical location variables. The *sociodemographic* factors examined as predictors of value orientations concerning forests include age in years, sex (1 = female, 0 = male), and level of formal educational attainment.[1] The indicators used to assess the *value orientations* of respondents include a self-assessment measure of general political orientation which was recoded into three dummy variables

[1]The question used was, "What is your highest level of education?" The following response scale was used: 1 = never attended school to 9 = an advanced degree.

(RIGHT, LEFT, and MODERATE)[2] and Inglehart's [1] indicator of post-materialist values.[3]

The interest variables include an indicator of personal and family economic dependence on the natural resource or agricultural industries,[4] and an indicator of membership in an environmental organization.[5] Two additional control variables are included in the forthcoming analyses which ascertain the level of attention respondents pay to natural resource and environmental issues,[6] as well as their view on how objective scientists are in the natural resource policy process.[7] The final variable incorporated into the forthcoming multivariate analyses controls for the country of each respondent with residents of Oregon and Washington forming one category and residents of British Columbia forming the other. Summary measures for the various independent variables used in the forthcoming multivariate analyses are presented in Appendix A.

FINDINGS

Univariate Results

Table 2 reports the distribution of responses for the five roles scientists can play in the natural resource management process ranging from a minimalist role (*Position A*: "scientists should only report scientific results and leave others to make natural resource management decisions") to a dominant role (*Position E*: "scientists should make natural resource management decisions"). In general, both Canadians and Americans in the Pacific West value the role scientists can play in making natural resource decisions and developing environmental policy with *Position C* receiving the highest level of support. Eighty percent of American and 87 percent of Canadian respondents agreed or strongly agreed that "scientists should work closely with managers and others to integrate scientific results in management decisions." *Position B* received the second highest level of support in both countries, with 63 percent of Americans and 68 percent of Canadians agreeing that "scientists should only report scientific results and then actively interpret the results for others involved in natural resource management decisions.

[2]The question used to ascertain subjective political ideology was, "On domestic policy issues, would you consider yourself to be?" The terms "liberal" and "conservative" were used in the United States and the terms "left" and "right" were used in Canada.

[3]Inglehart's [1] standard two question format was used to construct the postmaterialist scale.

[4]The question used was: "Do you or any of your immediate family depend on the timber, mining, livestock, or agricultural industry for your economic livelihood?"

[5]The question used was: "Are you a member of an environmentalist organization?"

[6]Respondents were asked "How much attention do you pay to natural resource and environmental issues including forests, rangelands, waterways, and wildlife?" The response category provided was a Likert scale: 1 = not much to 5 = a great deal.

[7]Respondents were asked to indicate their level of agreement with the following statement: "Scientists are generally more objective than others involved in natural resource management decisions." The response category provided was a Likert scale: 1 = strongly disagree to 5 = strongly agree.

Table 2. Citizens Preferred Role for Scientists in Natural Resource Policy

Position:		Pacific Northwest	British Columbia	*T*-test
A	Percent Agree	35%	27%	58.10***
	Mean	3.01	2.51	
	N =	1168	557	
B	Percent Agree	63%	68%	0.35
	Mean	3.75	3.78	
	N =	1166	557	
C	Percent Agree	80%	87%	13.50***
	Mean	4.07	4.24	
	N =	1166	557	
D	Percent Agree	32%	49%	42.93***
	Mean	2.94	3.37	
	N =	1168	557	
E	Percent Agree	14%	20%	35.60***
	Mean	2.23	2.57	
	N =	1162	557	

Note: Percent agree includes both "strongly agree" and "agree" responses.
Significance level: ***$p = \leq .001$.

Most respondents in both countries feel that scientists should neither simply report their findings without interpretation (*Position A*), nor should they be the sole crafters of natural resource policy (*Position E*). However, Americans are significantly more likely to support a minimalist role for scientists while Canadians are significantly more likely to support a dominant role. These results are consistent with the previously discussed literature that suggests Canadians are more supportive of elite decision-making when compared to more participatory and cynical Americans.

The data presented in Table 3 report correlations between the various preferred management roles scientists could play in natural resource management. Because the five positions are not necessarily mutually exclusive, these bivariate analyses give us a sense of how interrelated responses are for the preferred roles. Not surprisingly, the minimalist role for scientists (*Position A*) is significantly and negatively correlated with all other positions in Canada and the United States. Those Canadian and American respondents supporting a minimalist role for scientists in the management process are—for the most part—consistent in not

Table 3. Correlation Matrices for Preferred Role of Scientists

Positions:	A	B	C	D	E
Pacific Northwest					
A	1.0	−.25***	−.22**	−.30***	−.33***
B		1.0	.35**	.32**	.18**
C			1.0	.29**	.20**
D				1.0	.47***
E					1.0
British Columbia					
A	1.0	−.18***	−.08*	−.12***	−.21***
B		1.0	.39***	.19***	.17***
C			1.0	.19***	.05
D				1.0	.42***
E					1.0

Significance levels: *$p = \leq .05$; **$p = \leq .01$; ***$p = \leq .001$.

wanting scientists involved in any fashion or even advocating for their preferred management decision.

Another interesting finding in Table 3 is the strong correlation in both countries between *Positions D* and *E*—both of which support a more engaged role for scientists in natural resource management. Many of the respondents who support an advocacy role for scientists also support a dominant role for scientists in management decisions. The second strongest relationship in both research locations is the relationship between *Positions B* and *C*, both of which call for integrating scientists—and subsequently their research—into the actual decision-making process.

In summary, these survey data suggest that residents in the American and Canadian Pacific West value science and believe that it is an important factor in making natural resource decisions and policy. Furthermore, they want scientists to work closely with natural resource managers, citizens, and citizen advisory groups to interpret and integrate their findings in the development of natural resource policy. They feel strongly that scientists should neither simply report their findings without interpretation, nor should they be the sole crafters of natural resource policy.

Multivariate Analyses

Because the responses to some of the dependent variables are skewed, each variable was dichotomized, with 1 representing "agree" and "Strongly agree"

responses and 0 representing all other responses (see Table 2). Logistic regression models were then used to examine the impact of socio-demographic factors, interest factors, and political values on citizens preferred role for scientists in natural resource policy. The coefficient of a particular variable in Table 4 indicates the effect of that variable on agreement or disagreement with the five potential roles for scientists in the natural resource decision-making process. For the series of three dummy variable assessing ideological orientation, it is necessary to omit one dummy variable for the equation to be estimated. The dummy variable representing moderates is the category omitted. Both Canadian and American respondents are included in each model, however a dummy variable is included for comparison purposes (COUNTRY: 1 = Oregon/Washington and 0 = British Columbia).

For all five models presented in Table 4, the chi-square statistic is significant at the .001 level, indicating that the specified structure constitutes an acceptable model in the statistical sense. In addition, the percent of cases correctly classified by each model ranges from a low of 68.2 percent for *Position B* to 83.7 percent for *Position E.* In general, it appears that our models work well in predicting whether respondents agree or disagree with each of the preferred roles of scientists.

Because of the number of coefficients and hence complexity of the data presented in Table 4, we will discuss the general effect of each independent variable for all five models simultaneously. Beginning with the socio-demographic variables, we note that age has a statistically significant effect in one model—*Position E.* Younger respondents are significantly less likely than older respondents to support a dominant role for scientists in natural resource management. In regard to sex, women are significantly more likely than men to support *Position B,* but significantly less likely to support *Positions D* and *E.* Women want scientists interpreting scientific results for managers, but do not want them advocating preferred positions or making natural resource management decisions. The last socio-demographic indicator included in each model is formal educational attainment. Education has a statistically significant effect for the models assessing support for *Positions A* through *D,* but not *Position E.* There is a negative relationship between education and *Position A* and positive relationships between education and *Positions B, C,* and *D.* Those respondents with the highest levels of educational attainment—when compared to lower levels of educational attainment—want scientists to go beyond merely reporting scientific results. They prefer scientists interpreting scientific results for managers, working closely with managers to integrate these results, and even advocating for specific natural resource management decisions they prefer.

For the two interest indicators included in the logistic regression models, we find that membership in an environmental group (GREEN) has a statistically significant effect for only one model (*Position E*), while personal or family economic dependence on natural resource extraction or agriculture (EMPLOYMENT) has a statistically significant effect in three models (*Positions B, C,* and *D*). Not

Table 4. Logistical Regression Estimates for Citizens' Preferred Role for Scientists

Independent variables	Preferred role for scientists				
	A	B	C	D	E
AGE	.005	−.002	.002	.004	−.012**
	(.003)	(.003)	(.004)	(.003)	(.004)
SEX	.065	.381***	.039	−.556***	−.959***
	(.107)	(.101)	(.123)	(.106)	(.150)
EDUCATION	−.213***	.071*	.097*	.189***	.044
	(.037)	(.034)	(.043)	(.034)	(.047)
GREEN	.066	.124	.119	.173	−.426***
	(.122)	(.112)	(.103)	(.132)	(.082)
EMPLOYMENT	.057	−.476***	−.598***	−.402***	−.155
	(.116)	(.107)	(.124)	(.106)	(.126)
ATTENTION	.021	.304***	.273***	.072	−.167*
	(.047)	(.051)	(.055)	(.051)	(.070)
OBJECTIVE	−.301***	.411***	.272***	.521***	1.035***
	(.046)	(.044)	(.054)	(.047)	(.076)
POSTMAT	−.087***	.065***	.062***	.086***	−.331***
	(.014)	(.013)	(.015)	(.015)	(.020)
RIGHT	.462**	.233	−.336*	−.477*	−.359***
	(.157)	(.159)	(.171)	(.190)	(.050)
LEFT	−1.08***	.111	.721***	.637***	−.904***
	(.174)	(.136)	(.201)	(.131)	(.165)
COUNTRY	0.93	−.094	−.426**	−.406***	−.478***
	(.126)	(.117)	(.155)	(.115)	(.154)
% correctly classified	72.1	68.2	82.4	79.8	83.7
Chi-square =	226.90***	151.97***	141.08***	289.16***	292.78***
N =	1604	1603	1602	1604	1600

Note: The dependent variables are dichotomized responses (1 = strongly agree and agree, 0 = else) to the positions identified in Table 1.

Significance levels: *$p = \leq .05$; **$p = \leq .01$; ***$p = \leq .001$.

surprisingly, environmental group members are significantly less likely than nonmembers to support a dominant role for scientists in the natural resource management process. In regard to respondents who are economically dependent on timber, ranching, mining, or agriculture, they are significantly less likely than nondependent respondents to support scientists interpreting scientific research results for managers, scientists working closely to integrate science in management decisions, or scientists advocating specific natural resource management decisions.

For the two control variables which assess respondent attention to natural resource issues and the perception of scientists' objectivity, the coefficients in Table 4 indicate statistically significant results in three models for ATTENTION and all five models for OBJECTIVE. Those respondents who say they follow natural resource and environmental issues are significantly more likely than inattentive respondents to support scientists interpreting results for managers (*Position B*) and working with managers to integrate those results in management decisions (*Position C*). However, attentive respondents are significantly less likely than the inattentive to support scientists making natural resource management decisions (*Position E*).

Perhaps one of the most important independent variables included in these analyses is the degree to which respondents believe that scientists are objective (OBJECTIVE). Those respondents who believe that scientists are more objective than others involved in the natural resource management process disagree with a minimal role for scientists (*Position A*) and are supportive of all remaining positions including a dominant role for scientists in the management decision-making (*Position E*).

Concerning the relationship between political value orientations and preferred role for scientists in natural resource management, all the coefficients for the postmaterialist value indicator are statistically significant. Postmaterialists, when compared to materialists and "mixed" value types, are significantly less likely to support both minimalist and dominant roles for scientists (*Positions A* and *E*) and significantly more likely to support scientists interpreting results for managers, working to integrate these results with managers, and even advocating for specific management decisions they prefer. Postmaterialists recognize the importance of scientists in the management process and they want them working directly with managers and even giving their views on what decisions they prefer, yet they do not want them making natural resource management decisions themselves.

For the dummy variables used to assess general political orientations, we find that those respondents on the ideological right (RIGHT) and left (LEFT) are significantly different in their orientations from moderates (the omitted dummy variable for those describing themselves as "moderate" or slightly left or right of center) for four of the potential roles for scientists in natural resource management. Those respondents on the far right are significantly more likely to support a

minimalist role for scientists in the management process while those on the far left are significantly less supportive of this position (*Position A*). When it comes to scientists helping managers to integrate scientific results in management decisions (*Position C*) or scientists advocating for a preferred management decision (*Position D*), those on the far left are significantly more supportive than moderates and those on the far right are significantly less supportive. The only position that the far left and right seem to agree upon is that they do not want scientists making natural resource management decisions by themselves (*Position E*). Both the left and right are significantly less supportive of this option than moderates.

The final variable included in each model is a dummy variable which controls for the respondent country. The bivariate data displayed in Table 2 indicated that Canadians in the Pacific West are significantly more supportive of scientists being engaged in the natural resource management process than Americans in the Pacific Northwest. When controlling for the various sociodemographic, interest, and political orientation variables, we find that Canadians are indeed significantly more likely than Americans to support scientists working closely with managers to integrate research results into management decisions (*Position C*), scientists actively advocating management decisions they prefer (*Position D*), or scientists making natural resource management decisions (*Position E*).

These results indicate that there are important sociodemographic, interest, and value differences between those who support minimalist, integrative, and dominant roles for scientists in the natural resource management process. Of particular note are the effects of value orientations and perceptions of how objective scientists are in the management process. If scientists can maintain an aurora of objectivity, people are willing to have them actively involved in the management process and even advocate for their preferred management positions. In regard to values—including both subjective political ideology and postmaterialist values—we find that postmaterialists and those on the ideological left are most supportive of an integrative role for scientists, yet are opposed to either a minimal or dominant role. Materialists and those on the ideological right, however, are less supportive of integrating scientists in the management process. These results, while not surprising, indicate that the "science wars" described above may well continue into the future.

Another factor reinforcing these differing roles for scientists is the view of those economically dependent on natural resource extraction and agriculture. This important interest group does not want scientists integrated into the management process and they do not want scientists advocating for the management decisions they prefer. As discussed above, this may in part be due to recent decisions by governments in both countries to call for more sustainable resource management policies that in turn appear to adversely affect rural economies and families.

SUMMARY AND CONCLUSION

In *Compass and Gyroscope: Integrating Science and Politics for the Environment,* Kai Lee proposes a new form of planetary stewardship called "civic science," a blend of science and politics that uses adaptive management to apply scientific information to environmental policy [60]. The science involved is large-scale experimental science in the field, conducted over time scales of biological significance, that tests hypotheses about the behavior of ecosystems affected by particular management policies and practices. Consequently, some research scientists will have to emerge from their laboratories to work closely with teams of collaborators in natural resource agencies, to design and monitor ecosystem experiments and help set new management directions, once these experiments are completed [60].

Previous social research in the Pacific Northwest indicates that the public is generally supportive of basic adaptive management concepts, though there is also considerable public uncertainty because of the lack of examples of adaptive natural resource management [61]. Coupled with the analyses presented in this study, the research implies that Lee's efforts to define a new role for science and scientists in natural resource management would gain public support, especially in the Canadian West. Lee is recommending a more active, integrative role for research scientists; they are to go beyond their more traditional scientific roles to become more involved in management issues and work side-by-side with agency personnel to do environmental science and formulate environmental policies. At the same time he is not proposing that scientists become technocrats or that they advocate their personal management preferences.

In addition, the multivariate analyses in this study indicate fertile ground among the more polarized segments in resource debates who would "brown wash" or denigrate natural resource management plans developed by research scientists and who would exacerbate the "science wars" currently infecting many resource disputes. There are clearly some risks then for research scientists who become involved in civic science: not only must they leave the comforts of their laboratories and small-scale field experiments, but they must also learn how to work with natural resource agency personnel and managers. Moreover, such factors as the large scale and costs in these adaptive ecosystem experiments, the real possibilities for experimental error and failure, and the long time spans involved could all create difficulties that polarized and polarizing interests could use to their advantage, whether they are special interest political groups or entrenched bureaucracies in the agencies themselves. The experiments and resulting policy recommendations involving civic scientists would inevitably come under close public scrutiny and the more privileged and secure authority of research scientists as generators of relevant "objective" knowledge would be questioned, even by some of their scientist peers.

Perhaps these consequences are less likely in Canada, due to more public acceptability for integrating scientists into natural resource management. As these analyses have shown, citizens in British Columbia are significantly more supportive of scientists being involved more directly in resource management processes than their counterparts in Oregon and Washington. At the same time, as Pierce et al. [36] found in their recent study of public policy issues in British Columbia and the State of Washington, there appears to be some political and social value convergence taking place between the youth of these two post-industrial societies, and this has resulted in increasing levels of cynicism toward the status quo and support for "elite challenging" politics. It remains to be seen, then, what role and influence scientists will eventually have in the many contentious natural resource debates taking place in the Canadian Pacific West and the American Pacific Northwest.

APPENDIX A.
Determinants for Preferred Role of Scientists in Natural Resource Policy

Variable name	Variable description	Pacific Northwest Mean (*s.d.*)	British Columbia Mean (*s.d.*)
AGE	Respondent Age in Years [Range: 18 to 91 years]	50 (17.91) $n = 1162$	46 (15.07) $n = 559$
SEX	Dummy variable for respondent gender 1 = female 0 = male	.49 $n = 1160$	.52 $n = 559$
EDUCATION	Highest level of formal educational attainment 1 = some grade school to 8 = an advanced degree	4.77 (1.50) $n = 1160$	5.42 (1.62) $n = 555$
EMPLOYMENT	Respondent/family dependent on natural resource industry or agriculture for economic livelihood 1 = yes 0 = no	.15 $n = 1167$	.19 $n = 551$

APPENDIX A. (Cont'd.)

Variable name	Variable description	Pacific Northwest Mean (*s.d.*)	British Columbia Mean (*s.d.*)
RIGHT	Dummy variable for very conservative respondents 1 = very conservative/right 0 = other	.15 *n* = 1164	.06 *n* = 559
MODERATE	Dummy variable for moderate respondents 1 = moderate 0 = other	.69 *n* = 1164	.76 *n* = 559
LEFT	Dummy variable for very liberal respondents 1 = very liberal/left 0 = other	.16 *n* = 1164	.17 *n* = 559
POSTMAT	Dummy variable for Inglehart's indicator of postmaterialist values 1 = postmaterialist values 0 = mixed/materialist values	.22 *n* = 1142	.20 *n* = 549
COUNTRY	Dummy variable for country 1 = Oregon/Washington 0 = British Columbia	.68 *n* = 1174	.32 *n* = 559
GREEN	Member of an environmentalist organization 1 = member 0 = not a member	.12 *n* = 1161	.10 *n* = 555
ATTENTION	Amount of attention given to natural resource/environmental issues 1 = not much to 5 = a great deal	3.70 (1.06) *n* = 1166	3.79 (1.04) *n* = 557
OBJECTIVE	Level of agreement with the idea that scientists are more objective than others involved in natural resource management 1 = strongly disagree to 5 = strongly agree	2.68 (1.12) *n* = 1164	3.03 1.21 *n* = 557

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