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A Comparison of a Collaborative and Top-Down Approach to the Use of Science in Policy: Establishing Marine Protected Areas in California

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The National Research Council has proposed two distinct approaches over the past 20 years for guiding decision making about risk. These two approaches are widely applicable to environmental decision-making and are exemplified by two attempts to establish Marine Protected Areas (MPAs) in California with the implementation of the 1999 Marine Life Protection Act. The first attempt, which parallels the NRC's 1983 linear scientific approach, was a top-down process that involved a Master Plan Team of scientists who created a proposal before gathering public input. The second attempt, which parallels the NRC's 1996 analytic and deliberative approach, involved a diverse set of stakeholders, including scientists, who worked in a collaborative process to provide a range of recommendations. We apply a three-tiered model of elite belief systems drawn from the Advocacy Coalition Framework to show that stakeholder preferences for either of these approaches is a function of their deep core beliefs. Stakeholders with strong preferences for scientific management support empirical claims for the benefits of MPAs and are more optimistic about the linear scientific approach compared to the analytic and deliberative approach for protecting major habitats, avoiding adverse fishing effects, and avoiding unfair agency domination. In contrast, stakeholders with pro-collaborative beliefs respect local knowledge and are more optimistic about the analytic and deliberative approach compared to the linear scientific approach for avoiding adverse fishing effects and unfair agency domination.

Several studies have analyzed the use of collaborative institutions for resolving conflicts over natural resources (Leach & Pelkey, 2001; Leach, Pelkey, & Sabatier, 2002; Lubell, forthcoming; Lubell, Schneider, Scholz, & Mete, 2002; McGinnis, 1999; McGinnis, Woolley, & Gamman, 1999; Moote, 1997; Woolley & McGinnis, 1999). With the exception of Lubell (in press), these studies have not compared collaborative institutions to other decision-making approaches. In this analysis, we show how stakeholders' fundamental beliefs affect evaluations of a top-down approach compared to their expectations for a multistakeholder collaborative approach for integrating science in policy.

Over the past 20 years, the National Research Council (NRC) has offered two approaches for integrating science into the policy process. The NRC put forth a linear scientific approach in a 1983 report on risk entitled *Risk Assessment in the Federal Government: Managing the Process*—also known as the Red Book. In the Red

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Book, the NRC sought to preserve a positivist fact-value dichotomy and "to ensure that risk assessments are protected from inappropriate policy influences" (National Research Council, 1983, p. 14). Under the NRC's 1983 approach, scientific experts first developed a proposal with limited contributions from affected stakeholders; afterward, this science-based proposal was presented to interested and affected stakeholders for comment. The NRC's 1983 linear scientific approach symbolized a top-down strategy for combining science and policy and has been used by multiple government agencies (NRC, 1996).

More than 10 years later, the NRC (1996) argued that the linear scientific approach was largely ineffective. It claimed that the linear scientific approach was limited by scientific uncertainty and by not addressing the concerns of affected stakeholders. The NRC responded by advocating a collaborative process called the analytic and deliberative approach in *Understanding Risk: Informing Decisions in a Democratic Society*. The analytic and deliberative approach integrated scientific knowledge and local knowledge from affected stakeholders through a mutual and iterative process involving continuous interaction between scientists and stakeholders in every step of decision-making (NRC, 1996). The NRC provided five objectives for the analytic and deliberative approach: (1) Get the science right by using high scientific standards; (2) Get the right science by ensuring scientists address stakeholder concerns; (3) Get the right participation by choosing a representative set of affected stakeholders to participate in the process; (4) Get the participation right by giving stakeholders a fair opportunity to contribute; and (5) Develop accurate, balanced, and informative synthesis by addressing the full range of and acknowledge the limits of available knowledge (NRC, 1996). The analytic and deliberative approach and collaborative institutions share several important attributes such as incorporating stakeholders and intergovernmental officials in defining the problem and developing solutions and integrating experts from multiple disciplines into the decision-making process (Kenney, 1999; Lubell, Schneider, Scholtz & Mete, 2002; NRC, 1996; Schneider, Scholz, Lubell, Mindruta, & Edwardsen, 2002).

Several scholars have studied the NRC's 1983 and 1996 approaches (Kinney & Leschine, 2002; Webler & Tuler, 1999; Webler, Tuler, & Krueger, 2001). To our knowledge, however, none have directly compared stakeholder preferences for the NRC's 1983 and 1996 approaches using scientific methods of data acquisition and analysis. In this article, we use data gathered from the California Marine Life Protection Act process and base our analysis on the Advocacy Coalition Framework's hierarchical belief system (Sabatier & Jenkins-Smith, 1988, 1999) to pursue the following research question: To what extent do stakeholder fundamental beliefs affect their optimism of the processes and outcomes for the NRC's 1996 analytic and deliberative approach compared to the NRC's 1983 linear scientific approach?

We begin with a brief overview of the Marine Life Protection Act process and then introduce the Advocacy Coalition Framework, the hypotheses, and the methods of data acquisition. Most of the article involves the data analyses, which include a description of the belief measures, a comparison of beliefs among stakeholder affiliations, and a path diagram of the Advocacy Coalition Framework's three-tiered hierarchical belief system.

We show that stakeholder preferences for either the 1996 or the 1983 approaches can be largely explained by fundamental beliefs. Most stakeholders with pro-scientific management beliefs are pessimistic about the NRC's 1996 approach compared with the 1983 approach for protecting major habitats, avoiding adverse fishing effects, and avoiding unfair agency domination. Stakeholders with pro-collaborative beliefs are more optimistic about the NRC's 1996 approach than the 1983 approach for avoiding adverse fishing effects and avoiding unfair agency domination.

Overview of the California Marine Life Protection Act Process

The 1999 California Marine Life Protection Act requires the Department of Fish and Game (DFG) to develop a plan for improving the network of Marine Protected Areas (MPAs) along the California coast. MPAs are a spatially based management strategy that restricts the use of, and in some instances access to, an area of ocean waters. There have been two attempts by the DFG to implement the Marine Life Protection Act, and we use these two attempts to illustrate the NRC's 1983 linear scientific and 1996 analytic and deliberative approaches.

The first attempt to implement the Marine Life Protection Act involved a Master Plan Team of scientists and paralleled the top-down linear scientific approach. Starting in 2000, the Master Plan Team process involved only scientific experts (and excluded the input from affected stakeholders) to create a preliminary set of recommendations for the placement of MPAs. In the summer of 2001, the DFG organized ten public meetings along the California coast to present the preliminary recommendations from the Master Plan Team. In these public meetings, the public reacted with outrage. Six months later in the winter of 2002, the DFG abandoned the Master Plan Team process and plan. In this analysis, we use the Master Plan Team process as an example of the NRC's 1983 linear scientific approach.

In the summer of 2002, the DFG attempted to implement the Marine Life Protection Act a second time. The second attempt involved scientists from the Master Plan Team and affected stakeholders in a collaborative process that paralleled the objectives of the NRC's 1996 analytic and deliberative approach. First, the DFG attempted to get the science right by including an economist on the Master Plan Team—this was in response to criticisms that the Master Plan Team excluded the social sciences. Second, the DFG attempted to get the right science by asking Master Plan Team members to offer and combine their expertise with the knowledge and experience from local stakeholders. Third, the DFG attempted to get the right participation by creating seven Stakeholder Working Groups each consisting of a balanced representation of local stakeholders (e.g., federal, state and local agency officials, recreational and commercial fishing interests, recreational divers, commercial passenger fishing vessels representatives, environmental interests, charter/party boat operators, harbormasters, and scientists/educators). Fourth, the DFG attempted to get the participation right by hiring a neutral firm to facilitate the meetings. The Stakeholder Working Groups were asked to provide a range of recommendations by 2005. Negotiations began in the summer of 2002, but the

process was postponed in the spring of 2003, at least in part because of the California fiscal crisis. In this analysis, we use the Stakeholder Working Groups as an illustration of NRC's 1996 analytic and deliberative approach.

The Advocacy Coalition Framework

A functioning democratic society depends on citizens who can participate in public arenas meaningfully and express their interests coherently. This approach assumes that people organize their ideas and attitudes into a belief system (Converse, 1964). A belief system is a configuration of ideas and attitudes that are bound together interdependently (Converse, 1964). Without a belief system, people's opinions, if they had any at all, would be inconsistent and unstable (Converse, 1964).

Scholars have long debated whether or not belief systems exist (Converse, 1964; Herron & Jenkins-Smith, 2002; Hurwitz & Peffley, 1987; Nie & Anderson, 1974; Peffley & Hurwitz, 1985). Later studies found that the mass public and policy elites do have similar belief systems and that these belief systems have internal structure (Herron & Jenkins-Smith, 2002; Hurwitz & Peffley, 1987; Peffley & Hurwitz, 1985). Sabatier and Jenkins-Smith (1988, 1999), in their Advocacy Coalition Framework (ACF), developed an alternative model of a belief system that categorized beliefs by substantive scope and topic rather than by levels of abstraction (Peffley & Hurwitz, 1985).

The ACF posits a three-tiered hierarchical structure to belief systems, with deep core beliefs at the highest level constraining policy core beliefs in the middle and secondary beliefs at the lowest level. The ACF defines deep core beliefs as fundamental beliefs that operate across almost all policy subsystems; that is, they are extremely broad in scope. Deep core beliefs include topics such as the conventional left versus right political ideology, attitudes toward individual freedom versus social equality, or procedural questions, for example, preferences for collaborative institutions versus top-down approaches to decision-making. Deep core beliefs usually constrain policy core beliefs at the middle level of the ACF's belief hierarchy. Policy core beliefs are normative and causal perceptions that are restricted to, but span, an entire policy subsystem. In this analysis, the Marine Life Protection Act process in California is a policy subsystem that is restricted geographically to the California coast and restricted substantively to MPAs. At the lowest level in the belief hierarchy, the ACF identifies secondary beliefs, which are narrower in scope than deep core and policy core beliefs. Secondary beliefs deal with the seriousness and causes of a problem in specific locales, perceived policy impacts in specific locales, and policy preferences for proposals dealing with only a subset of the entire policy subsystem. Secondary beliefs are theorized to be more malleable than policy core and deep core beliefs because their more restricted scope requires less information to induce belief change. In the context of the Marine Life Protection Act policy subsystem, stakeholder perceptions of the impacts of the Master Plan Team process or the Stakeholder Working Group process are examples of secondary beliefs because they deal with the impacts of a specific set of institutional arrangements.

In an application of the ACF's three-tiered hierarchical belief system, we test three hypotheses regarding stakeholder preferences for the two NRC approaches. First, the NRC (1996) argued that the analytic and deliberative approach is more robust than the 1983 linear scientific approach. In making their argument, however, the designers of the analytic and deliberative approach largely ignored the possibility that some stakeholders might prefer the NRC's 1983 approach. In the ACF's terminology, this argument presumes that deep core beliefs do not influence secondary beliefs related to stakeholder preferences for either the 1983 and 1996 NRC approaches. We use this conclusion to establish the first hypothesis with regards to the Marine Life Protection Act process.

> Robust NRC 1996 Hypothesis: All stakeholders will prefer the Stakeholder Working Group process compared with the Master Plan Team process independent of their deep core beliefs.

The next two hypotheses examine the extent that deep core beliefs affect secondary beliefs via intervening policy core beliefs. The rationale behind the NRC's 1983 linear scientific approach assumes a set of deep core beliefs consisting of a positivist view of science and a prominent role of science in management, which we call pro-scientific management beliefs. The pro-scientific management beliefs are classified as deep core beliefs within the ACF because these beliefs can be applied to multiple policy subsystems. Applied to the Marine Life Protection Act, pro-scientific management beliefs are expected to indirectly influence (via intervening policy core beliefs) secondary beliefs related to stakeholder preferences for the Master Plan Team process over the Stakeholder Working Group process. This sets up the second hypothesis:

> 1983 NRC Belief Constraint Hypothesis: The greater the degree of stakeholder concurrence with pro-scientific management beliefs, which embodies the rationale of the 1983 NRC report, the greater the degree of stakeholder preference for the Master Plan Team process compared to the Stakeholder Working Group process.

The rationale behind the NRC's 1996 analytic and deliberative approach assumes pro-collaborative beliefs. Pro-collaborative beliefs symbolize a preference for integrating scientists and affected stakeholders in an egalitarian process where all participants collectively share their knowledge and experience to resolve disputes. The Robust NRC 1996 Hypothesis suggests that all stakeholders will prefer the NRC's 1996 approach independent of their deep core beliefs. The third hypothesis suggests that deep core beliefs regarding the desirability of collaboration will indirectly influence (via intervening policy core beliefs) secondary beliefs related to stakeholder preferences for the Stakeholder Working Group process compared with the Master Plan Team process.

> 1996 NRC Belief Constraint Hypothesis: The greater the degree of stakeholder concurrence with pro-collaborative beliefs, which embodies the rationale of the 1996 NRC report, the greater the degree of stakeholder preference for the Stakeholder Working Group process compared to the Master Plan Team process.

Methods of Data Acquisition

In this analysis, we use data gathered in the summer of 2002, seven months after the Master Plan Team ended and before the first meeting of each regional Stakeholder Working Group. We used two methods of data acquisition including two sets of in-person interviews and a mail-in questionnaire.

We conducted the first set of interviews (approximately 50) before administering the mail-in questionnaire. These preliminary interviews provided background information on the Marine Life Protection Act process and helped design the questions on the survey. The second set of interviews (n = 47) was semi-structured and was conducted during the mailing of the questionnaire.[1] In this analysis, we use the insights from the semi-structured interviews to help interpret the results.

The mail-in questionnaire was administered to 310 people who were actively involved or knowledgeable about the Marine Life Protection Act process in California. These policy elite could be DFG or other government officials, active or alternate members of the Stakeholder Working Groups, Master Plan Team members, or other knowledgeable stakeholders. A total of 193 people responded (62% response rate).[2] We limit attention to 153 respondents, who comprise four categories of participants.[3]

(i) *Active Members of the Stakeholder Working Groups (n = 70)*: The seven Stakeholder Working Groups each consisted of 14 to 18 participants for a total of 105 working group members. All but four members of the Stakeholder Working Groups were mailed questionnaires, and a total of 70 of the 105 original members responded for a response rate of 67%.

(ii) *Members of the Master Plan Team (n = 10)*: All 14 members of the Master Plan Team were mailed questionnaires and 10 responded for a response rate of 71%.

(iii) *Attendees of the Master Plan Team Public Meetings or Alternate Members of the Stakeholder Working Groups (n = 65)*: We include those people who are knowledgeable about the Marine Life Protection Act process and who either attended one of the Master Plan Team public meetings or who considered themselves alternate members of the Stakeholder Working Groups.[4] These stakeholders were identified in the spring and early summer of 2002 by a snowball sampling technique starting with suggestions from the preliminary interviews. The goal of the snowball sampling technique was to identify those stakeholders who were not directly involved in the Master Plan Team or the Stakeholder Working Groups but were still knowledgeable about the Marine Life Protection Act process. To ensure that the sample did not entirely depend upon those stakeholders who first provided names for the snowball sample, we also collected names of stakeholders who were directors of relevant stakeholder groups or who had published on the subject. We also solicited feedback on the thoroughness and balance of the sample list from a stakeholder advisory committee and several additional stakeholder representatives.

(iv) California Department of Fish and Game Officials (n = 8): A total of 13 DFG officials who were actively involved in the Marine Life Protect Act process were mailed the questionnaire, and 8 responded for a response rate of 62% (excluding two DFG officials who were members of the Master Plan Team). These stakeholders were identified by the same snowball sampling technique described above.

Data Analyses

We examine our hypotheses in four steps. First, we define our measures of deep core beliefs, policy core beliefs, secondary beliefs, and the relative measures of optimism for the Stakeholder Working Group process compared to the Master Plan Team process. Second, we examine the variance among stakeholder affiliations for deep core and policy core beliefs. Third, we examine the variance among stakeholder affiliations for the three relative optimism measures for the Stakeholder Working Group process compared to the Master Plan Team process. Fourth, we use path analysis to model the ACF's hierarchical belief system with deep core beliefs as the exogenous variables, policy core beliefs as the intervening variables, and the three relative measures of optimism as the dependent variables.

1. Measures of Deep Core, Policy Core, and Secondary Beliefs

We use two measures of deep core beliefs. The first measure is a Pro-Scientific Management scale and the second is a single question item for Pro-Collaborative beliefs. These are both deep core beliefs because they can be applied to multiple policy subsystems (i.e., are not restricted to the Marine Life Protection Act process in California) and because they deal with fundamental procedural questions of who should be included in policy making.

The pro-scientific management scale is composed of three questions and has a Cronbach's alpha of 0.77, suggesting the scale has high internal consistency and good reliability.[5] The three questions relate to an individual's value of local preferences versus scientific experts, belief that science is the best technique for understanding the natural world, and trust in the objectivity of scientists. The pro-scientific management scale encompasses a set of beliefs that are analogous to the fundamental premises of the NRC's 1983 linear scientific approach. The linear scientific approach and the pro-scientific management beliefs assume the objectivity of science and encourage a leading role of science in making decisions. We test the 1983 NRC Belief Constraint Hypothesis using the pro-scientific management scale.

The second deep core measure is pro-collaborative beliefs where respondents were asked whether they agreed or disagreed to the following question: "The best strategy for resolving environmental issues is consensus-based negotiations among stakeholders, including agencies and scientists." The pro-collaborative belief variable represents an important aspect of the NRC's 1996 analytic and deliberative approach. The principal contribution of the NRC's 1996 analytic and deliberative

approach is the integration of science and local knowledge in an iterative and deliberative process. Likewise, pro-collaborative beliefs incorporate a consensus-based approach with negotiations among stakeholders and scientists in making decisions. Thus, the 1996 analytic and deliberative approach and pro-collaborative beliefs favor equity among all participants and some degree of collaboration among stakeholders and scientists in making decisions. While the NRC's 1996 report does not require a consensus-based process to achieve its goal, integrating science and local knowledge requires some degree of collaboration among stakeholders and scientists. We use pro-collaborative beliefs to test the 1996 NRC Belief Constraint Hypothesis.

We use two measures of policy core beliefs in this paper: (i) a Pro-MPA Empirical Scale and (ii) a Pro-Local Knowledge Scale.[6] Both scales are measures of policy core beliefs because they pertain explicitly to MPAs and span the entire Marine Life Protection Act process in California.

The pro-MPA empirical scale is composed of three questions and has a Cronbach's alpha of 0.91. These questions include the ability of MPAs to increase fish populations in bordering areas, the capacity of MPAs to benefit damaged marine habitats, and the applicability of scientific findings conducted outside of California to provide evidence for MPAs in the State.

The second measure of policy core beliefs is a pro-local knowledge scale that approximates the value of local knowledge and experience in California's Marine Life Protection Act policy subsystem. The pro-local knowledge scale has a Cronbach's alpha of 0.67.[7] The pro-local knowledge scale incorporates two questions related to the value of local experience and knowledge for locating MPAs and the inclusion of local participation in collecting scientific data related to MPAs.

The measures of secondary beliefs are separated into two categories: (1) three secondary beliefs for the NRC's 1983 approach and three secondary beliefs for the NRC's 1996 approach, and (2) three relative measures of optimism, which compare the NRC's 1996 approach to the 1983 approach.[8] These are secondary beliefs within the ACF lexicon because they are limited substantively within the California Marine Life Protection Act policy subsystem to either the Master Plan Team process or the Stakeholder Working Group process. For the NRC's 1983 approach, the secondary beliefs are stakeholder *post hoc evaluations* of the process and outcomes after the Master Plan Team process ended. For the NRC's 1996 approach, the secondary beliefs are stakeholder *ex anti expectations* for the process and outcomes before the Stakeholder Working Group process began.

We use three measures of secondary beliefs about the Master Plan Team process and the Stakeholder Working Group process. The first secondary belief is a process-related question regarding evaluation of unfair agency domination in the Master Plan Team process and expectations for unfair agency domination in the Stakeholder Working Group process. The second and third secondary beliefs relate to the substantive outcomes of the Master Plan Team and for the Stakeholder Working Group processes. These secondary beliefs ask stakeholders to comment on whether the Master Plan Team's recommendations would have protected major habitats and avoided adverse fishing effects and whether the Stakeholder Working Groups'

recommendations will protect major habitats and avoid adverse fishing effects. This produces three questions for the Master Plan Team process and three similarly worded questions for the Stakeholder Working Group process.

We use these secondary beliefs to create three relative measures of optimism for the Stakeholder Working Group process compared with the Master Plan Team process. These relative measures of optimism are constructed from the differences between similar secondary belief questions asked about the Stakeholder Working Group and Master Plan Team processes. For example, "Optimism for Protecting Major Habitats" is a measure of optimism for the Stakeholder Working Group process compared with the Master Plan Team process and is derived from the differences between respondents' scores for the following two statements: "the working groups will propose MPAs that will protect major habitats" and "the Master Plan Team proposed MPAs that would protect major habitats." Both questions are based on 7-point Likert scales with 1 = Strongly Disagree and 7 = Strongly Agree. If an individual scores a seven for the Stakeholder Working Groups question and a five for the Master Plan Team question, then they would receive a score of positive two, which indicates a measure of optimism for protecting major habitats for the Stakeholder Working Group process compared to the Master Plan Team process. In each, the Master Plan Team score is subtracted from the Stakeholder Working Group score, so that the difference indicates relative optimism for the future of the Stakeholder Working Group process compared to the past Master Plan Team process (–6 = complete pessimism for the Stakeholder Working Group process, +6 = complete optimism for the Stakeholder Working Group process). This produces three relative measures of optimism for the Stakeholder Working Group process compared to the Master Plan Team process: (1) Optimism for Avoiding Unfair Agency Domination, (2) Optimism for Protecting Major Habitats, and (3) Optimism for Avoiding Adverse Fishing Effects. We use these optimism measures as our dependent variables in the path analysis.[9]

2. Policy Core and Deep Core Beliefs by Stakeholder Affiliation

The 153 mail-in questionnaire respondents are grouped into eight stakeholder affiliations: federal agency officials (n = 7); state agency officials (n = 15); local government officials and harbormasters (n = 8); commercial fishing interests (n = 35); recreational fishing interests (n = 28, including recreational anglers, consumptive divers, and commercial passenger fishing vessels operators); environmental interests (n = 27, including environmental group representatives and nonconsumptive divers); and scientists and researchers (n = 22). The eighth category includes "others" and consists of kelp harvesters, professional boating/touring representatives, and members of the media (n = 11).

Table 1 lists stakeholder affiliations horizontally across the top and deep core and policy core beliefs vertically down the side. All numbers are mean values with 1 = strongly disagree and 7 = strongly agree. The stakeholder affiliations are listed in order from the highest mean response on the pro-scientific management scale (5.8 for federal government officials) to the lowest (2.8 for commercial fishing interests).

Table 1. Deep Core and Policy Core Beliefs by Stakeholder Affiliation (mean values)[a]

	Federal Govt Officials	Scientists	Environ Interests	State Govt Officials	Local Govt Officials & Harbor masters	Recreational Fishing Interests	Commercial Fishing Interests	Other	Total	P-values[b]
Deep Core Beliefs										
Pro-Scientific Management (n = 150)	5.8	5.6	5.2	5.0	3.6	3.4	2.8	4.3	4.2	0.00
Pro-Collaboration (n = 142)	4.4	3.9	4.1	3.7	6.0	4.7	4.9	5.0	4.5	0.13
Policy Core Beliefs										
Pro-MPA Empirical (n = 152)	6.1	5.5	5.8	5.4	4.0	2.9	2.2	4.0	4.2	0.00
Pro-Local Knowledge (n = 151)	5.9	6.2	5.8	5.7	6.8	5.7	6.7	6.6	6.1	0.02

[a]All numbers are mean values with 1 = Strongly Disagree and 7 = Strongly Agree.
[b]P-values are calculated from a One-Way Anova for differences in beliefs among stakeholder affiliations.

Table 1 shows divergence among stakeholder affiliations for pro-scientific management and pro-MPA empirical beliefs ($p < 0.00$). For instance, local government officials and harbormasters, commercial fishing interests, and recreational fishing interests score a four or below suggesting these stakeholder affiliations are skeptical of science and of the effectiveness of MPAs. On the other hand, federal government officials, scientists, environmental interests, and state government officials score five or above suggesting they support a strong role of science in management and believe in the effectiveness of MPAs.

This divergence is not as evident for pro-collaborative beliefs ($p < 0.13$). The mean values for local government officials and harbormasters, recreational fishing interests, and commercial fishing interests all exceed four with local government officials and harbor masters showing the most support for collaboration (mean > 6.0). Showing less enthusiasm for collaboration, federal government officials, scientists, environmental interests, and state government officials have means clustering around an equivocal score of four.

Even though the ANOVA indicates a significant difference among stakeholder affiliations ($p < 0.05$), all stakeholder affiliations show strong support for pro-local knowledge (means > 5.7). The most support comes from commercial fishing interests and local government officials (means > 6.7).

This section indicates that stakeholder affiliations strongly diverge in their pro-scientific management and pro-MPA empirical beliefs. On the other hand, stakeholder affiliations exhibit either moderate support or are equivocal about collaboration, and all affiliations show strong support for pro-local knowledge.

3. Secondary Beliefs and Relative Measures of Optimism by Stakeholder Affiliation

Table 2 shows the mean values by stakeholder affiliation for the secondary beliefs and for the relative measures of optimism for the Stakeholder Working Group process compared to the Master Plan Team process. Table 2 is partitioned into three parts with the top part including "Avoiding Unfair Agency Domination," the middle part including "Protecting Major Habitats," and the bottom part including "Avoiding Adverse Fishing Effects."

For Avoiding Unfair Agency Domination, federal government officials score a mean of 5.4 for the Stakeholder Working Group process and 4.9 for the Master Plan Team process. The difference between these two secondary beliefs gives the relative measure of optimism for avoiding unfair agency domination (mean = 0.5) for the Stakeholder Working Group process compared to the Master Plan Team process. Almost all stakeholder affiliations agree that the Stakeholder Working Groups will do a better job than the Master Plan Team for avoiding unfair agency domination ($p < 0.28$). The only affiliation that scores on the negative side is environmental interests (mea n = –0.4).

For Protecting Major Habitats, commercial and recreational fishing interests tend to be critical of both the Master Plan Team and the Stakeholder Working Group processes (means < 4). Conversely, federal government officials, scientists, environmental interests, state government officials, and local government officials and

Table 2. Secondary Beliefs and Relative Measure of Optimism by Stakeholder Affiliation (mean values)[a]

	Federal Govt Officials	Scientists	Environ. Interests	State Govt Officials	Local Govt Officials & Harbor masters	Recreational Fishing Interests	Commercial Fishing Interests	Other	Total	P-values[b]
Avoiding Unfair Agency Domination										
Secondary Beliefs										
Stakeholder Working Groups (n = 135)	5.4	5.0	4.6	5.7	2.4	2.9	2.4	3.5	3.8	0.00
Master Plan Team (n = 143)	4.9	4.6	5.0	4.7	1.9	2.4	1.6	2.6	3.3	0.00
Relative Measure										
Optimism for the Stakeholder Working Groups Compared to the Master Plan Team (n = 124)	0.5	0.4	–0.4	0.7	0.4	0.7	0.7	1.0	0.4	0.28
Protecting Major Habitats										
Secondary Beliefs										
Stakeholder Working Groups (n = 139)	5.2	4.0	4.5	4.3	5.4	4.0	3.7	4.5	4.2	0.15
Master Plan Team (n = 124)	5.3	5.6	5.4	5.6	4.7	3.5	3.3	4.7	4.5	0.00
Relative Measure										
Optimism for the Stakeholder Working Groups Compared to the Master Plan Team (n = 113)	0.6	–1.6	–1.2	–1.2	1.0	0.7	0.6	–0.4	–0.2	0.00
Avoiding Adverse Fishing Effects										
Secondary Beliefs										
Stakeholder Working Groups (n = 129)	5.2	5.4	6.0	5.5	3.0	2.2	2.5	3.7	4.1	0.00
Master Plan Team (n = 140)	5.8	5.8	5.8	4.6	1.9	1.8	1.6	3.1	3.5	0.00
Relative Measure										
Optimism for the Stakeholder Working Groups Compared to the Master Plan Team (n = 118)	–0.2	–0.4	0.2	0.9	1.1	0.6	1.0	0.1	0.4	0.00

[a]All secondary beliefs are mean values with 1 = Strongly Disagree and 7 = Strongly Agree. All relative measures of optimism are mean values with –6 = Pro Master Plan Team Compared to the Stakeholder Working Group Processes and +6 = Pro Stakeholder Group Compared to the Master Plan Team processes. Discrepancies of the differences between the Stakeholder Working Group and Master Plan Team secondary beliefs and the relative measures of optimism are the result of missing values for respondents or from rounding.

[b]P-values are calculated from a One-Way ANOVA for differences in beliefs among stakeholder affiliations.

harbormasters tend to support both processes (means > 4). Stakeholder affiliations diverge on the measure of optimism for the Stakeholder Working Groups compared with the Master Plan Team for protecting major habitats ($p < 0.00$). The most pessimistic affiliations are state government officials, environmental interests, and scientists for protecting major habitats (means < –1.2). The most optimistic affiliation is local government officials and harbormasters (mean = 1.0).

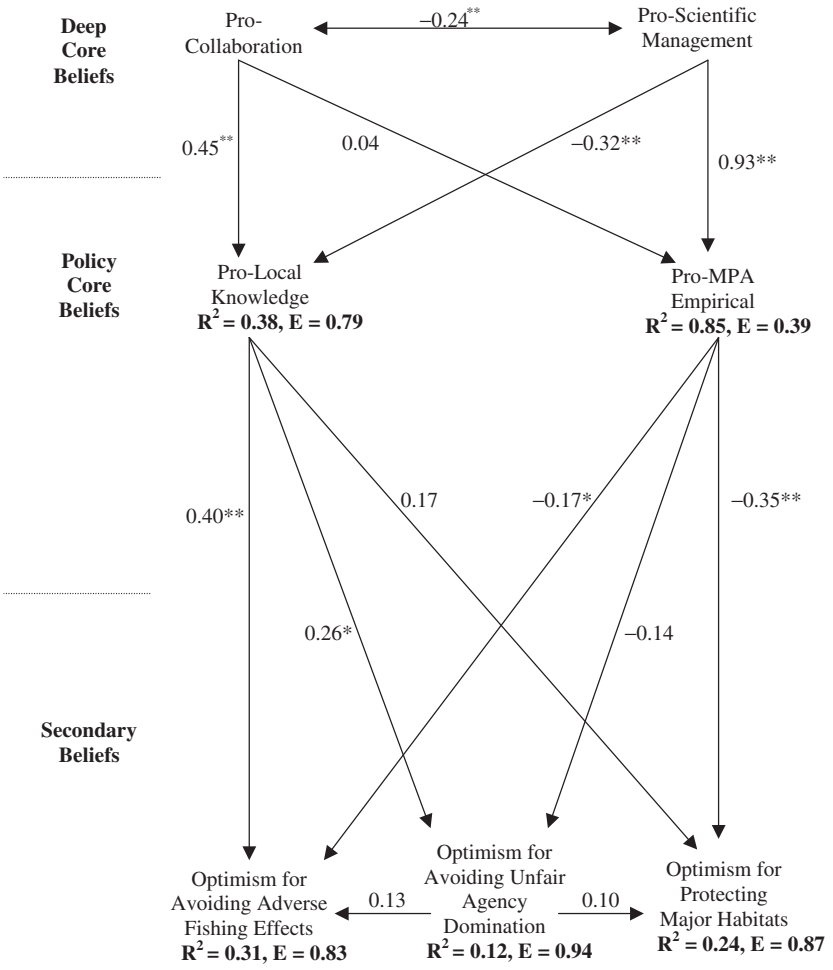
Stakeholder affiliations also diverge for Avoiding Adverse Fishing Effects ($p < 0.00$). Federal government officials, scientists, environmentalists, and state government officials believe both processes will avoid unwanted impacts on fisheries (means > 4) and the opposite position can be found for local government officials and harbormasters, commercial fishing interests, and recreational fishing interests (means < 4). Stakeholder affiliations diverge on their perceptions of optimism for the Stakeholder Working Group process compared to the Master Plan Team process to avoid adverse fishing effects ($p < 0.00$). Pessimistic affiliations include scientists (mean = –0.4) and federal government officials (mean = –0.2), whereas optimistic affiliations include local government officials and harbormasters (mean = 1.1), commercial fishing interests (mean = 1.0), and state government officials (mean = 0.9).

In summary, this section shows that some stakeholders actually prefer some aspects of the NRC's 1983 linear scientific approach compared with the 1996 analytic deliberative approach. State government officials, environmental interests, and scientists tend to favor the Master Plan Team process compared to the Stakeholder Working Group process for protecting major habitats and display mixed responses for supporting either process for avoiding unfair agency domination and for avoiding adverse fishing effects. The local government officials and harbormasters, commercial fishing interests, and recreational fishing interests are optimistic about the Stakeholder Working Group process compared to the Master Plan Team process for all three relative measures of optimism.

4. Path Diagram of Stakeholders' Belief System

To apply the ACF's conception of a belief system structure, we construct a path analysis using the structural equations program EQS. Path analysis is a causal modeling technique used to determine relationships among variables. The structure of the path analysis is based on the assumptions of the ACF with two deep core beliefs at the top as exogenous variables, the two policy core beliefs in the middle as intermediate explanatory variables, and the three relative measures of optimism at the bottom as dependent variables. The process-related optimism measure (optimism for avoiding unfair agency domination) is assumed to contribute to the two substantive outcome measures (optimism for avoiding adverse fishing effects and for protecting major habitats). We reduce measurement error by using three latent variables for the three scaled policy and deep core beliefs (Peffley & Hurwitz, 1985). The results (Figure 1) show a good fit to our model (Loehlin, 1998).[10]

Looking at the diagram, the numbers on the paths are standardized regression coefficients. At the very top of the diagram, there is a negative and significant ($p < 0.05$) relationship between pro-collaborative and pro-scientific management



All coefficients are standard regression coefficients. $p < 0.05$ = **, $p < 0.10$ = *.
Chi Sq = 48.32, p = 0.34, CFI = 0.99, RMSEA = 0.03, RMSEA 95% CI (0.00, 0.08)

Figure 1. An Application of the Advocacy Coalition Framework's Hierarchical Belief System.

beliefs. Between the deep core and policy core beliefs, the pro-scientific management scale positively explains most of the variance in the pro-MPA empirical scale ($R^2 = 0.85$).[11] In other words, faith in the general role of science in policy is associated with the validity of science regarding MPAs. On the other hand, pro-collaborative beliefs do not explain any variance in the pro-MPA empirical scale. Pro-collaborative beliefs and the pro-scientific management scale both explain a substantial amount of the variance in the pro-local knowledge scale ($R^2 = 0.38$).

The three relative measures of optimism for the Stakeholder Working Group Process compared to the Master Plan Team process are explained fairly well by the pro-local knowledge and pro-MPA empirical scales. The pro-local knowledge scale positively and directly explains some of the variance in optimism for avoiding

unfair agency domination (std. coef. = 0.26, $p < 0.10$) and for avoiding adverse fishing effects (std. coef. = 0.40, $p < 0.05$) but not for protecting major habitats. The pro-MPA empirical scale significantly and negatively explains some variation for optimism for protecting major habitats (std. coef. = –0.35, $p < 0.05$) and for optimism for avoiding adverse fishing effects (std. coef. = –0.17, $p < 0.10$) but not for optimism for avoiding unfair agency domination.

As assumed by the ACF, deep core beliefs partly explain policy core beliefs and policy core beliefs, in turn, explain secondary beliefs, which are represented in the path diagram as the three relative measures of optimism for the Stakeholder Working Group process compared to the Master Plan Team process. This is shown in the path diagram by standardized regression coefficients that are the *direct effects* between any two variables or scales. Because our hypotheses examine the capacity of deep core beliefs to indirectly influence secondary beliefs, we need to look specifically at the *indirect effects* of the two deep core beliefs on the three relative measures of optimism via the two policy core beliefs. The indirect effects can be calculated by summing the products of the direct paths from the deep core beliefs through the policy core beliefs to the secondary beliefs in Figure One.[12] The findings suggest that pro-scientific management *indirectly* influences optimism for avoiding unfair agency domination (indirect std. coef. = –0.22, $p < 0.05$), protecting major habitats (indirect std. coef. = –0.40, $p < 0.05$), and avoiding adverse fishing effects (indirect std. coef. = –0.32, $p < 0.05$). The pro-collaborative beliefs *indirectly* influence optimism for avoiding unfair agency domination (indirect std. coef. = 0.11, $p < 0.10$) and avoiding adverse fishing effects (indirect std. coef. = 0.19, $p < 0.05$), but not for protecting major habitats. There are no significant indirect effects from any of the policy core beliefs on the measures of optimism.

To summarize, the path analysis provides supporting evidence for the 1983 Belief Constraint Hypothesis because the pro-scientific management scale indirectly influences all three relative measures of optimism. We find supporting evidence for the 1996 NRC Belief Constraint Hypothesis for the indirect effects of pro-collaborative beliefs for avoiding adverse fishing effects and for avoiding unfair agency domination but not for protecting major habitats. However, this application of the ACF belief system must be interpreted with two important caveats. First, the model fit is also acceptable if we remove insignificant paths (e.g., from pro-collaborative beliefs to pro-MPA empirical beliefs)[13] or if we include direct paths from deep core beliefs to secondary beliefs (e.g., from pro-collaborative beliefs to optimism for protecting major habitats).[14] This implies that there may be more than one way to interpret and apply the ACF's belief system. Second, the model fit is acceptable if the arrows are reversed.[15] In other words, the direction of causality could go both ways, which prevents confirmation of the ACF's argument that deep core beliefs constrain secondary beliefs via intervening policy core beliefs.

Conclusions

The two attempts to implement the Marine Life Protection Act provide an excellent opportunity to analyze the extent that deep core beliefs affect stakeholder

preferences for two distinct environmental decision-making processes that parallel the NRC's 1983 linear scientific and NRC's 1996 analytic deliberative approaches.

In terms of our hypotheses, we can strongly reject the Robust NRC 1996 Hypothesis that everyone would prefer the analytic and deliberative approach independent of their deep core beliefs. Scientists, environmental interests, and state government officials actually prefer the NRC's 1983 approach compared to the 1996 approach in part because they believe it to be superior for protecting major habitats.

We find support for the 1983 NRC Belief Constraint Hypothesis by showing that pro-scientific management beliefs indirectly influences all measures of stakeholder optimism for the 1983 approach compared to the 1996 approach. We provide some corroborating evidence for the 1996 NRC Belief Constraint Hypothesis because pro-collaborative beliefs indirectly affect optimism for avoiding unfair agency domination and for avoiding adverse fishing effects for the 1996 approach compared with the 1983 approach, but there is no significant indirect effect for protecting major habitats.

Stakeholders with pro-scientific management beliefs probably prefer the NRC's 1983 approach because it is dictated by science, and they see collaborative institutions as a means of compromising a science-based decision in favor of a decision influenced by local stakeholders. As one environmentalist summarized: "I think there will be severe pressure to capitulate to the recreational and commercial fishing interests. If Fish and Game are able to follow the tenets of the Marine Life Protection Act then I will be happy. The law is clear. The law says let science decide."

The most surprising results are the views of scientists. Scientists are generally hostile to the 1996 approach compared to the 1983 approach for protecting major habitats and for avoiding adverse fishing effects. This is somewhat surprising given that the original Master Plan Team process created near riots in several communities and proved to be so politically unpalatable that the California Department of Fish and Game had to completely revise the process. Rather than becoming more collaborative, however, many scientists appear to have interpreted the public meetings as a frontal attack on the validity of science. The tendency for scientists to "circle the wagons" was probably strengthened when the Department of Fish and Game blamed the scientists for the failure of the Master Plan Team process.[16] There is also evidence that many scientists believe that they—not stakeholders—should be making policy decisions. One scientist stated it this way: "I am apprehensive that [the final recommendation] won't be effective in preserving and preventing exploitation. This is a highly political issue, and I don't want influential stakeholders making decisions."

Illustrating that policy activists have belief systems is certainly not original. Most researchers agree that policy activists and the general public have belief systems (Herron & Jenkins-Smith, 2002; Hurwitz & Peffley, 1987; Peffley & Hurwitz, 1985; Sabatier & Jenkins-Smith, 1988). This study, however, is original by applying the three-tiered belief system dictated by the ACF. Thus, this analysis shows how deep core beliefs, via intervening policy core beliefs, influence secondary beliefs. It suggests that disputes between opposing stakeholders over the effectiveness of

MPAs for protecting fisheries and habitat, which are policy core beliefs, may not be due to the inadequacy of the science but governed instead by broader deep core beliefs related to the proper role of science in decision-making. These deep core beliefs are akin to religious convictions and are very difficult to alter. This may help explain why communication among stakeholders regardless of the decision-making approach is so difficult. However, this interpretation is tentative at best since the direction of causality can go from secondary to deep core beliefs just as well as from deep core to secondary beliefs.

Our findings that deep core beliefs indirectly influence stakeholder preferences for a decision-making approach also reflect Schattschneider's (1960) assertion that "organization is the mobilization of bias." He suggests any institutional arrangement instills the biases of the designers. The two attempts to implement the Marine Life Protection Act and the polarized preferences of opposing stakeholder affiliations provide an excellent illustration of this principle. For stakeholders with pro-scientific management beliefs, the linear scientific approach is an institutional design that concurs with their beliefs by favoring scientific information over local preferences in a decision-making process. On the other hand, fishing interests and other local stakeholders who disagree with pro-scientific management beliefs are primarily concerned about their right to fish and their economic well-being. They are certainly not enthused about establishing MPAs. When faced with pending restrictions, however, collaborative institutions provide them with a voice and the potential opportunity to minimize the adverse economic effects and avoid agency domination. In sum, the results from this analysis support the assertion that institutional designs instill biases and that stakeholders prefer institutional arrangements that favor their fundamental concerns (Libecap, 1989; North, 1990; Ostrom, 1990).

More and more resources are being put into collaborative institutions in hopes of reducing conflict and improving decision-making. The 1983 linear scientific approach is viewed by the NRC (1996) as an outdated process that leads inevitably to increased litigation, conflict, and inadequate decisions. The agency touts collaborative institutions as an improved decision-making design largely because it incorporates the perspectives of locally affected stakeholders. As a result, the collaborative institutions have become a prominent decision-making tool among scholars and practitioners. The findings from this analysis suggest that not everyone buys into the rationale of collaborative institutions and that stakeholder preferences are partly a function of their fundamental beliefs. Since a majority of the evidence for collaborative institutions is made without comparison to other institutional designs, we suggest that the endorsement of collaborative processes be made cautiously until the processes and outcomes of collaborative institutions are compared directly to other decision-making approaches.

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Notes

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1. We conducted 47 semi-structured interviews that included federal agency officials (n = 3), state agency officials (n = 8), local government officials or harbormasters (n = 3), commercial fishing interests (n = 7), recreational fishing interests (n = 8), environmental groups (n = 8), scientists (n = 8), and two people who fall in the "other" category.

2. We conducted a nonresponse analysis using two techniques. First, we looked at the date when the questionnaires were returned. This approach assumed that those respondents who responded after two additional promptings (i.e., a postcard mailed 2 weeks after the first questionnaire and a second questionnaire mailed 2 weeks after the postcard) were more likely to represent nonrespondents. All questionnaires were returned within 16 weeks of the original questionnaire and 95% of them were returned within the first 10 weeks (for four returned questionnaires the return date was unknown). The Pearson correlation coefficient between the number of weeks to respond (1 to 16) and the belief variables used in this paper showed no statistically significant relationship and a One-Way ANOVA by stakeholder affiliation and the week of response showed no significant patterns.

   Second, we know the affiliation of 105 out of 310 people in our sample because they were assigned to represent a stakeholder interests in the working groups. Of the 105 Stakeholder Working Group members, 70 responded, which include 76% of the commercial fishing interests (n = 21), 71% of CPFV representatives (n = 7), 67% of the recreational fishing interests (n = 9), 67% of the consumptive diving interests (n = 9), 44% of the nonconsumptive diving interests (n = 9), 73% of the scientists/educators (n = 11), 71% of the environmentalists (n = 14), 63% of the local government officials and harbormasters (n = 8), 100% of the state government officials (n = 2), 80% of federal government officials (n = 5), 75% of the kelp harvesters (n = 4), 100% of party/touring boat operators (n = 1), 0% of the Tribal interests (n = 2), and 0% of the U.S. military representatives (n = 3).

   Based on the nonresponse analysis, we acknowledge that we are unable to generalize our sample to include Tribal and U.S. military interests; at the same time, we see no further evidence of response bias in our sample.

3. A total of 40 respondents of the mail-in questionnaire do not fall into these four categories and are excluded from this analysis. We excluded them because we are interested in a comparison between the Master Plan Team process and the Stakeholder Working Group process; hence, we selected only those respondents who demonstrated some direct involvement in either process. Including these 40 individuals does not significantly change the implication of the results.

4. These 65 people include four people who did not attend the public meetings but were alternate members to the Stakeholder Working Groups, 12 people who attended the public meeting and were alternates to the Stakeholder Working Groups, and 47 people who attended the public meetings but were not alternates to the Stakeholder Working Group process. Two respondents indicated that they were alternate members but did not indicate whether they attended a Master Plan Team public meeting. We make no claims about the generalizability of our results to those who attended the Master Plan Team public meetings but recognize that some respondents in our sample fall in that population.

5. The pro-scientific management scale is composed of four 7-point Likert scale questions with 1 = Strongly Disagree and 7 = Strongly Agree (alpha = 0.77): (1) Scientific methods provide the best technique for understanding the natural world (factor loading = 0.76); (2) Scientific experts often look for data, which supports their own personal values (factor loading = –0.87, reversed); and (3) Local preferences should ultimately prevail, even when they conflict with the judgment of scientific experts (factor loading = –0.85, reversed).

6. The pro-MPA empirical scale is composed of three 7-point Likert scale questions with 1 = Strongly Disagree and 7 = Strongly Agree (alpha = 0.90): (1) No-Take areas will increase fish populations in bordering areas (factor loading = 0.91); (2) Empirical studies based outside of California provide sufficient evidence that MPAs will benefit marine resources in California (factor loading = 0.92); and (3) MPAs will benefit damaged marine habitats (factor loading = 0.90).
   The pro-local knowledge scale is composed of two 7-point Likert scale questions with 1 = Strongly Disagree and 7 = Strongly Agree (alpha = 0.67): (1) Scientists and fishermen should work together in collecting data about MPAs (factor loading 0.80); and (2) Local experience and knowledge is a valuable source of information that should be used in locating MPAs (factor loading = 0.80).
7. We recognize that an alpha of 0.67 is somewhat lower than the conventionally accepted alpha of 0.70. We still consider 0.67 to be acceptable, particularly for only two variables. We investigated the effects of using each single variable compared to the Pro-Local Knowledge scale by rerunning our path analysis with each variable in the scale and found the results not discernibly different (the Pro-Local Knowledge scale did have a higher certainty as expected).
8. The measures for unfair agency domination are based on the following questions for the Master Plan Team process and for the Stakeholder Working Group process on a 7-point Likert scale with 1 = Strongly Disagree and 7 = Strongly Agree: (1) Government agencies had too much influence within the Master Plan Team process (reversed); and (2) Government agencies will have too much influence within the working group process (reversed).
   The secondary beliefs for protecting major habitats consist of one question for the Master Plan Team process and one for the Stakeholder Working Group process on a 7-point Likert scale with 1 = Strongly Disagree and 7 = Strongly Agree: (1) The Master Plan Team proposed MPAs that would protect major habitats; and (2) The working groups will propose MPAs that will protect major habitats.
   The evaluations of the Master Plan Team for Avoiding Adverse Fishing Effects consists of two 7-point Likert scale questions with 1 = Strongly Disagree and 7 = Strongly Agree (alpha = 0.91): (1) The Master Plan Team proposed MPAs that would close too many traditional fishing grounds (factor loading 0.96, reversed); and (2) The Master Plan Team proposed MPAs that were too large (factor loading 0.96, reversed).
   The expectations of the Stakeholder Working Groups for Avoiding Adverse Fisheries Effects consists of two 7-point Likert scale questions with 1 = Strongly Disagree and 7 = Strongly Agree (alpha = 0.87): (1) The working groups will propose MPAs that will close too many traditional fishing grounds (factor loading 0.94, reversed); and (2) The working groups will propose MPAs that are too large (factor loading 0.94, reversed).
9. The dependent variables are limited to one process-related variable and two substantive outcome variables. These criteria do not include measures of implementation and enforcement, which are major arguments for the NRC's 1996 approach over the NRC's 1983 approach (NRC, 1996). Nonetheless, the two substantive outcome variables in this analysis are useful and appropriate criteria. Protecting major habitats was specified as one of the primary goals of the Marine Life Protection Act, and avoiding adverse fishing effects is the concern of many of the stakeholders who live and make their living on the coast. Together these two outcome variables represent two important but distinct dimensions for evaluating the Marine Life Protection Act process.
10. The chi-square (p = 0.28) suggests we cannot reject the hypothesis that the model fits the data well. The Comparative Fit Index (CFI = 0.99) indicates that the model fits the data compared to a baseline model of uncorrelated variables. And the Root Mean Square Error of Approximation (RMSEA = 0.03, 95% CI = 0, 0.08) indicates that we can reject the hypothesis that the model fits the data poorly and we can assume a good fit.
11. It can be argued that these high correlations indicate that pro-scientific management and pro-empirical beliefs are measuring the same concept, particularly since the questions were located on a survey about MPAs. However, the questions were located in different parts of the survey (an MPA science part and a general attitudes part), and the wording of the deep core questions clearly do not specify MPAs and the wording of the policy core questions clearly apply to MPAs. This distinction is consistent with the theory of the ACF, which we seek to apply.
12. The indirect effect of a deep core belief on a secondary belief is the sum of the products of all the direct paths connecting the two belief measures. For example, the indirect effects from pro-scientific management to avoiding unfair agency domination is the sum of (0.93 * –0.14) + (–0.32 * 0.26) +

(–0.24 * 0.45 * 0.26) = 0.24. The indirect effect of a deep core belief on a secondary belief can be interpreted as the increase in the secondary belief while holding the deep core belief constant and increasing the policy core belief to the value the secondary belief would attain under a unit increase of the deep core belief (Pearl, 2001).

13. Pruning the insignificant paths between pro-collaborative beliefs and pro-MPA empirical beliefs, between pro-MPA empirical beliefs and avoiding unfair agency domination, between the pro-local knowledge beliefs and protecting major habitats, and between avoiding unfair agency domination and protecting major habitats gives a RMSEA of 0.03, 95% CI between 0 and 0.08, chi-square p-value of 0.34, and CFI of 0.99. The R^2 for avoiding adverse fishing effects rises to 0.37, for avoiding unfair agency domination rises to 0.16, and for optimism for protecting major habitats drops slightly to 0.20. The relative direct and indirect effects of each of the upstream variables remain approximately the same.
14. Adding direct links from the deep core beliefs to the three measures of optimism gives a chi-square p-value of 0.26, CFI of 0.99 and the RMSEA value of 0.04 with a 95% CI between 0 and 0.09. The model has a R^2 for avoiding adverse fishing effects of 0.28, for avoiding unfair agency domination of 0.13, and for optimism for protecting major habitats of 0.30. The relative direct and indirect effects of each of the upstream variables remain approximately the same.
15. Reversing the arrows on Figure One gives a chi square p-value of 0.66, CFI = 1.00, and a RMSEA of 0.0 with a 95% CI of 0.0 and 0.6. This result is not too surprising because with cross-sectional data there are bound to be reciprocal relationships. We could analyze the reciprocal relationships among these variables with two-stage least squares if we had a good instrumental variable or if we had panel data (Finkel & Muller, 1998).
16. This was mentioned by a broad array of stakeholders in the interviews.

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