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FELLOWSHIPS
in
PUBLIC POLICY

Increasing the Social Power of Scientific Information used for Decisions on Marine Protected Areas in New Zealand

Prepared by
David N. Wiley

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Ian Axford (New Zealand) Fellowships in Public Policy

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Established by the
New Zealand government in 1995
to facilitate public policy dialogue
between New Zealand and
the United States of America

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Ian Axford (New Zealand) Fellowships in Public Policy

Established by the New Zealand Government in 1995 to reinforce links between New Zealand and the US, Ian Axford (New Zealand) Fellowships in Public Policy provide the opportunity for outstanding mid-career professionals from the United States of America to gain firsthand knowledge of public policy in New Zealand, including economic, social and political reforms and management of the government sector.

The Ian Axford (New Zealand) Fellowships in Public Policy were named in honour of Sir Ian Axford, an eminent New Zealand astrophysicist and space scientist who was patron of the fellowship programme until his death in March 2010.

Educated in New Zealand and England, Sir Ian held Professorships at Cornell University and the University of California, and was Vice-Chancellor of Victoria University of Wellington for three years. For many years, Sir Ian was director of the Max Planck Institute for Aeronomy in Germany, where he was involved in the planning of several space missions, including those of the Voyager planetary explorers, the Giotto space probe and the Ulysses galaxy explorer.

Sir Ian was recognised as one of the great thinkers and communicators in the world of space science, and was a highly respected and influential administrator. A recipient of numerous science awards, he was knighted and named New Zealander of the Year in 1995.

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- To build a network of policy experts on both sides of the Pacific that will facilitate international policy exchange and collaboration beyond the fellowship experience.

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David N. Wiley
Wellington, August 2011

EXECUTIVE SUMMARY

Environmental problem-solving in the 21st century has moved away from the techno-rational approach that dominated past decision-making and management. Modern decision-making is increasingly viewed as deliberative and participatory, characterised by multi-stakeholder processes such as those convened to inform decisions in New Zealand's marine protected areas. Information provided to stakeholders for decision-making contains both social and technical components. Traditionally scientists have focused on the technical aspects of problem-solving and counted on confidence in the scientific process to eliminate social concerns, such as research bias or the vested interests of scientists affecting their results or the communication of their findings. However, this study demonstrates that social aspects of research are a high-order concern and invariably used by stakeholders to invalidate information that is counter to their preconceptions or desires. Therefore, research that ignores social concerns has substantially reduced impact on problem-solving and decision-making. In this study, the ability of information to influence stakeholder decisions is termed "social power", with increased social power associated with increased positive influence.

Results from stakeholder interviews (n=30) and analysis indicate that one way scientists can reduce the social concerns that invalidate their findings is to increase the inclusive aspect of their research. Stakeholder involvement in research can take many forms and I provide a "Ladder of Scientific Participation" that can help identify ways that scientists might interact with stakeholders, and the potential outcome and results of each. Rungs 1 – 3 of the ladder are "first-order" methods, which are typical of traditional forms of stakeholder participation. Traditionally stakeholder participation in science has been relegated to reading scientific information or listening to scientific information summarised by managers. First-order participation has low social power because the numerous barriers to accepting information identified in this study are ignored. The outcome of first-order participation is that stakeholders selectively accept information that bolsters their position and reject information that could undermine it. Therefore, such levels of participation lead to stakeholders becoming increasingly entrenched in their positions instead of using information to promote problem-solving and consensus decisions.

Rungs 4 – 6 of the ladder consist of "second-order" methods, demonstrating increased participation. Second-order techniques would consist of scientists presenting their research design to stakeholders prior to initiating an investigation, providing stakeholders with updates on research as it is being conducted and providing stakeholders with the opportunity to visit and observe the research as it is being conducted. The outcome of second-order participation is that scientists and stakeholders are educated about the research and the conditions under which it will occur. This would include the ability of stakeholders to identify unexpected deficiencies and concerns that could invalidate the research's final results and the ability of scientist(s) to mitigate such concerns by adapting design changes while it is still possible to do so. Therefore second-order methods add substantial social power to research by increasing stakeholder confidence that their concerns are being understood and addressed.

Rungs 7 – 9 of the ladder are "third-order" methods, incorporating maximum levels of participation. Rung 7 involves stakeholders participating in the selection of scientists conducting the research, allowing the research to be conducted by scientists with whom opposing interests have confidence (i.e., Research by Champion). Increased participation (rung 8) would involve stakeholders contributing to the selection of the scientists conducting the research and the research design that they would use. This could involve stakeholder participation in the review and selection of grant proposals or reviewers placing a positive emphasis on proposals that demonstrated stakeholder involvement. The outcome of these types of participation is the collaboration of scientists with a diversity of views, a robust problem definition and research design and increased social power of the results.

The top rung of the ladder (rung 9) would have stakeholders or stakeholder scientists directly participating in the research (i.e., Team of Rivals). This would assure that the greatest diversity of interests and perspectives were included in the research and that the concerns of all were being addressed. As such, it would provide maximum social power to the results. However, such large collaborations could become expensive, logistically difficult and paralysed by infighting.

In summary, the traditional perception that scientific research is viewed as providing credible and unbiased information because research is conducted in isolation from those most impacted by its results (i.e., stakeholders) is invalidated by this study. Such research contributes to stakeholder entrenchment by allowing stakeholders to construct myriad reasons to reject it, rather than contributing to problem-solving by providing agreed upon information for decisions. Research that is inclusive, balanced by a diversity of interest and demonstrates a full set of problem definitions and potential solutions, as identified by those impacted by them, is identified as providing results that are seen as more credible and more likely to be accepted by stakeholders for consensus decisions. Attention to such aspects of research will increase the social power of results and help scientists achieve the scientific ideal of producing information that is judged unbiased and defensible. Ultimately, increasing the social power of scientific research will increase its efficacy as a cost effective problem-solving tool, thereby increasing its ability to conserve biodiversity and protect the resources and economies on which we depend.

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INTRODUCTION

The establishment of marine protected areas (MPAs) is emerging as an important tool for managing and conserving the marine environment[1]. MPAs are often in the vanguard of formulating marine policy initiatives because of their acknowledged ecological significance and elevated political and social status. As a result, they are also often at the centre of contentious debates caused by high stakes, disputed values and scientific uncertainty characterised by knowledge conflicts over the validity of information used for decisions[2]. While stakes and values are traditionally viewed as social aspects of environmental problems, knowledge conflicts are considered within the realm of traditional science, and scientists are often called upon to provide the information needed to resolve them. However, resolving knowledge conflicts involving the marine environment is a complex and highly challenging task, hampered by issues of difficult operating environments, constraints arising from the high cost of data collection or the rare nature of the species or phenomenon being observed. In addition to technological challenges to problem-solving, the stochastic, nonlinear nature of the marine environment also conspires against the ability of scientists to deliver clear, incontestable information to decision-makers[3].

Another difficulty facing marine scientists seeking to provide information to solve ocean problems is that the decision-making paradigm in which they operate has changed. Decision-making in the 20th century, and the concept under which many scientists were trained, was driven by the "techno-rational" or "technocratic" approach. This paradigm is characterised by a system where technically trained professionals (usually in government) make decisions for the public by virtue of specialised knowledge which is provided by scientists[4]. The 21st century has seen a change from decisions made by "professionals" to more collaborative forms of decision-making[5]. As stated by Koontz and Thomas, "If the 20th century was the era of the administrative state, then the 21st century may be the era of the collaborative state."[6]

The evolution of this shift from technocratic to participatory problem-solving can be seen in the approaches to integrating science and policy championed by the US National Research Council (NRC). In 1983, the NRC published *Risk Assessment in the Federal Government: Managing the Process*[7]. This book supported a positivist, technocratic approach where expert scientists developed products in isolation and delivered them to affected stakeholders, who were then allowed to comment on and accept them. This top down or 'command and control' style of management became the norm used by multiple government agencies[8]. In 1996, the NRC published, *Understanding Risk: Informing Decisions in a Democratic Society*. This publication reversed the techno-rational approach to problem-solving, identifying it as unsuccessful because it was limited by scientific uncertainty and a lack of stakeholder

[1] National Research Council (2001)
[2] Funtowicz and Ravetz. (1991)
[3] Mangel *et al.* (1996)
[4] Fischer (1990)
[5] Daniels and Walker (2001)
[6] Koontz and Thomas (2006), p. 111.
[7] National Research Council (1983)
[8] National Research Council (1996)

input. Instead, NRC (1996) advocated a more inclusive, deliberative approach to problem-solving with stakeholder involvement at its core.[9] As a result, the use of multi-stakeholder, deliberative working groups to evaluate the acceptability of information in a problem-solving context has become an increasingly popular method of dealing with environmental controversies[10].

The use of stakeholder input and the deliberative approach to problem-solving is particularly true of decision-making in MPAs, which has come of age in the 21st century. For example, incorporating stakeholders into MPA decisions has been identified as an important strategy by numerous authors[11,12] and is embraced by the New Zealand Department of Conservation[13] and United States Office of National Marine Sanctuaries[14]. This change in paradigms has important implications for 21st century scientists, particularly those working in MPAs. Under the techno-rational paradigm, the audience for scientific work was primarily other scientists who reviewed the work and determined its validity. However, under collaborative decision-making regimes, the audience for scientific work is not the scientific community, but stakeholders who constitute a new form of peer review[15].

The goal of such participatory, deliberative groups is to solve problems by consensus, thereby reducing conflict and increasing support for management actions[16]. Consensus decisions are best achieved if all stakeholders agree on the validity of the information used for decisions[17], and, in theory, the multi-stakeholder process is designed to create the trust and mutual understanding needed for such agreement. However, the degree to which stakeholders actually accept information for decisions and their reasons for doing or not doing so, has rarely been examined. In this project I first investigated how stakeholders involved with New Zealand's MPA forums accepted the validity of anecdotal information as a basis for reaching consensus decisions. I then investigated stakeholder's acceptance of scientific information and how different research paradigms or methods might influence the degree to which scientific information is accepted by them as valid. Finally, I used the insights gained from these results to make recommendations on how scientists could conduct research in ways that can increase the "social power" of their results (i.e., the research's ability to be judged credible by stakeholders and become convincing in the policy process). The ultimate goal of the project is to provide agencies and scientists with insights that can be used to increase the efficacy of scientific research as a problem-solving tool, thereby increasing its ability to conserve biodiversity and protect the resources and economies on which we depend.

[9] National Research Council (1996)
[10] Wondolleck and Yaffee (2000)
[11] Lundquist and Granek (2005)
[12] Jones *et al.* (2011)
[13] www.biodiversity/govt.nz
[14] http://sanctuaries.noaa.gov/management/ac/welcome.html
[15] Funtowicz and Ravetz. (1991)
[16] Kessler (2004)
[17] Wondolleck and Yaffee (2000)

1. METHODS

In Part I of the project, I investigate how New Zealand MPA stakeholder participants view information provided to them from other members of the decision-making team, some of whom are scientists. This information was classified as anecdotal and allowed me to understand the conditions under which information exchange occurred and how anecdotal information was accepted or rejected for decision-making. In Part II of the project, I focus specifically on how participants viewed information derived from scientific research and examine how research team composition might or might not influence its perceived validity. To accomplish these evaluations, I used a qualitative, semi-structured interview technique where participants scored a series of questions on a prepared worksheet (see Figure 1, Appendix I). Concurrent to their scoring, their verbal rationales explaining the scoring was recorded for transcription (see below). A qualitative approach was used because qualitative studies are particularly useful when an investigation is focused on a process with the goal of describing how the process worked or failed to work, while quantitative approaches are best suited for hypothesis testing[18].

Categorisation of information

Information used for decisions was categorised as anecdotal or scientific. Anecdotal information was defined as information based on beliefs, local knowledge or second-hand information and was described as that verbally provided by stakeholders to each other during "around the table" discussions such as those typically occurring during the multi-stakeholder deliberative process. Scientific information was defined as that achieved through the scientific process and described to the interviewees as that provided to the group in a PowerPoint-type presentation by the scientist(s) who conducted the research.

Information source

Information Source was defined as the stakeholder group from which the information was delivered. In Part I, information source categories were: Aquaculture, Commercial Fishing, Conservation, Government Scientists, Management (government), Minerals & Energy, Non-government Scientists, Recreation, Tangata Whenua and Tourism. These sources were chosen because they represent the groups typically involved in New Zealand's marine protected area decisions.

In Part II, information sources were identified as the scientists who conducted the research. Information source categories were: Commercial Fishing, Minerals & Energy, Conservation, Management, Tangata Whenua, Government and Non-government (i.e., universities, consultants or Crown research institutes). These sources were chosen because they represent the groups that do or could conduct research relative to New Zealand's marine protected area decisions.

Acceptance level

The Acceptance Level (or perceived validity) of the information provided to

[18] Weiss (1995)

stakeholders was determined during one-on-one interviews and measured on a scale of 1 – 100; with one being a total rejection of the information and 100 being total acceptance. Total acceptance was defined as the information being capable of changing the interviewee's mind on a contentious issue. A score of 50 was identified to the interviewees as the "tipping point" of acceptance (i.e., doubt was creeping in concerning their previous understanding or belief). Participants supplied acceptance levels by placing a mark on the questionnaire signifying where on the 1-100 scale they would rate information origination from that source.

Stakeholder identification and categorisation

Interviewed stakeholders were participants in one of four different forums that were convened to identify the location of MPAs along the New Zealand coast. MPAs are contentious because once they are created, all fishing (commercial, indigenous and recreation) is banned from the area in perpetuity. Stakeholder interest groups were identified as: Commercial Fishing, Conservation, Management, Recreation/Tourism, Science, and Tangata Whenua, since these were the dominant groups taking part in the processes to create the MPAs. Interviewees were put into a stakeholder interest group based on their appointment to the decision-making group, which was usually a result of their dominant occupation (e.g., a commercial fisherman was placed in the Commercial Fishing stakeholder group, an employee of a conservation organisation was placed in the Conservation stakeholder group, a scientist was placed in the Science stakeholder group, etc.). Interviewees were promised anonymity to encourage honest responses to the questions. Therefore, their names and the MPA processes in which they were involved are not provided. As an additional aid to maintaining the anonymity of participants any genders associated with interviewee statements might or might not be correct. When referenced in the text, interviewees are identified by abbreviations for their stakeholder group and interview number. For example, a statement attributed to Recreation stakeholder number four would be referenced as RS4 and a statement attributed to Tangata Whenua stakeholder number three would be referenced as TWS3.

Fact checking

Statements and assertions are reported as they were made by interviewees. No attempt was made to "fact check" or correct any information provided during interviews.

Interview; anecdotal information

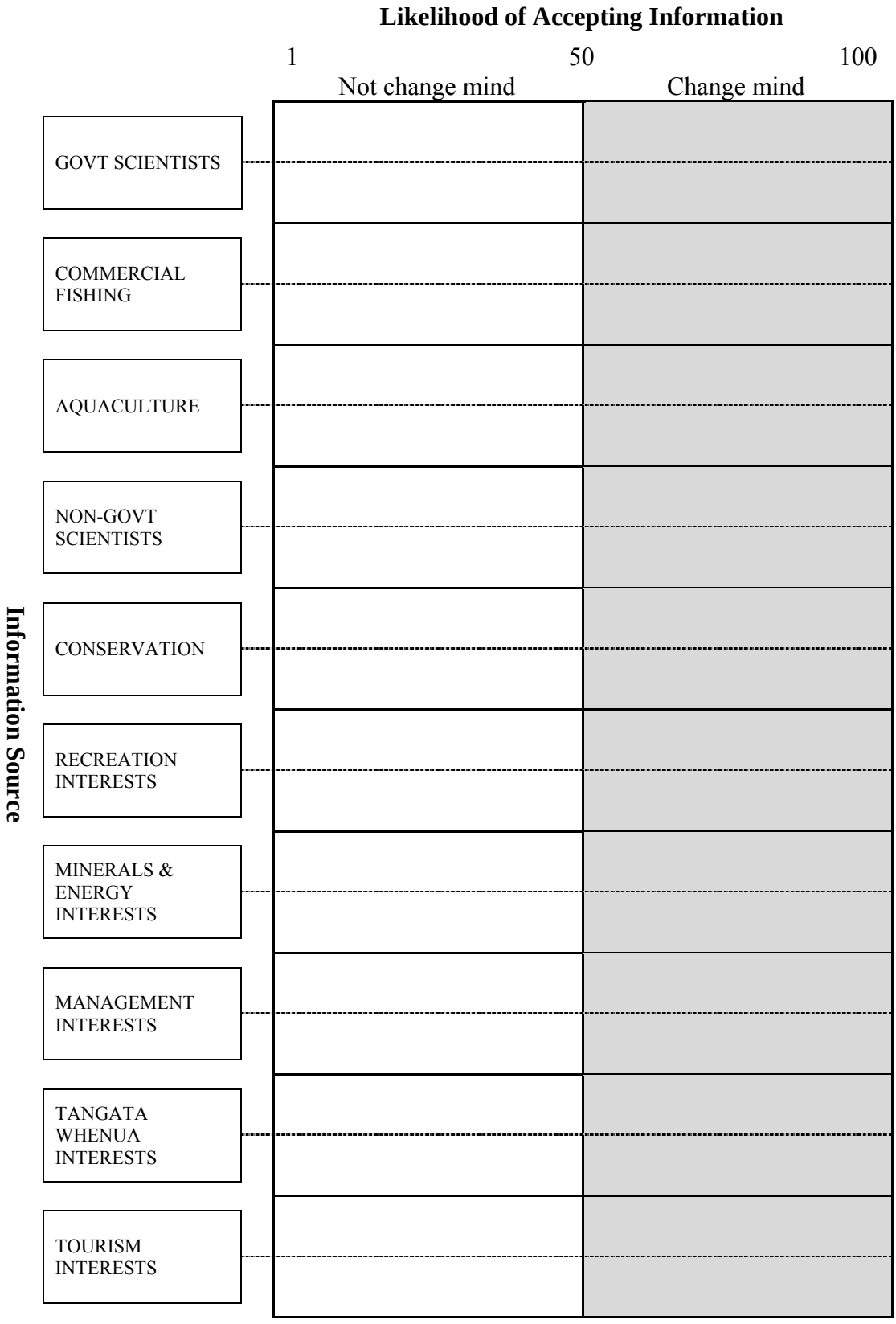
To understand how participants valued anecdotal information originating from various sources, the following scenario was read and explained to each interviewee:

> You are at a meeting to decide a contentious MPA issue. Many people are talking, each of whom you are able to place into one of the column groupings. Using 100 as your total acceptance of the information provided, 1 as your total rejection of the information provided and 50 as the tipping point where you might start to believe the information sufficient to change a previously held position (doubt creeping in?), place a mark in the box above each source grouping that depicts your level of acceptance of the information. Explain your reason(s) for the rating you provided.

The Information Source categories were: Government Scientists, Commercial Fishing Interests, Aquaculture Interests, Non-government Scientists (e.g., academic or Crown research institutes), Conservation Interests, Recreation Interests, Minerals & Energy Interests, Management Interests, Tangata Whenua Interests and Tourism Interests. These categories were developed in conjunction with the Department of Conservation's Marine Conservation Team, one of the government agencies that convene forums for locating MPAs. The location of information source categories along the questionnaire's x-axis was randomised.

Scores were placed on a worksheet (Figure 1) and verbal rationales for those scores recorded on an iPad running Hindenburg Field Recorder software. The vertical scoring line in the box above each source was 100mm in length and measured to calculate the score for that source. Verbal recordings were transcribed by a commercial transcription service and coded for themes.

Figure 1. Worksheet used during stakeholder interviews relating to the acceptance of anecdotal information relative to the information's source. The actual worksheet also had tick marks at 10 unit intervals.



Interview; scientific information

To understand how participants valued scientific information originating from various research sources and groupings, each interviewee was provided the following scenario:

> You are at a meeting to decide a contentious MPA issue. Scientists are presenting research that has been done, which differs by who participated in the research. Using 100 as your total acceptance of the results, 1 as your total rejection of the results and 50 as the tipping point where you might start to believe the results sufficient to change a previously held position (doubt creeping in?), place a mark on the line in the box above each research grouping that depicts your level of acceptance of the results. Explain your reason(s) for the rating you provided.

Single-source research

Single-source research groupings were used to represent the traditional scientific condition where research is conducted in isolation from other interests. Single-source research categories were: Minerals & Energy, Conservation, You, Commercial Fishing, Tangata Whenua, Government and Non-Government (e.g., university or Crown research institute). The location of research categories along the questionnaire's x-axis was randomised.

Scores were placed on a worksheet (worksheet #2, Appendix I) and verbal rationales for those scores recorded on an iPad running Hindenburg Field Recorder software. The vertical scoring line in the box above each source was 100mm in length and measured to calculate the score for that source. Verbal recording were transcribed by a commercial transcription service and coded for themes.

Paired-source research

To understand how increased participation might influence the acceptance of scientific information, single-source research categories were paired for collaboration and randomised along the questionnaire's x-axis. Scores were placed on a worksheet (worksheet #3, Appendix I) and verbal rationales for those scores recorded on an iPad running Hindenburg Field Recorder software. The vertical scoring line in the box above each source was 100mm in length and measured to calculate the score for that source. Verbal recordings were transcribed by a commercial transcription service and coded for themes.

Multi-source research

To understand how increasingly inclusive or participatory research might influence the acceptance of scientific information, single-group research categories were additionally combined into groups containing three, four and ultimately five interest groups. The location of these groups along the questionnaire's x-axis was randomised within their respective size class.

Scores were placed on worksheet #4 (worksheet #4, Appendix I) and verbal rationales for those scores recorded on an iPad running Hindenburg Field Recorder software.

The vertical scoring line in the box above each source was 100mm in length and measured to calculate the score for that source. Verbal recordings were transcribed by a commercial transcription service and coded for themes.

Published versus non-published scientific literature

In addition to research that is directly presented to them by scientists during the deliberative process, stakeholders are also provided with research that has been published in scientific journals or research reports that have been produced by scientists but not published in scientific journals. To understand the influence of this information and its strength relative to single-, paired- and multi-source research, stakeholders, a scoring category for each was included in the multi-source worksheet (worksheet #4, Appendix I).

Analysis

Data were analysed by calculating "Acceptance Values" (AVs) from the worksheet scorings and by using the audio transcripts to provide an in-depth understanding of the factors contributing to the AVs provided by the participants. Acceptance Values were developed for all stakeholder groups combined (Overall Acceptance Values – OAVs) and for each individual stakeholder group (Group Acceptance Values – GAVs). Overall Acceptance Values and Group Acceptance Values were not used for statistical analysis. Rather, they were used to provide visual summaries of, and guides to, the explanations provided by participants during the interviews. In this way, they provided structure to the qualitative analysis that allowed comparisons to be more clearly made.

Overall Acceptance Values

Overall Acceptance Values were used to gain insights into how the MPA group, as a whole, viewed information that originated from the different anecdotal or research group sources. To develop OAVs, I averaged the AVs from the entire participant pool for each anecdotal or research source category. For example, each participant provided an AV for information originating from the Commercial Fishing stakeholder source. When averaged among all participants, this AV was used to evaluate the Commercial Fishing source relative to its ability to be persuasive (1 – 100 score) and rank Commercial Fishing source information relative to that provided from other stakeholder groups.

Group Acceptance Values

Group Acceptance Values were used to gain insights into how individual stakeholder groups viewed information originating from the different sources. To develop GAVs I averaged the AVs provided by a specific stakeholder group for each of the other stakeholder group sources. For example, I calculated the mean AV provided by the Commercial Fishing stakeholder group for each of the other interest group sources. In this way I scored how persuasive to Commercial Fishing stakeholders was information coming from other groups (1-100), identified which sources might be capable of swaying commercial fishing stakeholders (i.e. >50) and ranked groups relative to their influence to Commercial Fishing stakeholders.

2. RESULTS

I conducted in-depth interviews with 30 stakeholders[19] (five each from the six stakeholder groups) that are typically involved in New Zealand's marine reserve conflicts and deliberations. These 30 people represented four different MPA processes. A typical interview lasted ~1 hour. In total, there were 32.6 hours of recorded interviews and 890 pages of transcribed and coded interview text.

Part 1: Anecdotal Information

Multi-stakeholder deliberative groups are often convened to share information designed to promote a common understanding of an area being considered for management or being managed. This information is often anecdotal, arising from the personal experiences and observations of the stakeholders. For this information to be useful in reaching consensus decisions, its credibility or Acceptance Value (AV) must be sufficient to result in stakeholders changing, or casting considerable doubt on, the preconceived beliefs or positions with which they began the deliberative process. Overall Acceptance Values were used to examine how persuasive was information to the deliberative group as a whole, while Group Acceptance Values were used to examine how persuasive was information to a particular stakeholder group. An AV of 1 was identified as having no influence in terms of creating doubt or mind change, an AV of 50 was identified as the "tipping point" of mind change where doubt concerning preconceptions or beliefs was beginning to creep in and an AV of 100 was identified as the point at which the information was capable of creating a total mind change or "flipping" a preconception or belief.

Overall Acceptance Values

Overall Acceptance Values (OAVs) were highest for anecdotal information provided by the Government Scientist (OAV=65.5) and Non-government Scientist (OAV=65.4) categories and lowest for the Aquaculture (OAV = 45.9) and Minerals & Energy (OAV = 47.9) categories (Table 1). All other categories had OAVs ranging between 50 and 57.

Group Acceptance Values

Group Acceptance Values (GAVs) provided insight into how specific stakeholder groups responded to anecdotal information provided by other stakeholders (Table 2). GAVs were analysed to show (1) the degree to which specific stakeholder groups were influential to other stakeholders (2) the degree to which specific stakeholder groups were influenced by other stakeholder groups and (3) the acceptance of local knowledge.

[19] An additional interview was conducted. However, that person (CFS6) was unable to complete the scoring sheets. None of the scores from that person were used to calculate OAVs or GAVs. However, I did use comments from the person during the qualitative analysis of transcripts.

Table 1. Overall Acceptance Values (OAVs) describing the influence to stakeholders of anecdotal information. Stakeholders represented commercial fishing, conservation, management, recreation, science and tangata whenua interests. A value of 1 represents total disregard of the information articulated, 100 represents total acceptance of the information (mind change) and 50 represents the tipping point where a stakeholder might experience doubt concerning a preconception or belief. The highest OAV has been bolded and the lowest OAV has been bolded and underscored.

	Source of Anecdotal Information									
	Govt Scientists	Comm. Fishing	Aquaculture	Non-Govt Scientists	Conservation	Recreation	Min. & Energy	Management	Tang. Whenua	Tourism
OAV	**65.5**	56.7	**45.9**	65.4	54.3	49.7	47.9	54.7	54.2	55.8

Table 2. Cross-case comparison of Group Acceptance Values (GAVs) describing the influence of anecdotal information on stakeholder groups. Information sources are those typical in New Zealand's marine protected area process. A value of 1 represents total disregard of the information articulated, 100 represents total acceptance of the information (mind change) and 50 represents the tipping point where a stakeholder might experience doubt concerning a preconception or belief. The highest Acceptance Value (AV) for each stakeholder group (row) has been bolded and the lowest AV for each stakeholder group has been bolded and underlined. The highest AV for each information source (column) has been denoted with † symbol and the lowest AV for each information source has been denoted with a * symbol.

		Source of Information									
		Govt Scientists	Comm. Fishing	Aquaculture	Non-Govt Scientists	Conservation	Recreation	Min. & Energy	Management	Tang. Whenua	Tourism
Stakeholder Group	Commercial Fishing	50.8	**84.4**†	55.8	51*	**20.2***	44*	60.8	51	38.4*	43.6*
	Conservation	69.2	38*	**20.25***	**72.2**	62.8†	45.8	30.6	56.8	60.8	63
	Management	**83**†	***56.6***	60.4†	72.8	61.6	49.8	63.6†	79†	71.2†	65.2†
	Recreation	**67**	46	55.6	66.4	60.6	58.8†	46.6	**40.8***	42.4	56.8
	Science	**76.4**	44	35	74.8†	58.6	48.2	**30.2***	46	59.8	58
	Tangata Whenua	**46.4***	**71.4**	58.2	55.4	61.8	51.6	55.8	54.4	52.8	54.2

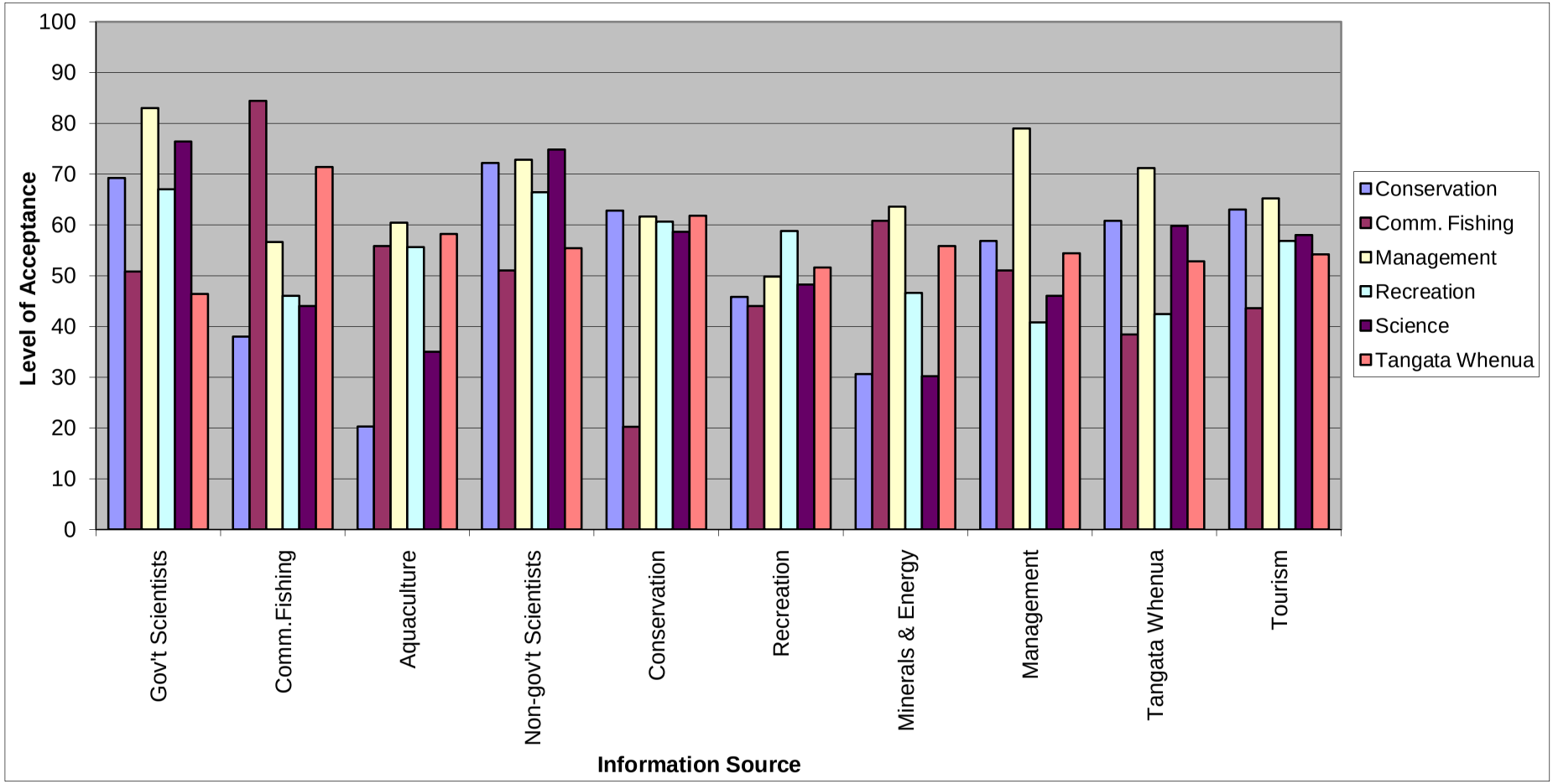


Figure 2. Group acceptance values (GAVs) of stakeholders for anecdotal information provided by other stakeholders during multi-stakeholder deliberations involving New Zealand's marine protected area process. A value of 1 represents total disregard of the information articulated, 100 represents total acceptance of the information (mind change) and 50 represents the tipping point where a stakeholder might experience doubt concerning a preconception or belief.

The degree to which specific stakeholder groups were influential to other stakeholders

When a stakeholder group provided information, there was a tendency for the highest GAV to come from that same stakeholder group (Figure 2, Table 2). Commercial Fishing (Commercial Fishing; 84.4), Conservation (Conservation; 62.8), Management (Management; 79), Recreation (Recreation; 58.8) and Non-government Science (Science; 74.8) stakeholders all provided their own group's highest AVs. The exceptions to this were Tangata Whenua stakeholder information to which Management stakeholders provided the highest GAV (71.2) and Government Science stakeholder information to which Management also provided the highest GAV (83). Management also provided the highest GAVs for information from Aquaculture (60.4) and Minerals & Energy (63.6), but this was complicated by the fact that neither Aquaculture nor Minerals and Energy stakeholders were part of the interview process and, unlike the other groups, could not weigh in on and possibly increase the scored value of the information they provided. Thus, groups were most influential to themselves or to Management.

There was also a tendency for stakeholders to be influential to groups that had backgrounds similar to their own rather than being influential to dissimilar groups. For example, the second highest GAV for Commercial Fishing information was from Tangata Whenua (71.4) many of whom had a fishing background or, like fishers, had a history of daily resource contact. The lowest GAV for Commercial Fishing information came from Science (44) and Conservation (38), groups with less direct resource contact and more formal science education. Similarly, the highest GAVs for information originating from Science stakeholders came from other groups with more formal science education and less daily resource contact: Management; 77.9 (Government and Non-government Scientists combined), Non-government Science; 75.6 (Government and Non-government Scientists combined) and Conservation; 70.7(Government and Non-government Scientists combined). The lowest GAVs for information from Science stakeholders came from groups with typically less formal science education and more direct resource contact: Commercial Fishing; 50.9 (Government and Non-government Scientists combined) and Tangata Whenua; 50.9 (Government and Non-government Scientists combined).

The degree to which specific stakeholder groups were influenced by other stakeholders

In general, there as a tendency for non-extractive stakeholders to be influenced by information originating from non-extractive sources and for extractive stakeholders to be influenced by information originating from extractive sources (Figure 2, Table 2). For example, non-extractive Conservation, Management and Science stakeholders provided their highest GAV to anecdotal information originating from Science stakeholders (Government Scientist; 69.2, 83 and 76.6 respectively and Non-government Scientist; 72.2, 72.8, and 74.8 respectively). However, this affinity for Science stakeholder assertion was not shared by the more extractive Commercial Fishing or Tangata Whenua stakeholders (50.8 and 46.4, respectively) who placed greater weight on assertions made by Commercial Fishing stakeholders (84.4 and 71.4, respectively). Similarly, Conservation and Science stakeholders provided their lowest affinity for information from extractive sources. Conservation stakeholders

GAVs for Aquaculture, Commercial Fishing and Minerals and Energy were 20.3, 30.6 and 38, respectively, while Science stakeholders GAVs for the same groups were 35, 44 and 30.2, respectively.

This trend was supported by the GAV from Recreational stakeholders, whose score typically fell between those provided by non-extractors and larger-scale extractors. As small-scale extractors dominated by recreational fishers, Recreational stakeholders provided Science assertions with their highest GAVs (Government Scientists; 67 and Non-government Scientists; 66.4), but those GAVs were less than GAVs provided by non-extractive Conservation, Management and Science stakeholders (see above). Their affinity for information from larger-scale extractors was relatively low (Aquaculture; 55.5, Commercial Fishing; 46, Minerals and Energy; 46.6), but higher than those provided by non-extractive stakeholders (see above).

The case of local knowledge

The value of local or traditional ecological knowledge for decision-making is often debated, with those working in close daily resource contact (e.g., commercial fishers) promoting its worth and those with less direct contact (e.g., scientists and conservation interests) being less supportive. However, GAVs indicated that the acceptance of local knowledge is more complex and also depends who is providing it. For example, both Commercial Fishing and Tangata Whenua stakeholders provide local knowledge, but Commercial Fishing stakeholders provided little value to information originating from Tangata Whenua sources (38.4), while providing very high value to information from Commercial Fishing sources (84.4). Similarly, if local versus scientific knowledge were the main concern for Science and Conservation stakeholders they should be equally sceptical of information originating from Commercial Fishing and Tangata Whenua sources. However, Conservation stakeholders provided local knowledge from Tangata Whenua with a GAV substantially higher than that from Commercial Fishing (60.8 and 38, respectively). Scientists also provided a higher value to Tangata Whenua source information than Commercial Fishing source information (59.8 and 44, respectively).

Qualitative Explanation of Overall and Group Acceptance Values

The primary themes explaining barriers to acceptance of anecdotal information shared among stakeholders were trust issues focused on (1) vested interests, (2) the selective providing of information to support desires rather than promote problem-solving, and (3) mismatches between personal experience and the information provided.

Vested Interests

Nearly all participants identified the vested or self-interest of other stakeholders as an obstacle to accepting the anecdotal information provided by them. However, few participants identified vested or self-interest barriers to information originating from their own group or downplayed its impact. For example MS5 stated, “There’s always the danger that there’s…something at stake for that group...that might be influencing what they’re saying”. However, he downplayed that aspect for Management because, “They [management] don’t have any commercial interest in the issue or the area…they may have a personal interest in the area, but that should be tempered by

the mandate they have to work under." Similarly, CFS3 said, "The thing with virtually all of these groups is that they have their own agenda". But CFS3 portrayed Commercial Fishing stakeholders as honest purveyors of information because, "It's not in their interest these days to falsify information. Sooner or later it gets found out and your credibility goes out the window." CFS3 portrayed Management as a highly vested political interest desiring a predetermined outcome to the MPA process. "You get a bureaucrat [manager] coming in and saying – not explicitly, particularly not in public, but behind the scenes – saying, 'We're going to have this [marine protected area], but we've got to be seen to go through a public process'… And we were able to actually prove that through official documents." Similarly, RS5 thought Management stakeholders were too politically vested to be reliable, saying, "They would not change my mind because they're too entrenched in the politics." CFS4 agreed, saying, "The ones who managed this whole area? Well, once again, they said they were unbiased, but I believe they were as biased as bias, you know?"

Self-interest was described in economic, career or philosophical terms. Aquaculture, Commercial Fishing, Minerals and Energy, Recreation, Tangata Whenua and Tourism were all seen as having a clear economic stake in any decision and, with the exception of Tourism and in some cases Tangata Whenua, having the most to potentially lose from MPA implementation. However, Conservation, Management and Science stakeholders were seen as no less vested. Conservation stakeholders were seen as having a large economic stake arising from their need to solicit funds from the public. As described by MS3,

> If you're reliant on donations or bequests or street appeals for your funding base, then you have an interest in making sure there's public concern out in the market. [T]hat there's sufficient cause [for] people to donate money to you…You're not going to make any money going out telling people everything's fine, keep your money in your pocket. You need to tell them that the world's coming to an end and you need to donate money, so I can save – or can help. So that doesn't help [their credibility].

CFS3 described Conservation groups as the, "Marine Protection Industry." Conservation stakeholders were also seen as being highly vested in the outcome in terms of a desire to see their own vision of marine protection created.

While scientists received the highest AVs, they were also seen as self-interested. In the case of Government scientists, stakeholders from all interest groups questioned their ability to be independent of the desires of their government or parent agency. According to RS4,

> There's a difficulty with the independence of (government) scientists that are – that are giving advice. There's a desired outcome that's wanted to be achieved. And that – that creates mistrust. You know, I think that some kind of greater degree of independence in those people who are providing that scientific advice to the group potentially would be an advantage.

This concern was particularly strong within the Commercial Fishing and Tangata Whenua stakeholders. "There might be two – two government scientists that I believe implicitly and there might be 10 that I think are driven by a personal green agenda" (CFS6). "The unfortunate thing about the government – the government scientists are trying to sway you into not just the science, but also a little bit…by the government

itself" (TWS3). TWS5 agreed, "They're getting their directions from above. Its kind of horses for courses really in terms of their department or agenda." The possibility that Government scientists were vested in the government position was also a concern to other scientists.

> The government scientist is very strongly constrained by the government of the day and in fact they sign a public service agreement…saying that government scientists…were highly constrained in what they could say publicly, particularly in areas of their own expertise. They were there to serve their clients' interests (SS2).

Concern about the influence of agency position on Government scientists resulted in most participants wanting clarification on whether the hypothetical scientist was from the Ministry of Fisheries or Department of Conservation, with Commercial Fishing stakeholders speaking more positively about the Ministry of Fisheries and Conservation stakeholders being supportive of information from the Department of Conservation.

> If your Government scientist is a fisheries scientist (Ministry of Fisheries) that might influence how I would look at the information versus if it's a scientific working for DOC (Department of Conservation)…because of the different mandates that they've got. And you know science is not a value-free thing. And often the interpretation that those scientists might make of information – or the way they approach it can be very much shaped by the institutions that they're working within. I mean, I don't think anybody's totally – you know separate – from relationships with others or values that are influencing what they do…Can we assume all Government scientists are going to be approaching things from the same perspective? Not necessarily…Where are they coming from and what are they driven by? What are ultimately the objectives of the organisation in this process? (TWS2)

Non-government scientists were seen as unconstrained by government policy and objective by training, but not independent of influence from their clients or personal desires. "They're trying to be independent, but a lot of them rely very much on funding from commercial fisheries…and despite wanting to be independent they have a potential conflict of interest" (CS5). CS1 stated the case more succinctly, "It depends on who their major clients are." Commercial Fishing stakeholders shared the concern over the actual independence of Non-government scientists, saying, "A lot of them have their own personal agenda and will set research and information from research to best suit their argument" (CFS2), "I'm sure they make things up to suit whatever they want to do" (CFS5) and "I'd have to take it with a grain of salt until proven otherwise" (CFS1). TWS2 agreed, saying, "Non-government scientist? Have we employed them? Has the government employed them? It kind of comes back to who they're working for." A degree of scepticism surrounding information originating from Non-government scientists was acknowledged by Management stakeholders. "Non-governmental – they're normally working for one body or another so they're-they're trying to tailor their information to suit a certain audience" (MS2). Scientists provided some agreement, observing that, "Sometimes they're employed by industry or environmental groups, whatever, and they tend to push – push different lines and things…but I think if they were clearly scientists who at least aim to give objective information, I would tend to be influenced by their views (SS4).

Tangata Whenua stakeholders were seen as providing a historical and holistic view to the process, but one that was emotive and highly vested in the commercial and political aspects of the issues. In addition, the role of Tangata Whenua stakeholders was often ambiguous within the MPA process as its members could also be commercial fishers, involved in minerals operations, or have a strong conservation focus. The vested nature of Tangata Whenua stakeholder involvement was felt particularly by Commercial Fishing and Recreation stakeholders, who saw them as competing for resource access: "A lot of their stuff in my opinion is self-interest, complete self-interest…Now they're coming and saying, well we – this is all traditional fishing grounds of ours. We want it back." (CFS4). Conservation stakeholders also saw the commercial aspect to Tangata Whenua claims observing, "A lot of it's traditional [information]. I mean it's – it's talking about their traditional fishing rights. And there is a power play there quite obvious. 'Cos there's money at the end of the day; so it's driven by commercial – commercial claims" (CS3).

Tangata Whenua stakeholders were also seen as having Treaty of Waitangi rights that provided them with privileged governmental status and access, resulting in special government acceptance of their information. The latter was demonstrated by the high AVs provided to Tangata Whenua stakeholder information (71.4) by Management, which was the highest provided to that group and one of the highest AVs provided to any group (Table 2). The relationship between Management and Tangata Whenua stakeholders was summarised by MS3, who said,

> I guess it also depends on the subject matter, but I would… weight reasonably highly the views of Tangata Whenua, primarily – well, for one reason, perhaps not primarily but as I said,… the Crown has a special relationship with Tangata Whenua and it's different to other stakeholders and that might result in maybe primacy or greater weight being provided to certain – to certain views. If – not all views.

As a result of the "special relationship" between the Crown and Tangata Whenua, the local knowledge provided by Tangata Whenua stakeholders has been institutionalised, while the local knowledge of commercial fishermen remains outside of the process as reflected by the ambivalent GAV provided to Commercial Fishing stakeholders by Management stakeholders (56.6).

In general, participants felt that most stakeholder groups were "pushing a barrow" defined by SS1 as, "with a cause to advocate for." The overall vested nature of the process was summarised by RS3 who stated, "Everyone comes there trying to protect their patch."

Selective Information

Concern over the completeness of the information provided was a universal apprehension. Stakeholders were often viewed not as providing false information, but providing information that was incomplete or slanted to bolster their preconceived positions. For example, concerning assertions by Minerals & Energy interests, CS4 stated that, "I would be sceptical about the information they provide… I wouldn't be that trusting that there wouldn't be a vested interest behind it, so they may not be giving us the full set of information or they may be giving us information that they would like us to hear." The tendency to omit information that could be detrimental

was acknowledged by FS6, who said, "I mean, we were quite happy to show people where we fished. We made no attempt whatsoever to show people where we didn't fish."

Conservation stakeholders were viewed as providing usually well researched, but particularly slanted and emotive information chosen specifically to support their cause.

> Conservation interests? I'm going to say that (it's) not likely that I would change my mind based on conservation interests, given my experience as far as information, the manipulation of information to their own ends. Very well documented that – that they will use very selective information, outdated information, simply to progress their own ends (CFS3).

"Time and again they will distort the – the truth of fishing …[R]esearch that's been done by respected scientists they will take a piece out of … the actual findings. They'll take this little piece out that suits their argument" (CFS2). According to CFS1, Conservation stakeholders, "[H]ad all been on the internet, picked out whatever thing they could and presented it as gospel from around the world." This tendency was not lost on Management. "I often see instances of conservation interests manipulating information or being very selective about information they use and clearly being disingenuous about how they interpret and present or respond to information" (MI3). MS2 agreed, saying, "Obviously their – a lot of their information is tainted. It's – it's selected – selective information, so they're making sometimes tenuous extrapolations from success of a marine reserve in one place would work here, will do this, will do that."

Conservation stakeholders were not alone in the perception that they provided information slanted to suit their cause, as noted by TWS5 concerning Commercial Fishing information:

> [F]ishing interest, it's tough to know really, because some of the information you get is pretty doctored…quite often we end up in the situation where commercials are kind of biasing their fishing – fishing practices and their fishing activity towards that area [being considered for management], so they're actually over-playing, overstating the activities that occur there. – I wouldn't say they were fudging it, but they were certainly trying to suggest that there was more activity occurring in those areas than there were.

Science stakeholders agreed with the selectivity of the commercial fishing information saying, "The fishing industry they – they're very much saying the line that – that is of the benefit to the fishing industry" (SS1).

The providing of information selected to bolster and defend a position rather than problem-solve was seen as most characteristic of stakeholders representing constituencies, as opposed to that provided by more local individuals, with the more "national" the stakeholder, the more "one-eyed" (slanted to support a particular position) the information or position.

> So generally where the conservation interests are local they tend to have, in my view, more influence on the groups that I've been involved with, as opposed to the national advocates because they can really just argue a – you know, a policy or a position. I've seen the same thing around the sort of

> fishing interests (and) for some reason government agencies who kind of run those processes tend to want to involve national advocates and that's really the situation that we've found with the conservation and the fishing interest, we end up with the sort of national lobbyists who have very little information that we can actually really use…They're really just advocating a position...[T]he more local there are, the more knowledge they have, and it's those guys, when you have that type of community initiative – I guess that's why it gels, because we're talking – you know we're talking local fishers, local conservationists, you know local tangata whenua, with local government officials all talking and feeding off each other because they have such a detailed array of local knowledge that we get to that – you know such a higher level because we're all feeding off each other… [B]ut probably in the worst case scenario (is) when you've got national advocates (TWS5).

Recreation stakeholders perceived a difference between local participants and those representing larger interests. According to RS5,

> [I]f I'm looking at the individual fisher that's going out there in his boat, I have – I probably have as much respect for what they are telling me as what the scientists are telling me…. But not necessarily the fishing companies, fishing companies would not change my mind…I would be very suspicious of them… I didn't learn anything in the [name of forum] process that led me to think that the fishing companies are really particularly mindful of what's best for the environment and–[name of rep] his job was to advocate for the fishing rights of quota holders and the property rights that they have and he just was totally one-eyed about – he could only push couldn't give at all on – and I suspect that that was because it was his job and if he was seen to be taking any other point of view, he'd lose his job.

Science stakeholders also perceived a difference between information coming from local members and those representing larger interests. "I was convinced by a lot of information they (local fishermen) provided, I think…Quota owners tend to have not as much on-the-water knowledge, and they're angled towards protecting the fishing industry" SS4.

Commercial Fishing participants tended to agree:

> There's a disconnect between the skippers who are seeing actually what's happening on the water than to the quota owners or companies that are sitting in the board room – not – there's no relationship there, they don't know what's actually going on the water. They see it in the – you know, the profit – profit and loss, you know, each year and that's, you know – that's their relationship with the fishery (CFS2).

This dichotomy between local and national stakeholders was underscored by the comments of the two "most national" participants representing large conservation and commercial fishing constituencies. While each maintained that they judged information on a case-by-case basis, they were also the only participants to talk about politics and power, and minimised the role of information.

> I see it all the time in policy-making and – and decision-making. They think, 'Ah if only we could present the logic of the argument or our science… then – and the decision makers will make the right decision.' And it's rubbish. It

> doesn't understand power. Doesn't understand politics… [P]olitics is not about logic. Politics is about power. Politics is about being elected. Politics is about a whole pile of things that is – and of which science and…information is only a very small part of it (CS5).

> Well, that assumes that people are going to do that [search for consensus], rather than take positional stances, which is what happens. What we saw in the MPA process, is those positional stances stay throughout. Because it's your mandate. Maybe from your organisation to minimise the effects on fishing or you're mandated by your organisation to maximise the protection element…So it just – it becomes positional. It really doesn't matter what information you put in there…. And then you have to look at the levels of collusion between the different parties… We might have gone and done a lot of work with aquaculture and mining. You know, to develop a strategy, which might – we might do a deal before we even get there... For our power (CFS6).

Mismatches between personal experience and the information provided

Another barrier to the acceptance of information was its contradiction with people's personal experience. This was particularly strong for Commercial Fishing stakeholders, who drew on their direct observations accumulated through years of first-hand experience interacting with resources and the environment. According to CFS4,

> [T]here's no science, well there's absolutely no science – I know more about what's going on under the water [geographic area] because I'm there every day and I see what's coming up in my [fishing gear] and I see what I see in the sea. I see. – These people sit in their offices and they're telling me what the bottom of the ocean is like because they've got a map which has got different substrates on it and I'm saying, 'That's crap, that's mud there. Where you're saying is – is rocky ground or gravels or silt or something else, it's not – because I've been there – I know.' But you couldn't tell them that because, on a map somewhere, some joker's written it down that that's what that substrate is.

CFS1 agreed, saying,

> I mean, we know from what species we catch where what the actual bottom is. I mean a chart – we had a chart there saying that it was sand and gravel. Well we know that it's mud. Because the species you're catching don't match with sand and the gear we have to use to actually be able to fish there. I mean there's lots of area – things like that and I mean there's area that was supposedly gravel, which is not – it's just sand. And there's areas that are supposedly rocks which are just sand and gravels. Yeah, so I mean there's lots of things, yeah. And the conservation people you know if that's what was on a coastal chart, a New Zealand coastal chart, that was right, that was gospel to them, that was gospel to them.

Relative to his acceptance of information from Conservation stakeholders and the need to have a first-hand understanding of information, CFS1 summed it up by saying,

> But anyway we were talking about conservation interests and why, why did we not believe what they said. [It's] because they don't know. They have no concept of how the system works in the ocean. They are not fishermen.

CFS1 also provided an example of what can happen when commercial fishermen accept science for decisions in their fishing practices.

> I've seen the end results of that [listening to scientists] over many years now…I can remember an American coming over here and talking to [name of scientist] about them [species and gear type]. And he reckoned we could do the same thing here, and the person I worked for at the moment, at the time, invested $50,000 in a container load of fricken gear from America, this fella came over here. We told him it wouldn't work, but because the scientist said it would work, same as, the money was spent, the time was wasted and after three weeks at sea, I gave up trying to use the gear… It just didn't work, it didn't work that way here, it just doesn't work. I mean the months were wrong, everything was wrong and the American chap he was a great believer in what science said, and he convinced my employer at the time that this is what we should be doing, and it was a very, very expensive failure, very expensive failure.

Discussion and Conclusions on Anecdotal Information

The goal of multi-stakeholder working groups is to allow stakeholders to share information and arrive at consensus-based resource decisions. For consensus to occur in the contentious environments that cause multi-stakeholder groups to be convened, some stakeholders must accept information at a level that will allow them to change, or seriously question, their original preconceptions and beliefs. While most stakeholder participants tried to make information decisions on a case-by-case basis, the results of this section indicate that social-type concerns, attributed to the stakeholder groups that were providing the information, were a major barrier to its acceptance. These concerns focused on apprehensions based on the worldview and values (e.g., local versus scientific knowledge or extraction versus protection sympathies) of the stakeholder groups and how closely aligned were the views of the information's sender and receiver.

In general, stakeholders with similar values and worldviews tended to accept information from each other, while rejecting that originating from others. For example, the groups with some of the lowest AVs for each other's information were Commercial Fishing vs Conservation, groups with disparate worldviews and values. More closely matched were AVs between Commercial Fishing and Recreation stakeholders, and Conservation and Science stakeholders; groups with more closely aligned worldviews and values. Another barrier to accepting or rejecting information for consensus decisions was based on the size of the constituency a stakeholder represented. Local stakeholders were seen as providing better information and being more able to re-assess their position based on information than more national stakeholders. National stakeholders were seen as unable or unwilling to alter their preconceptions, and were seen as more likely to defend their position and constituent's interests independently of most information provided.

There was some indication that values could be primary to worldview when it came to accepting information. For example, the acceptance of local knowledge for decisions can be cast as a clash of worldviews, with stakeholders in close resource contact (e.g., Commercial Fishing and Tangata Whenua stakeholders) favouring its use and those with more positivist criteria for information (e.g., Conservation and Science stakeholders) rejecting it. If this scenario were correct, Commercial Fishing would be predicted to favour local knowledge and Conservation interests to deny it. However, the actual situation was more complex and values-based. Commercial Fishing stakeholders showed high acceptance for their own local knowledge, but attributed low acceptance for information based on the local knowledge of Tangata Whenua, placing it below the level of even casting doubt on their preconceptions. Similarly, Conservation stakeholders would be predicted to have low acceptance for all local knowledge, but showed a level of acceptance for Tangata Whenua local knowledge that far exceeded that given to the local knowledge of Commercial Fishers, with information from Tangata Whenua exceeding the threshold of doubt and commercial fishing below it. These discrepancies would support the interpretation that shared values can trump worldview as a criterion for accepting information and that information is primarily judged in light of its ability to bolster or endanger a preconceived position.

Using the information from this section, it is possible to construct scenarios that might predict a multi-stakeholder group's success or failure at reaching consensus decisions. Groups most likely to reach consensus would consist primarily (if not exclusively) of local members with similar worldviews and values, and would lack national representation. Groups failing to achieve consensus would have groups with widely dissimilar worldviews and values, and would have substantial national representation.

An interesting example of this prediction can be found in the case of New Zealand's Guardians of the Fiordlands (Guardians) MPA working group. The Guardians group is one of the few forums to achieve consensus and is often provided as an international model for success. In its initial phase, and when consensus was reached, the Guardians consisted almost exclusively of local commercial and recreation fishing stakeholders[20], groups with substantially aligned worldviews and values (e.g., support local knowledge as an information base, accept some level of extraction as positive and are economically tied to the resource). Missing from the group were conservation stakeholders, who hold a distinctly different set of worldview and values, and national representatives who have an agenda that minimises or sacrifices local needs in favour of a larger agenda. In contrast to the Guardians, most other New Zealand MPA forums are or have been composed of groups with substantially different worldviews and values, including the polarised Commercial Fishing and Conservation stakeholders and national-type players who are representing larger interests. This interpretation does not disparage the accomplishments of the Guardians' forum, which still took many difficult years and pioneered key policy innovations (e.g., the gifts and gains concept) to achieve its goal. However, in terms of consensus, its make-up would tend to make it destined to succeed whereas the other groups could be seen as destined to fail.

[20] Fiordland Marine Conservation Strategy, (June 2003)

Part 2: Scientific Information

The failure of multi-stakeholder groups to arrive at consensus decisions based on anecdotal information is not a surprise to many in the science and management communities. The biased and contestable nature of anecdotal information and local knowledge is well accepted by them and it is for these very reasons that they turn to science as a problem-solving tool.

The scientific method is designed to use systematic observation and testing to produce unambiguous results that can be separated from competing possibilities and confounding variables. This is accomplished by adhering to a well defined process of using observations and inductive reasoning to formulate hypotheses, using deductive reasoning to make predictions about the hypotheses, testing the predictions of the hypotheses through experimental design, and providing a methodology sufficient that others could replicate and verify the results[21] . The method provides a means to gauge the reliability of information generated through experimentation, and how much confidence should be placed in its findings.

The standards of scientific testing are stringent, exceeding those imposed by trial courts[22]. By imposing such standards and methods, positivist science provides a mechanism for choosing between the many plausible alternatives that can potentially explain observations. Without such a process, accepted knowledge can be unreliable[23]. As stated by Starr and Taggart (1989: 20), "Systematic observations, hypotheses, predictions, tests – in all of these ways, science differs from systems of belief that are based on faith, force, authority, or simple consensus." Explicit in the scientific process is the adherence to an unbiased, objective approach that is independent of the personal desires and convictions of those engaged in the investigation.

In this section I will investigate the role of scientific research in stakeholder deliberations. For scientific information to be useful in reaching consensus decisions, its credibility or AV must be sufficient to result in stakeholders changing, or casting considerable doubt on, the preconceived beliefs or positions with which they began the deliberative process. To gain insight into stakeholder perceptions of scientific information I investigated the AVs originating from three categories of research based on their level of participation. The categories are (1) single-source research (research conducted by scientist working in isolation from other stakeholders), (2) paired-source research (research conducted by paired teams of scientists representing different stakeholder interests) and (3) multi-source research (scientists working in teams of 3 – 5 scientists representing different stakeholder interests). Hypothetical source groups conducting the research were chosen to represent members of the stakeholder groups typical of New Zealand's MPA decision-making process (Appendix I).

Overall Acceptance Values (OAVs) were used to examine how persuasive was information to the deliberative group as a whole, while Group Acceptance Values (GAVs) were used to examine how persuasive was information to a particular stakeholder group.

[21] Starr and Taggart (1989)
[22] Romesburg (1981)
[23] Ibid

Single-source Research

Overall Acceptance Values

All OAVs for single-source research exceeded the 50 level, indicating that all were capable of casting some level of doubt in the aggregate "mind" of the group. OAVs for single-source research were highest for research that was conducted by the individuals themselves (85; 'You' category) and lowest for research conducted by Conservation scientists (54) (Table 3). All other categories had OAVs ranging from 56 to 67.

Group Acceptance Values

The GAVs provided insight into how specific stakeholder groups responded to information reported by scientists conducting single-source research. All stakeholder groups reported their highest AVs for research that they, as individuals, conducted themselves. With the exception of Recreation (67.6) all GAVs for the You category were above 80. Excluding the You category, when a single-source researcher reported information, the highest GAV came from the stakeholder group with which the scientist was associated[24] (Figure 3, Table 4). For example, Commercial Fishing stakeholders provided the highest AV for research conducted by scientists associated with the fishing industry (67.4). Conservation stakeholders provided the highest AVs for information from research conducted by scientists associated with conservation groups (73.2). However, they provided slightly higher AVs for information from Non-government scientists (75.2) than for Conservation organisation scientists (73.2).

Stakeholders provided their lowest AVs for results from single-source research conducted by scientists with interests perceived to be dissimilar to their own. For example, Commercial Fishing stakeholders provided a low GAV for research by Conservation scientists (30.6) and Conservation stakeholders provided low AVs for research by Minerals & Energy (45.2) and Commercial Fishing (46.4) scientists. Counters to this trend was a low AV by Science stakeholders for Minerals & Energy research (47.2) and by Commercial Fishing stakeholders for Tangata Whenua research (48.4).

[24] Management and Recreation stakeholders were not given management or recreation research group choices.

Table 3. Overall Acceptance Values (OAVs) describing the influence to stakeholders of scientific information derived from single-source research. Stakeholders represented commercial fishing, conservation, management, recreation, science and tangata whenua interests. A value of 1 represents total disregard of the information articulated, 100 represents total acceptance of the information (mind change) and 50 represents the tipping point where a stakeholder might experience doubt concerning a preconception or belief. The highest OAV has been bolded and the lowest OAV has been bolded and underscored.

	Source of Scientific Research Information						
	Min. & Energy	Conservation	You	Comm. Fishing	Tang. Whenua	Government	Non-Government
OAV	56	**<u>54</u>**	**85**	57	63	64	67

Table 4. Cross-case comparison of Group Acceptance Values (GAVs) describing the influence of single-source scientific research information on stakeholder groups. A value of 1 represents total disregard of the information articulated, 100 represents total acceptance of the information (mind change) and 50 represents the tipping point where a stakeholder might experience doubt concerning a preconception or belief. The highest Acceptance Value (AV) for each stakeholder group (row) has been bolded and the lowest AV for each stakeholder group has been bolded and underlined. The highest AV for each information source (column) has been denoted with † symbol and the lowest AV for each information source has been denoted with a * symbol.

		Source of Scientific Research Information						
		Min. & Energy	Conservation	You	Comm. Fishing	Tangata Whenua	Government	Non-Government
Stakeholder Group	Commercial Fishing	61.8	**<u>30.6</u>***	**87.4**	67.4†	48.4*	64.4	52.2*
	Conservation	**<u>45.2</u>**	73.2†	**87**	46.4*	67.4	72	75.2
	Management	69.4†	**<u>62.6</u>**	**93**†	63.4	68.6	82.8†	77.2†
	Recreation	52.8	**<u>49.2</u>**	**67.6***	55	53.2	57.4	60
	Science	47.2*	62	**90.4**	**<u>46.6</u>**	62	65.6	74.6
	Tangata Whenua	56.8	45.4	**82**	63.8	78.2†	**<u>45.2</u>***	62.6

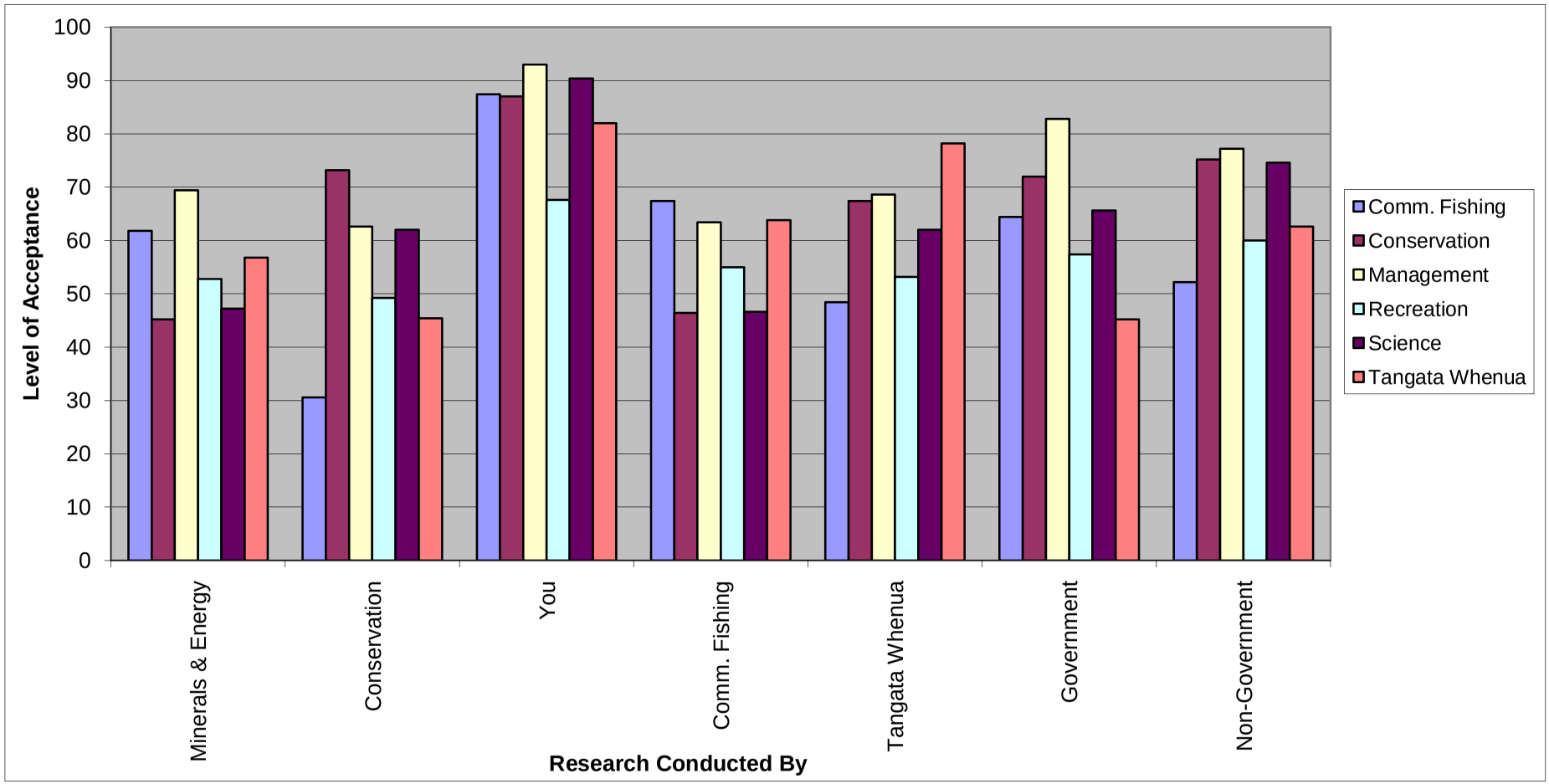


Figure 3. Group Acceptance Values of stakeholders for information provided by single-source research. A value of 1 represents total disregard of the information articulated, 100 represents total acceptance of the information (mind change) and 50 represents the tipping point where a stakeholder might experience doubt concerning a preconception or belief.

Qualitative Explanation of Overall and Group Acceptance Values

The goal of scientific research is to produce information that is dependent on technical expertise and methodology, and independent of the scientist(s) conducting the research or where they work. However, OAVs and GAVs indicated that stakeholders did not necessarily agree with this interpretation of scientific research. Results from scientific research did not reach the AVs associated with changing the mind of stakeholders. The primary themes explaining barriers to stakeholder acceptance of scientific information were trust issues focused who did the research and where or for whom they worked. These concerns focused on a lack of scientific independence based on the vested interests of scientists and the tendency of scientists to provide selective information to support their desires or that of their employers. As TWS4 stated, "Somebody is paying somebody to come and talk to you. My question is, 'How much?'"

In addition, there were concerns that the narrow problem definition and restricted data interpretation arising from the limited experience and bounded rationality of scientists, combined with their desire to answer questions within their own field of technical expertise could result in scientists reaching incorrect conclusions even if their methods were solid. Commercial Fishing stakeholders in particular had examples of research where they believed scientists "got it wrong" and these examples were powerful in discrediting other research by extension. For example, according to CFS1, "[Y]ou see other scientists come [to make presentations] and…I can't dispute it, but that one I could [provided example], you see. So it makes you think, 'Well how many of these other jokers are the same?'[provide incorrect information].

Lack of Independence

While scientific information is often cast as independent and neutral, scientists were seen as having a wide array of vested interests that countered this perception and affected stakeholder acceptance of their results. These interests ranged from personal to institutional and economic to philosophic. As stated by SS1,

> I think each of the groups, for good reasons; focus their research on – the things that push their barrow or whatever. And so, you always need to take that into account when you're considering scientific information that comes from any particular organisation.

CFS2 had a similar perception saying,

> Minerals and Energy – [T]he information that would be supplied would be to benefit the company or whoever they're representing rather than being unbiased and – Conservation Interests. Same thing…and this'll be true of most of these [research categories].

CS5 agreed,

> It all relates to the science itself. And, back to what I said earlier about; well actually a lot of science is value-laden. The scientists doing it, they're coming from the precept of the organisation who employed them.

As a result, many stakeholders cast their acceptance of scientific information as dependent on the individual scientists providing it, what special group they represented and/or by whom they were employed. In terms of the individual scientists,

CFS6 said, "[A]gain it's that whole credibility question of – of the individual doing the research…. Because it comes down [to] the individual and the credibility." MS3 had a similar perception:

> My confidence in the science depends on the person, or it might be dependent on the person, because you know we accept that scientists are generally pretty objective, but you know no one is totally objective, including myself.

The position that the individual scientists needed to be examined was acknowledged by Science stakeholders as indicated by SS2 who stated, "You're biased, you're going to be biased, everybody's got to be biased" and by SS3 who said,

> In a place like New Zealand you tend to know who are good scientists and who are bad; not so good scientist…[A]nd so where do the good scientists go? And where do the not so good scientists end up?...The good ones go to either the Crown research institutes or universities. The not so good ones end up with [government agency].

Another view of needing to consider the individual scientist conducting research was offered by RS4 because, "There are plenty of scientists that just make it up."

While stakeholders were concerned about the bias and ability of individual researchers, most of their apprehensions were centred on whom the scientist(s) worked for or who funded their research. Stakeholders tended to perceive scientific results originating from research categories associated with their own or similar stakeholder group as less vested and more credible than that originating from research categories less representative of the stakeholder's own group. As an extreme example, the highest OAV was provided to research in which each individual stakeholder conducted or participated in it (the "You" category). The primacy of the You category was evident in that it also received the highest GAV within each stakeholder group. Rationales given by stakeholders for accepting research that they themselves conducted or participated in usually came down to the simple condition of, "seeing is believing." According to TWS4, "I'd believe in him [the researcher], because I've seen it. I'd be open to change because; I'd like to – I'd like to see it"**.**

RS3 concurred,

> Yeah I believe I would [change my mind] 'cos I would know what had gone into it. I'd know there was no bias to it. I guess seeing is believing. And if I can see it myself I'll believe it.

CFS1 agreed, saying,

> I suppose I am involved in research because I've got – well I've got four [type of gear] that every day I measure and I measure every fish that comes out of that and that goes into the management group that look after the [species] in our – in area [name] where I fish – and at the end of the day that gives us a catch per unit effort, which is – Yeah, so – and we do that every day so if I'm involved in it I'd have to believe, right up to a hundred percent, or 95 percent**.**

Conservation stakeholders continued the trend**.**

> Oh in that case you'll change your mind. You've done it yourself. You've gone through that – you've gone through that process – obviously in that – this situation you've taken quite a while to do it (CS5).

Management also agreed, saying,

> I believe in what I see, so if you've seen that something is how it is, then I'm going to believe that, and if that was different to what I thought before doing the research, then yeah [I'd change] (MS4)

And

> Because it's my research and/or deliberations, or experiment I'm probably more likely to accept it than I am to accept someone else's. I guess that's just human nature (MS3**).**

If stakeholders could not directly conduct or participate in the research, they were most likely to accept research conducted by representatives of their own stakeholder group. CFS2 stated. "If they [Commercial Fishing scientists] were doing research I think I'd be – yeah I'd be swayed. 'Cos there is integrity there." CFS1 observed,

> The fishing industry has their own scientists and we are – we're double checking or checking on the government scientists I suppose all the time to try and make sure that they are doing it right. So I'd believe the fishing industry more than what I would believe the non-fishing industry

Conservation stakeholders had similar views about Conservation scientists, saying,

> Yes, capable of changing one's mind. Again because of – I guess my experience in the conservation area (CS1) and [T]hat's [conservation scientist research] going to change my mind. That's fine. Okay? 'cos – 'cos I have confidence in them and the work that – the methodology…so that's fine (CS5).

Tangata Whenua also followed the trend, saying,

> In some ways maybe that is my bias, that I'm probably more likely to trust an Iwi scientist… I'm more likely to believe an Iwi person, a person from my tribe that would come to me and show me – I guess of course showing that they've followed a good systematic approach and you know the science can be believed. (TWS5).

TWS3 agreed, "Because obviously they've done the scientific research in the interests of the iwi, rather than the interests of commercial – I'm hoping that."

Scientists followed suit, providing their highest GAVs to Non-government scientists and Government scientists, respectively. In addition to their belief that scientists were most often likely to get it right, scientists also believed that their use and understanding of the scientific method made it easier for them to spot errors in methods or interpretation of results. As observed by SS5,

> If somebody's standing there presenting their results, it would at least be easier to – to evaluate because maybe their messages are kind of – are geared towards what they want to tell you but their underlying science and how they've done things is much harder to hide. So the process they've gone through to get that information is much harder to disguise.

As stakeholders moved away from research conducted by them or those associated with their stakes, they still maintained the trend of having greater confidence in groups that were more similar than dissimilar to them. To accomplish this they often

developed rationales as to why groups similar to them would be less vested and more balanced in their research than dissimilar groups. For example, CFS3 observed,

> From a personal point of view and experience, there are other groups who would stand in front and produce research or research results that I would tend to trust a little bit more than perhaps conservation interests. They're a group that, in my experience, in New Zealand, tend to be least balanced in their arguments. And that goes against – is contrary to what I was just saying before where the mineral and energy…and fishing… interests obviously they're trying to push their – their own case, and you could say well, because they're trying to do that and there's an economic driver behind it, they won't be very balanced either. But they are probably put under more scrutiny. Group – user groups are normally subject to more scrutiny than simply a lobby group like conservation interests, who tend to be able to make claims that aren't investigated or explored or challenged to the same level as a – as a commercial group.

CFS1, put it more succinctly, "Mineral and Energy, I would have to believe them."

Conservation groups often saw Tangata Whenua interests as more in-line with their own and so placed greater value on Tangata Whenua research. According to CS1,

> It seemed to me very holistic research that integrates both the science and the well-being of the resource. And that whole concept that Māori have of mauri in terms of waterways, mainly fresh water, which is the sort of the health of the waterway. And the spirit of the waterway. And because of the holistic approach to the resource.

CS2's impression of Tangata Whenua science,

> [I]s that Tangata Whenua are not totally independent but they're actually looking at research from the 'greater good' perspective, not just necessarily entirely from their own perspective."

Tangata Whenua themselves displayed an interesting dichotomy of perspectives, typical of their more diverse make-up. TWS3 saw greater credibility in Conservation scientists saying, "I grew up a conservationist. My people believe in conservation – they would have the ability to change my mind." while TWS2 noted,

> Fishing interests? So this is a scientist that's got fishing experience – is working for the industry?...I guess when you're working with those people you develop an element of trust because I guess you're working for the same end. So you tend not to question so much…Or how much they're trying to argue for something that you're in alliance with them about. It's very cynical, I suppose, isn't it?

Management stakeholders provided their highest acceptance to Government scientists, which is line with both being from government agencies. MS2,

> I would give most credibility to the Government scientists because they're there as independents. They're there to facilitate the process to invite independent advice. They shouldn't have a bias one way or the other. Whereas all the others are presenting information to support their argument so they would need to work a lot harder to make me change their mind.

MS3 agreed, saying,

> If Government scientists presented me with information that was contrary to my preconceived ideas I would probably more likely to change my mind than if I was presented information with anyone else here.

MS1 noted, "Of course [his agency] scientists will be off the scale [given the highest AV possible]."

Concerns focused on the vested nature of scientific information came to the forefront when stakeholders perceived the groups conducting the research to be potentially counter or antagonistic to their interests. For example, with regards to Minerals & Energy research CS4 stated,

> Minerals and Energy I would rank low because of the research that [name of Government agency] presented [in] a discussion document on mining protected areas last year and the very slanted way that work was put together and the conclusions they reached. So I would always tend to discount that because of that total self interest.

TWS3 agreed, saying, "Minerals & Mining? I'd have to know what they're trying to sell."

SS2 also saw as research originating from Minerals & Energy interests as suspect,

> [F]or the most part they're interested in their own – in their own welfare and livelihood. They're interested in what they can get from the system; almost regardless of the future…They're devious.

MS5 summed up his feeling by observing,

> [I]t's easier to say it like this. I've never heard a Minerals & Energy scientist coming out and saying "It's the worst possible thing for the environment, and it shouldn't be done."

Research conducted by Commercial Fishing scientists caused scepticism similar to that of the Minerals & Energy scientists. According to TWS5,

> There is the perception that they're [fishing industry research group] kind of hired guns and they're kind of – they're paid to say what the industry want them to say. So you know that's out there…I guess there's always that thought in the back of your mind that maybe they do have that bias and how reliable is this information?…Like I would never – I don't think I'd be in a situation where an industry-paid scientist would …change my mind.

SS4 also saw research originating from Commercial Fishing scientists as suspect,

> I think they – they can do a lot of good scientific work at times. You know, especially if it's to do with their maintaining the fish stocks and things, but I think, again my experience, that they do tend to try to maximise, I suppose, the catch of fish when it comes down to it, and so they put their scientists in to argue for those sorts of things in some ways. So I think I'd put them down as similar to the mining industry.

SS5 agreed, saying,

> Again the fishing interests, probably for the same reasons as before [provided for anecdotal] I – I find that they're self-interested groups. So the research that

> they do supports their business, their core business. They're not in the business of doing research that wouldn't contribute to their core business and enable them to continue using the resource….I feel they have a vested interest in continuing to exploit the resource.

Recreation interests could also have a jaundiced eye for research originating from fishing interest scientists. Said RS4,

> Often [in] their science, they've gone out to do something because they want to achieve a certain result. I've seen some really bad stuff done over the years. I've seen science done by industry to justify a TACC [Total Allowable Commercial Catch] that had already been [determined], and it was obviously wrong because two years later the fishery collapsed.

While many of the stakeholder groups pointed out the vested nature of the other stakeholder groups, they saved their greatest assertions for the vested nature of Government and Non-government scientists. The vested issues for Government scientists centred on a lack of independence resulting from the need to satisfy the desires of the government of the day, or those of their supervisors and managers. As viewed by CS4,

> I'm perceiving that science in the [name of government agency] for example is definitely being qualified by management as opposed to being clearly independent and free science.

MS4 supported that view, saying,

> If there's something at stake for that organisation or that department or the country from the outcome of the results then there might be political pressure from this person's managers or supervisors or Minister or whatever, for a particular outcome. I mean I'd like to think that that wouldn't happen and a scientist can be completely objective, but I think that is a reality.

Tangata Whenua stakeholders also believed that Government scientists came to meetings with an agenda.

> A Government scientist will come onto that forum to – to try and influence us…The suspicion is the governments are there to make money. That's one of the suspicions I have. And so to make more money, they would try and influence how – where they get the money from, which is the fishing industry. They don't get any money from – from Tangata Whenua (TWS3).

RS4 agreed, saying,

> If the government has decided on a certain policy course, then it almost becomes incumbent upon people to follow it. And I know that doesn't fit personally with a lot of scientists, and they struggle – and that goes right through the public service, that people, you know, they have to virtually lose their own personality to follow the line that they've been told to follow by their boss further up the line, because if they don't, well they don't have a job.

The need to maintain employment or funding, and the resulting loss of independence, was a common theme for concerns over the validity of results provided by the government and non-government scientists.

> When you come to government scientists, the thing that worries me with science and even non-government science; who does the paying, normally gets the decision they want, because if they don't, normally the scientist doesn't get another job (RS2).

MS5 concurred, saying,

> There's the old saying that you never bite the hand that feeds you, and basically [in] a very fiscally difficult environment, I imagine a lot of consultants are doing as much work as they can to – to get the sort of big dollars. You know, and if you're consistently saying things against the industry or the very bad effects of – of what a particular activity would be, then I'm sure that they're not going to keep you on.

The need for non-government scientists to maintain funding often resulted in the perception that they had been captured by clients, which could be protective or extractive. Questioned CS1,

> Non-government? Some of them are captured by their clients…It's where are they coming from? Have they got fishing industry clients?

Similar sentiments were expressed by TWS5, who said,

> You know the fact that they're [non-government scientists] wanting to maintain that sort of link [funding] – they don't – they don't tend to say things that are outrageously detrimental to the fishing industry and the view is, of course, that they're not wanting to rock the boat.

MS4 thought the lack of independence was less about money and more about personal desires on the part of researchers.

> [It's] not so much about money, more about a particular personal interest in an area of research or wanting a particular outcome for an area or a species or whatever and using that to cloud their ability to be completely objective.

Commercial Fishing stakeholders had a similar view.

> Non-government scientists would be the same, or less [than Government scientists]. I'd possibly do them less. Because they've possibly got an axe to grind and that they possibly are conservation-type people, rather – yeah, some scientists are green scientists (CFS1).

CFS2 agreed, saying,

> The information that would be supplied would be to benefit the company or whoever they're representing rather than being unbiased.

RS4 said,

> Non-government scientists? I don't know if you can find an independent one.

The concern over science and vested interests was summed up by TWS1, who said,

> Government scientists have a barrow to push. If you're not a Government scientist, you're basically getting paid by somebody, and whoever pays the piper sets the tune.

Selective information and mismatched information

The need to maintain employment, support an agency position or "push a barrow" to advocate a position led stakeholders of all persuasions to believe that scientists tended to slant information or selectively provide information rather than being completely unbiased and objective. Scientists were not seen as failing to tell the truth, but tending to withhold information and failing to present the whole picture.

Relative to Conservation scientists, RS3 believed, "They only bring the facts and figures that support their argument, obviously". CFS1 stated that Conservation stakeholders only used information to, "Flat out discredit everyone else." While of Commercial Fishing scientists, CS5 said,

> I would be interested again in terms of what fishing interests scientists have to say, but I would also feel sceptical about the information in terms of – it would be science that's being presented, but I would be concerned that all of the science may not be being presented…I'd just expect that there would be some bias in the information that was being put forward and I would expect the same from the minerals and energy interests…[W]hich is fair enough. They're coming from their point of view…giving very specific and as much as they can information that is towards their fishing industry's interests. Likewise they'll accuse us obviously of doing the same thing. So it's – you know – opposition.

In terms of Minerals & Energy scientists, CS3 believed,

> Their data was pretty good. Self serving, but good. I'm not too sure then that if they had something that didn't support their case we would have seen it.

Another aspect of scientific information was that, once it was bought and paid for those receiving it or that had procured it could use it as they liked. SS5 said that,

> [Name of Non-government research group] would provide a lot of their [fishing industry] research and [that group] has a lot of very good people. But I guess it's always about how that information is presented, and if the industry's paid for it, they can pick and choose the bits they wish to show you.

According to SS1, a similar condition occurred around information generated by Minerals & Energy scientific information.

> [It's] often difficult with the Minerals & Energy one because it's all confidential information. So if someone stands up and says "We've got an oilfield there." you've got no way of checking. No way of knowing. No-one's going to tell you.

SS5 summed up the situation by saying,

> I think it's not about – well it is misleading people but it's – it's not about presenting misinformation, it's just not presenting all the information. And I think scientists – scientists generally often do that.

Commercial Fishing stakeholders agreed that most groups, including their own, were providing selective information, but they were more worried about information that, in their view, was just wrong. More than any other group their near-daily close contact with resources and the environment provided Commercial Fishing stakeholders with a suite of information against which to test that provided by

scientists. Often, they found the scientific information inconsistent with their experiences and therefore lacking in credibility. As CFS1 observed,

> Government scientists? Oh I should take more notice, but they're proven themselves so wrong over the years…– I've had personal experience.

As an example of a problem he had in accepting information from scientists, CFS1 stated,

> Like their trawl surveys… they've been doing them for many years. They follow the same lines which they have to try and see if there's any trends and species decline or whatever. But there's no regard to the weather conditions at the time, their change in gear that they use, change in technology and things like that.

Commercial Fishing stakeholders had numerous stories about inconsistencies of scientific information and their first-hand knowledge about an area or situation. CFS4 gave an example of when his observations on the distribution of Hector's dolphin conflicted with distribution maps developed by scientists:

> Say Hector's dolphin, which is the rarest dolphin in the world, you know. And I'm saying, well there's no Hector's dolphins there because I've been there, I've been there every day, I know that that area there doesn't contain [Hectors dolphins] – but along here it does, and maybe along there it does, but right there it doesn't. So they [scientists] – I'm sure they make up things to suit whatever they want to do.

CFS5 gave an example where the observations of commercial fisherman were at odds with the health of the orange roughy fishery:

> [W]hen they [scientists] did the biomass study on orange roughy and…the Government said, this is – this is a red gold, orange gold, it's unbelievable how much is there and there's just huge quantities. Two or three years down the line the commercial guys were going to the Government and saying, 'Look here, we're not catching the fish like we were two years ago. Look here', and the scientists were still saying, 'The biomass is still there, the biomass is still there'… and we said, 'You're killing these when they're spawning. You're getting these fish and they all school up and they're spawning', and they [fishermen] were dragging the net through and they were doing 20-minute tows and filling the boat up, just filling the boat to the top, you know and he's [refers to fishing partner] got photos there of you [fishing partner] walking out, the net would stretch from here up to those sheets up there and it was as round as this bloody room and they'd walk way down and put splittings on it to get it on the bloody boat. It was just huge, the net fills of fish that they were getting, you know, and they [commercial fishermen] were saying, 'The fish – we're killing those fish out.' It took another five or six or seven years before the Government said, 'The orange roughy's collapsed, there's none left.' These guys [commercial fishermen] were trying to tell them…The conservationists got on to us, everyone got on to us and said, 'Those bloody commercial fishermen, they've done all that.' We were only doing what the Government told us to do or we could do. And if we didn't do it, the guy next door would or the guy – the [name of fishing company] would or [name of fishing company] would, or one of the other companies would. So I mean – but they [scientists] said that biomass was there, but it wasn't.

In addition, Commercial Fishing stakeholders observed that scientists themselves often disagreed with each other, so why should they accept what scientists told them?

> The problem with scientists, and I've had quite a bit to do with scientists over the years, and some of them are absolutely – I mean you can get two scientists studying the same thing and come up with dead opposite scenarios and that's the thing with scientists (CFS4).

RS3, using global warming as an example, observed, "I guess you can find a scientist to support anything".

Wrong question or incorrect or biased interpretation of data

Stakeholders were also concerned that the narrow focus and sometimes parochial view of scientists could result in a failure to formulate questions that were appropriate to the problems confronting decision-makers or devise questions in a way that biased the results. In addition, stakeholders were concerned that such narrow views could result in scientists accepting false assumptions on which to base their research, cause them to incorrectly interpret data or interpret data in a biased manner. As observed by MS3,

> [T]he fishing industry and the conservation interest and the mining and energy interests are trying to steer the result in a particular direction. So there's always going to be some bias in here – and it might not be inherent in science but it might be inherent in the question that they ask or the hypothesis they test.

CS5 agreed, saying,

> Well obviously it's about – it's about methodology – about assumptions – assumptions behind the – the research – you know, 'cos you can have great research but wrong assumptions.

As an example of research using incorrect assumptions in its interpretation of data, CS5 provided research done to mitigate the capture of sea lions in trawl fishing nets.

> We'll use the example of the sea lion exclusion devices. There's a very large number of sea lions that have been killed [in fishery] and they [industry scientists] developed this – this idea of a sea lion exclusion device. So that the sea lion hits this barrier as it goes into the net and gets pushed out. You know. And – and this has been a very contentious bit of science…because [of] the assumptions that were being made…[F]irst of all they [name of fishing industry research group] put it in and said, 'Well we're getting less sea lions…And because we're not finding them dead in the back of the net we must have stopped killing sea lions.' And the immediate question is, well no they're actually – they may be traumatised and whacking into these things, and yes they may be pushed out through the sea lion exclusion device but they may be dead. But the fact that you haven't got them in the net, where we know they're dead doesn't say you're not killing them… So they started off giving a science which says, 'We no longer are catching – you know only a few are getting through the device into the back of the net, therefore we're not killing sea lions.' And we [Conservation stakeholders] said, 'No you can't actually draw that conclusion.…[T]he conclusion you can draw is less dead sea lions are ending up in the back of the net. That's the only conclusion you can

> draw'…[T]he information does not support the conclusion they did draw which was, 'We're no longer [killing sea lions] – all the rest are being saved.'

Conservation scientists in particular were seen tending to provide a narrow or biased interpretation to their data. According to RS2, "[T]he biggest percentage of them [conservation scientists] have got tunnel vision, – it comes beyond science to an obsession." MS5 agreed, saying, "Some of the conservation scientists that I've been around on forums have, you know, swayed towards the extreme – and the extreme interpretation of data." SS3 concurred, saying,

> [I]n marine mammal research for instance – you know dolphins and warm fuzzy things – the data are absolutely #%*@ hot. They're great. They go out. Lots of work. Lots of work. And then their research paper says "Discussion". And it just goes right off the wall. You know they go down to – they go down to becoming – becoming an advocate. And some of the things that they say that are in the discussion and the implications of what they're trying to say is an advocacy position which isn't brought by the data.

SS5 provided an example of an occasion when conservation research potentially skewed a question to provide an answer that supported their position.

> [T]hey tend to pick very small, very specific things that will tell them something very positive. So for example they [name of conservation group] did a lot of survey's – telephone surveys a few years back asking people 'how much do you love a marine reserve?' and the results get sort of skewed that 50 percent of people love marine reserves. It's kind of partly about the question.

Discussion and Conclusions on Single-source Research

Professional managers and scientists often lament the lack of rationality in stakeholder decisions and the inability of stakeholders to accept scientific information as a basis for changing their minds on contentious issues. The results of this section indicate that stakeholders are logical and have myriad reasons for rejecting scientific information that counters their preconceptions and/or desires. However, their logic is often based on social concerns relating to the research's credibility rather than, or in addition to, the technical issues that are the focus of scientists. The fact that the person providing information was a scientist and that the information was derived through the scientific method did little to change the issues that were identified by stakeholders as barriers to the acceptance of anecdotal information in Part 1 of this study. Obstacles to the acceptance of scientific research results continued to be trust issues focused on the impact of the vested interests of those conducting the research and concerns that information presented by scientists would be slanted to support their personal desires or those of the researcher's funder or employer. In addition, stakeholders added new concerns specific to scientific research, such as the bounded rationality of scientists resulting in their asking incorrect questions or interpreting results from within a narrow range of possibilities that often precluded interpretations and conclusions that the stakeholders themselves might have made.

The implications of these conditions were readily apparent in the OAVs and GAVs recorded for stakeholders. The highest OAV and the highest GAVs in all groups were contained in the 'You' category, in which the stakeholder themselves were involved in the research. In this way the stakeholder could be assured that the research was free

of the biases that were frequently the basis for their rejection of the results. Most stakeholder groups provided their second highest acceptance levels to research that originated from within their own stakeholder group, indicating that if they could not verify the process themselves, someone representing their interests could, although to a lesser degree. The ability of like-minded research to produce results capable of making stakeholders question their preconceptions or potentially change their mind is likely, because these are the groups that reduce the social concerns of the stakeholder, which makes the results more palatable.

Paired-source Research

Overall Acceptance Values

OAVs for the thirteen paired-source research groupings ranged from a high of 73.7 (Conservation/Commercial Fishing) to a low of 49.1 (Minerals & Energy/Tangata Whenua) (Table 5). Pairings of Conservation/Commercial Fishing (73.7), Government/Non-government (72.3), Conservation/Minerals & Energy (71.1), and Government/Tangata Whenua (64.9) were the most persuasive to stakeholders, while pairings of Minerals & Energy/Tangata Whenua (49.1), Commercial Fishing/Tangata Whenua (52.3), Non-government/Minerals & Energy (57.2) and Non-government/Commercial Fishing (58.2) were the least. In general, stakeholders tended to perceive research originating from groups with non-aligned interests (e.g., Commercial Fishing and Conservation) to be more credible than that originating from groupings perceived to have potentially aligned interests (e.g., Minerals & Energy and Tangata Whenua).

Group Acceptance Values

GAVs provided insight into how specific stakeholder groups responded to information reported by scientists conducting paired-source research. Among stakeholders, Management found paired-source research particularly persuasive, providing the highest GAV for nine of the 13 pairings (Figure 4, Table 6). Conservation stakeholders were cautious of many pairings and provided the lowest GAVs for six of the 13 pairings. GAVs indicated that Commercial Fishing and Conservation stakeholders showed opposite tendencies. For example, Conservation stakeholders reported the highest GAV for results from the Non-government/ Conservation pairing (85.4), while Commercial Fishing provided that groupings lowest score (40.6). Similarly, Commercial Fishing stakeholders provided the highest GAV for results from the Non-government/Commercial Fishing pairing (71.4), while Conservation provided the lowest (43.4).

Stakeholders tended to provide high GAVs for research pairings that included their interests and lower scores for pairing from which their interests were excluded. Notable exceptions were the Conservation/Commercial Fishing and Conservation/Minerals & Energy pairings. These pairings produced high GAVs even from stakeholders whose direct interests were not included in the research. However, for each of these pairings, Conservation stakeholders provided the lowest within group GAV (64.4 and 55.8, respectively) even though their interests were included. Another exception was low scores provided by Science stakeholders for results from Government/Commercial Fishing and Government/Minerals & Energy (52.8 and

53.6, respectively) and Non-government/Commercial Fishing and Non-government/ Minerals & Energy (52.6 and 47, respectively). Since the Science stakeholder group contained Government and Non-government scientists, all of these groupings would have included them in the pairings. Science stakeholders did provide their highest GAV to the Government/Non-government pairing (82.2).

Table 5. Overall Acceptance Values (OAVs) describing the influence to stakeholders of scientific information derived from paired-source research. Stakeholders represented commercial fishing, conservation, management, recreation, science and tangata whenua interests involved with deliberations in New Zealand's marine protected area process. A value of 1 represents total disregard of the research results, 100 represents total acceptance of the results (mind change) and 50 represents the tipping point where a stakeholder might experience doubt concerning a preconception or belief. The highest OAV has been bolded and the lowest OAV has been bolded and underscored.

	Source of Scientific Research Information												
	Non-Govt + Conservation	Comm. Fishing + Tang. Whenua	Min. & Energy + Tang. Whenua	Govt + Comm. Fishing	Govt + Min. & Energy	Comm. Fishing + Conservation	Min. & Energy + Conservation	Govt + Tang. Whenua	Govt + Conservation	Govt + Non-Govt	Non-Govt + Comm. Fishing	Non-Govt + Min. & Energy	Non-Govt + Tang. Whenua
OAV	63.2	52.3	**49.1**	60.9	59.6	**73.7**	71.1	64.9	63.7	72.3	58.2	57.2	63.7

Table 6. Cross-case comparison of Group Acceptance Values (GAVs) describing the influence of paired-source scientific research information on stakeholder groups. A value of 1 represents total disregard of the information articulated, 100 represents total acceptance of the information (mind change) and 50 represents the tipping point where a stakeholder might experience doubt concerning a preconception or belief. The highest Acceptance Value (AV) for each stakeholder group (row) has been bolded and the lowest AV for each stakeholder group has been bolded and underlined. The highest AV for each information source (column) has been denoted with † symbol and the lowest AV for each information source has been denoted with a * symbol.

		Source of Scientific Research Information												
		Non-Govt + Conservation	Comm. Fishing + Tang. Whenua	Min. & Energy + Tang. Whenua	Govt + Comm. Fishing	Govt + Min. & Energy	Comm. Fishing + Conservation	Min. & Energy + Conservation	Govt + Tang. Whenua	Govt + Conservation	Govt + Non-Govt	Non-Govt + Comm. Fishing	Non-Govt + Min. & Energy	Non-Govt + Tang. Whenua
Stakeholder Group	Commercial Fishing	**40.6**	49.4	53	77.6	77.6	78.4	**78.6**	57.2	48*	58.2	71.4†	66.4	51*
	Conservation	**85.4**†	42.8*	**34**	53.2	43.8	64.4*	55.8*	68	78.2	82	43.4*	43*	68
	Management	70.2	**64**†	67.6†	78.6†	79.6†	87.4†	86†	82†	80.6†	**91.2**†	65	68†	69.4
	Recreation	53.6	49	**32.4***	43.6*	42.4*	**68.6**	67.4	52.8*	50.4	64.2	52.8	52.8	55
	Science	79.2	44.6	**41.8**	52.8	53.6	70.4	66.6	64.8	74	**82.2**	52.6	47	69.8†
	Tangata Whenua	**50.4***	64†	65.8	59.8	60.8	**72.8**	72.4	64.8	51.2	56.2*	64	66	69.2

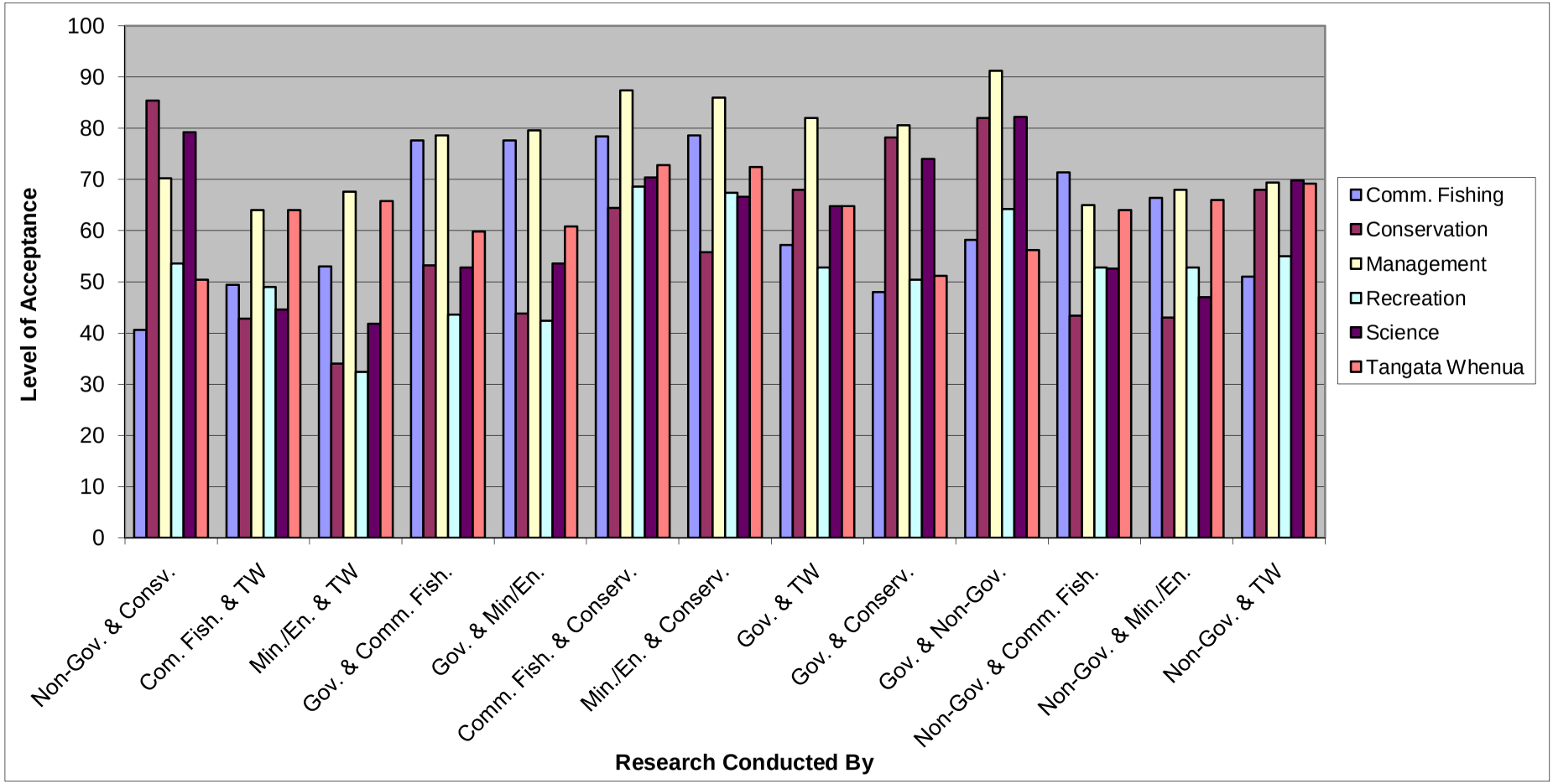


Figure 4. Group Acceptance Values of stakeholders for information provided by paired-source research. A value of 1 represents total disregard of the information articulated, 100 represents total acceptance of the information (mind change) and 50 represents the tipping point where a stakeholder might experience doubt concerning a preconception or belief.

Qualitative Explanation of Overall and Group Acceptance Values

Many of the themes identified for single-source research were still evident for paired-source research groupings. Individual stakeholders had the greatest faith in research conducted by pairs of scientists whose interests they identified as aligned with their own and the least for research conducted by scientists whose interests they perceived as antagonistic. Stakeholders from all interest groups were sceptical of scientific results because of perceptions relating to (1) the lack of independence of researchers because of vested interests, (2) a tendency for researchers to selectively present results that support their preconceived desires or that of employers and (3) an inclination to narrowly or incorrectly interpret data. However, a new theme emerged which was that the pairing of scientists representing opposing interests could provide data that was perceived as more honest and trusted. This adversarial research was perceived as producing higher-quality results because opposing interest would make sure that vested interest were neutralised, information was not selectively presented, and data would be interpreted in a robust manner that took in the widest range of assumptions and possibilities.

Adversarial Research and Research by Champion

Two of the highest OAVs for paired-source research were for the Commercial Fishing/Conservation source and the Minerals & Energy/Conservation source, which combined the most polar interests. These oppositional groupings were seen as providing the balance needed for high-quality results that could be accepted as legitimate. According to CFS3,

> Extraction and conservation interests, that's an interesting combination. I'd actually say that that would be quite – quite high, because the two provide two ends of the spectrum, and if they are able to actually provide information that they agree on, because of that balance between the two – the two poles, I think I would tend to treat that in a fairly positive light. That it – that it could be accepted.

The concept that polar interests could result in balanced research and results was also reflected in CFS5's comment.

> [I]f the Fishing and Conservation people both get together and they come up with – and they're in agreement over what they're putting to us, I'd feel quite comfortable with that…[and Minerals & Energy/Conservation] I'd rate that the same. If they could work together and agree – agree on things I'd be comfortable with that [because] I just sort of feel that there'd be a balance there.

CFS4 agreed that the combination had merit,

> Because if the fishing industry and the conservation interest can work together, I – yeah, if the two scientists can work together and come up with a compromise they shouldn't be far out. They shouldn't be far off, should they? So I'd believe them…[And if] it's a conservation scientist and a mineral extraction. Well once again they're at loggerheads so if they come up with an answer, it would have to be a consensus answer that they're both happy with, so you'd have to agree with them too.

Tangata Whenua stakeholders also found the pairing of extraction and conservation scientists convincing.

> Theoretically it's a great idea… Because then you would be able to cover the two extreme interests in a sensible logical research, piece of research. So if you were to actually cover the interests of both stakeholders in one piece of research, you'd be pretty much nailing it on the head… That would be super powerful. It would be right up here …but I won't ever see it happening. (TWS1)

TWS5 agreed that the combination could be powerful.

> If these two groups can come up with results, then it's got to be right. I mean in terms of the polar extremes working together to come up with something – because we're in the middle obviously, of these polar extremes,. So if they can give me that information, then I could see it as being quite reliable. So it would be more likely to – for me to change my mind.

TWS4 provided a concise summary, stating, "Of course it would change my mind."

Recreation stakeholders also found the pairing of oppositions influential. According to RS3,

> I think if you could ever get them to agree on anything it would be interesting document….. So yeah, extraction and conservation, will they ever agree? If they ever agreed I think you'd put quite a – quite a bit of weight on it.

RS2 also saw the combination as potentially powerful.

> The trouble is it wouldn't happen. They're the two extremes, aren't they? Why it wouldn't happen is that they're too extreme – and they're totally different way of thinking, you know. Well, they did work together with Fiordland, and when they worked together it was up about there [high]…because of the transparency and honesty. That's why it was so powerful.

RS5 saw the balance of views as important saying,

> Because they're poles apart, probably, and so you'd like to think that the work that they would do together would bring those poles together to some sort of consensus view…I think the study would be more likely to be framed in a more balanced way, perhaps.

Both Science and Management stakeholders also had positive views of the pairings.

> Extraction and conservation interests, so they're interesting bed-fellows. I'd probably be reasonably convinced by some work, just because of the natural tension there. I would hope if they could agree on results, then – they weren't gaming the process too much. [By gaming] I mean asking a loaded question or maybe being a little sloppy in your analysis or in your interpretation of results. So manipulating is probably stronger than gaming, but it has that flavour to it. And perhaps the more polarised initially the people conducting the research, you know assuming they've arrived at some research that was sensible and unequivocal, then probably the more likely I am to be convinced that people aren't gaming the science. Whereas if you've got, you know, the fishing industry and the minerals industry together doing some work, they're probably – you know, their incentives are probably much better aligned, so maybe I'd

> be a little bit more circumspect about that work than if, you know, the mining industry and the green group had got together and conducted some research (MS3).
>
> I think the objectivity of the study would have to be really high because – because of the differing viewpoints they probably came from to start with… If they're now presenting this joint research together, then I think the checks and balances of both having different views from the start would have – I don't mean keep each other honest, but keep the work really objective and the presentation of the results as well (MS4).
>
> Good luck with that one. If Extraction Fishing and Conservation interests, if they were on the same page, then I'd put that a lot higher. Probably sit there incredulous at first. But anyway – but I'd certainly put that higher (SS1).
>
> Well once again if they had come to a common point for the extraction you would say that – that that must be highly acceptable because you wouldn't ever expect it to be (SS3).

Conservation stakeholders were more cautious in their support of the pairing.

> Extraction and Conservation – you wouldn't get that sort of research. Well, I'm assuming that there will be – will have been quite wide debate by conservation folk to establish the terms of reference for the research. ...So that would increase the likely credibility but still not above the line [50 tipping point of doubt] (CS1).
>
> If you got a scientific paper out of them [Conservation and Commercial Fishing scientists] on fishing…I'd rate that pretty highly because of their own people they represent. They'd have to be very careful if they ever put their name to a joint paper 'cos they could be attacked by their own bloody membership otherwise. So I'd say what you'd get would be pretty good. And I think the same would go with the [other] extraction (CS3).
>
> Certainly from a science perspective, we would – we would be able to agree on – on certain things, but it's the interpretation of the science that would be interesting. I would place a lot of value on that information and potentially be swayed by it. But…, I would be particularly interested in the areas that they didn't agree on, or that they interpreted differently. And I would be, yeah, I guess I would be reasonably neutral about how that information would – would sway me (CS4).

SS2 would be suspicious of any conservation group or conservation scientists that would collaborate with an extractive group or scientists, saying,

> I can't imagine they could produce – come to you with a unified position, quite frankly. Yeah. I'd be wary – I'd be wary of a conservation group that presented a case in consultation – in collaboration with an extraction company.

Not all stakeholders agreed with the pairing as viable or productive. TWS3 said that, if he found conservation scientists and extraction scientists presenting agreed-upon research results he would, "Get out of the room and lock the door!"

MS1 said,

> Extraction and conservation interests together? Gosh, how much did you pay them to work together? Okay, I don't believe we'll ever see it happen. They would fight like crazy. How would they even present something? Okay, how would I even make that – I'm so confused about how that would even work, that it's hard to figure out what the end result would be…because they would just fight and then there would be no information ever presented. And we'd probably have a police investigation on our hands. Okay, so I'd put that high, 100 – if they were to ever get there.

While some stakeholders had a hard time conceiving of scientists representing conservation and extraction interests conducting joint research, the concept that the balance provided by disparate or non-aligned interests would produce the most trusted results was a consistent theme.

> I think whenever you get more than one interest working together, you're going to – you're going to push the honesty levels up overall,…I think that again having two different sort of groupings watching each other, knowing what they're doing, helps keep things honest and makes things a little bit – you might be less inclined to skew – skew things or put forward certain angles. (MS1)

RS3 perceived tension within the Government/Commercial Fishing pairing as beneficial, observing,

> And presuming that – the Government comes with a slant towards protecting and the fisherman and the extraction people want to extract so I would definitely give that quite a lot of consideration…. I would just see them as coming from a different side, if you like, from the conservation and from the extraction and the Government scientists to me would be from, from the protection side. I think if they can meet somewhere in the middle that has to have quite a lot of weight put to it. I may be less inclined if I thought they were both coming from the same angle.

SS3 saw a similar valuable tension in that group.

> Well the two are not necessarily a marriage in heaven so if they've worked together and come to a common goal and presented the results of that common goal, without hearing what it is right now -- you would tend to think that it's pretty well thought out. And it would be much the same with – with the Minerals as well

Conservation stakeholders thought tension within the Government/Non-government pairing was useful because the oversight each could provide ensured the formulation of good questions and independent results.

> Government and non-government scientists? I would place quite a lot of weight on that information. I just think the independence actually is really useful to qualify perhaps the constraints that government scientists might work within. So I would place a lot of value on that because the Government hopefully would actually be setting a research question – and – you've got that overview from the non-government scientists to make sure that the research is all kosher (CS4).

RS3 summed up the perception of many of his fellow stakeholders when he said,

> Is it [information derived from paired-source research] more believable? It probably is. You'd like to think there's a bit more balance in it if you've got two different opinions combined into one lot of research. I guess they should all effectively score higher than on the previous sheet [single-source], just because you'd like to think there's some more balance there. Maybe you would treat it with a little less scepticism. It probably makes it higher in confidence but does it necessarily make me change – more inclined to change my mind?

Discussion and Conclusions on Paired-source Research

Stakeholders indicated that paired-source research could reinforce or counter the concerns that caused them to mistrust results that contradicted their preconceptions or desires. While stakeholders showed high acceptance for pairings that teamed interests aligned with their own, these same groupings caused substantial concern for stakeholders whose interests were not included in the pairing. Therefore, such pairings would be unlikely to solve knowledge conflicts and promote problem-solving. Pairings of groups with more adversarial positions was seen as resulting in a more balanced research approach, with the oversight of one group over the other neutralising real or perceived biases and ensuring robust methodologies and interpretation of data. However, few could actually conceive of such pairing being capable of working together and producing results.

The three top pairings, Commercial Fishing/Conservation, Government/Non-government and Minerals & Energy/Conservation (73.7, 72.3, and 71.1, respectively), were almost 10 points higher than the next highest pairings, suggesting substantially increased acceptance of their results compared to other pairings. The inclusion of the Government/Non-government pairing in this top tier is significant because it provides the potential for that group, if properly configured, to conduct research that could be acceptable to the polarised extraction and conservation stakeholders. This 'Research by Champion' approach could consist of conservation, extraction and other stakeholders participating in research by helping to choose scientists and designs that would be acceptable to them, while not actually conducting the research themselves. This could be accomplished by having stakeholder involvement in the review and selection of grant proposals or by grant or contract reviewers providing increased merit for proposals that showed the applicant scientists had worked with stakeholders in formulating them. Such participation provides the additional benefit of producing more cost effective research because scientists will understand concerns stakeholders would use to refute project results at the onset when design changes can be made to accommodate or mediate such issues. Without such participation, scientific results are likely to be rejected and funds expended without contributing to solving the problem.

Multi-source Research

Overall Acceptance Values

OAVs for the multi-source research groupings ranged from a high of 80.8 for the most diverse and inclusive grouping (Government/Non-government/Tangata Whenua/Commercial Fishing/Conservation to a low of 66.0 (Government/Non-government/Minerals & Energy) (Table 7). GAVs for all multi-source groupings were substantially above 50, indicating that all were capable of causing the multi-

stakeholder group to move towards resolution of knowledge conflicts and possible consensus decisions. There was a strong trend for the more inclusive and diverse groupings to deliver more powerful and accepted results than less inclusive and less diverse groupings (Table 7).

Group Acceptance Values

GAVs provided insight into how specific stakeholder groups responded to information reported by multi-source scientists conducting research (Figure 5, Table 8). Among stakeholders, Management found multi-source research particularly persuasive, providing the highest GAV for eight of the nine groupings. Recreation stakeholders were cautious of many groupings and provided the lowest GAVs for five of the nine categories. Commercial Fishing and Conservation stakeholders continued to show opposing preferences. Commercial Fishing stakeholders registered their highest GAVs for research sources that included scientists associated with extraction and excluded those from conservation, while Conservation stakeholders continued to register their highest GAVs for research sources that included scientists associated with conservation and excluded those from extraction. However, the gap between Commercial Fishing and Conservation stakeholder GAVs was closed almost completely in the most diverse grouping that included scientists associated with all interests (Commercial Fishing, 76.2; and Conservation, 80.8). Tangata Whenua stakeholders also registered their highest GAV for research that included their scientists and were particularly cautious of groupings that excluded extraction, but included conservation. The highest GAV in the study was registered by Tangata Whenua stakeholders for the all-inclusive Government/Non-government/Tangata Whenua/Commercial Fishing/Conservation research source (93.6). The importance of participation in the acceptance of research results was underscored by the relatively low GAVs provided by Recreation stakeholders, who did not have a research choice that included them.

Table 7. Overall Acceptance Values (OAVs) describing the influence to stakeholders of scientific information derived from multi-source research. Stakeholders represented commercial fishing, conservation, management, recreation, science and tangata whenua interests involved with deliberations in New Zealand's marine protection area process. A value of 1 represents total disregard of the research results, 100 represents total acceptance of the results (mind change) and 50 represents the tipping point where a stakeholder might experience doubt concerning a preconception or belief. The highest OAV has been bolded and the lowest OAV has been bolded and underscored.

	Source of Scientific Research Information								
	Govt + Non-Govt + Comm. Fishing	Govt + Non-Govt + Min. & Energy	Govt + Non-Govt + Conservation	Govt + Non-Govt + Tang. Whenua	Govt + Non-Govt + Tang. Whenua + Comm. Fishing	Govt + Non-Govt + Tang. Whenua + Min. & Energy	Govt + Non-Govt + Tang. Whenua + Conservation	Govt + Non-Govt + Tang. Whenua + Comm. Fishing + Conservation	Govt + Non-Govt + Tang. Whenua + Min. & Energy + Conservation
OAV	68.0	**66.0**	69.5	73.2	71.8	71.3	75.3	**80.8**	79.3

Table 8. Cross-case comparison of Group Acceptance Values (GAVs) describing the influence of multi-source scientific research information on stakeholder groups. A value of 1 represents total disregard of the information articulated, 100 represents total acceptance of the information (mind change) and 50 represents the tipping point where a stakeholder might experience doubt concerning a preconception or belief. The highest Acceptance Value (AV) for each stakeholder group (row) has been bolded and the lowest AV for each stakeholder group has been bolded and underlined. The highest AV for each information source (column) has been denoted with † symbol and the lowest AV for each information source has been denoted with a * symbol.

		Source of Scientific Research Information								
		Govt + Non-Govt + Comm. Fishing	Govt + Non-Govt + Min. & Energy	Govt + Non-Govt + Conservation	Govt + Non-Govt + Tang. Whenua	Govt + Non-Govt + Tang. Whenua + Comm. Fishing	Govt + Non-Govt + Tang. Whenua + Min. & Energy	Govt + Non-Govt + Tang. Whenua + Conservation	Govt + Non-Govt + Tang. Whenua + Comm. Fishing + Conservation	Govt + Non-Govt + Tang. Whenua + Min. & Energy + Conservation
Stakeholder Group	Commerical Fishing	**81.6**†	**81.6**†	**63.2**	68.0	78.0	80.6	64.0	76.2	79.0
	Conservation	50.2*	**40.4***	**80.8**	73.4	49.2*	49.2*	78.4	**80.8**	75.3
	Management	82.6	84.8	**81.6**†	86.0†	89.8†	89.8†	86.2†	**91.8**	**91.8**
	Recreation	60.8	**55.0**	60.2	60.0*	59.4	57.0	63.4*	**72.0**	69.8
	Science	**60.0**	61.6	73.8	77.2	76.6	76.2	**78.8**	70.2*	66.8*
	Tangata Whenua	72.8	72.8	**57.4***	74.4	78.0	75.0	81.0	**93.6**†	92.4†

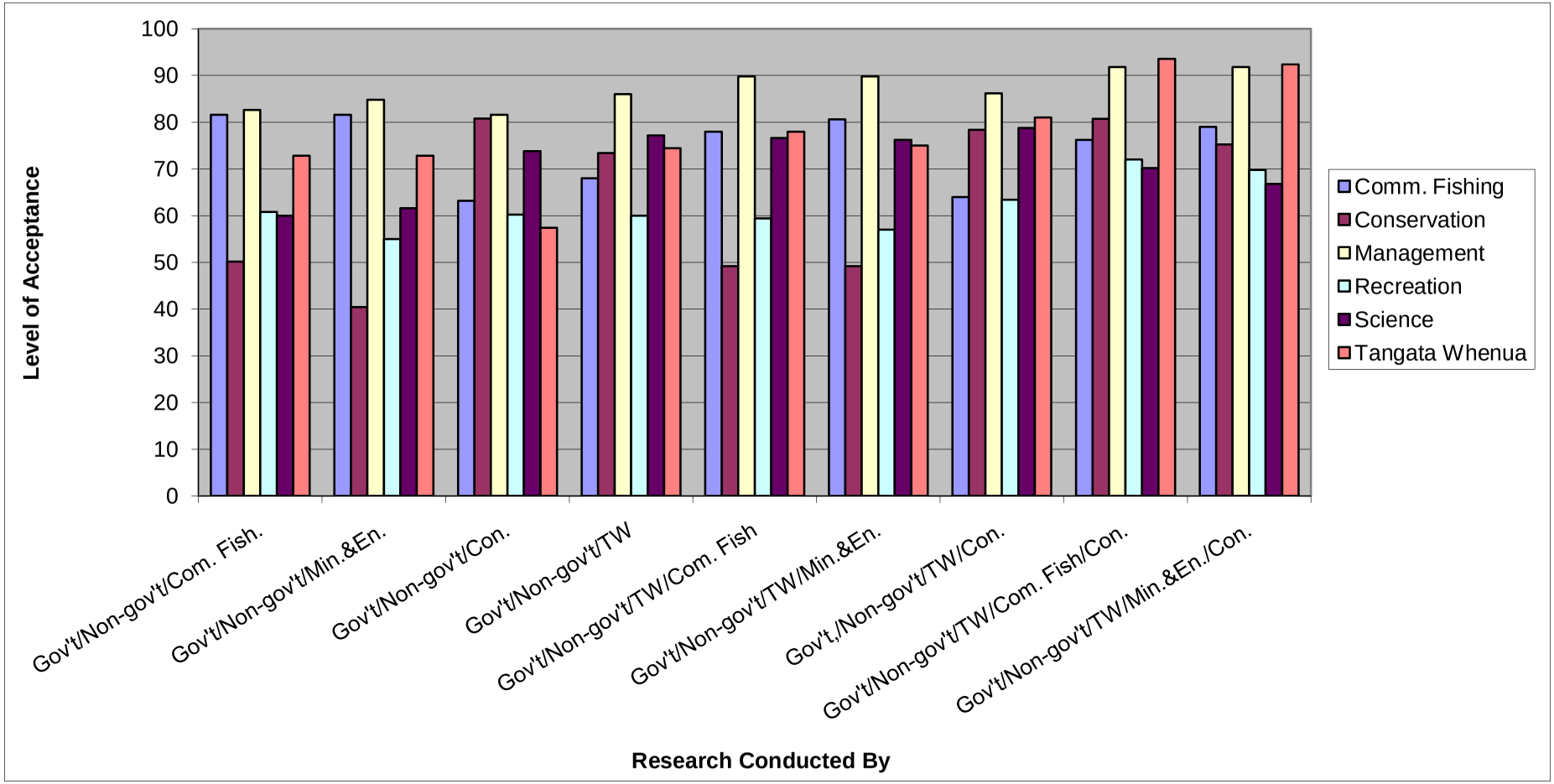


Figure 5. Group Acceptance Values of stakeholders for information provided by multi-source research. A value of 1 represents total disregard of the information articulated, 100 represents total acceptance of the information (mind change) and 50 represents the tipping point where a stakeholder might experience doubt concerning a preconception or belief.

Qualitative Explanation of Overall and Group Acceptance Values

The main theme emerging from the multi-source research section is that the balance provided by research that included a diversity of views led to research results that were more robust and better accepted by stakeholders. Even within the multi-source category, research groupings with the greatest participation and widest diversity of views provided the highest OAVs and those with the least participation and possibly narrowest diversity of views the lowest. The exception was the 3-member Government/Non-government/Tangata Whenua grouping had an OAV (73.2), slightly higher than the 4-member Government/Non-government/Tangata Whenua/ Commercial Fishing team and the 4-member Government/Non-government/Tangata Whenua/Minerals and Energy Team. In the latter two cases stakeholders perceived that the extraction aspects that can be part of Tangata Whenua interests might be aligned with extraction interests, thereby eliminating the tensions that stakeholders believed led to unbiased and reliable results.

Team of Rivals: Advantages of multi-source research

TWS2 summed up the dilemma for researchers seeking to provide information to support problem-solving this way,

> [How do you] get science done or research done in a way that's not going to be wasted because the people in the end who receive it all just don't trust each other enough to accept it because it's been initiated by one of them?...Where you've got different interest groups going away and purchasing advice – and again scientists, they have integrity – they've got processes and… ethical questions they have to ask….But, again no-one's entirely free from values, which is always an issue [and] it shapes the research.

TWS2 answered the question for himself, saying,

> [W]here you've got collaborative processes – particularly for doing research and trying to come up with information – where you've got something that's collaborative and where you're kind of negotiating some of these things all along the way, and you come out with a result that everyone's prepared to accept because they've been involved in doing the research; Then – I'd be prepared to trust that over anything, really.

TWS1 agreed that greater participation and diversity of views led to a research product with better acceptance, stating,

> Now we're into combinations of four, well that would be super powerful…[G]overnment, Non-government scientists, Tangata Whenua and extraction: so that would be – that would be all the extractors and the scientists and the government. Government, Non government scientists, Tangata Whenua and Conservation: so theoretically, if you get that to happen, that's got to be the best, just in terms of the gradation of more people participating in it – you'd get a closer, there'd be less room for bias because they've got the counterpoint in there. So I'm running out of space in this end of the range [top of the scoring sheet]. Government and Non-government scientist, Tangata Whenua, extraction and Conservation: well, more again, I can't get much closer to that line [100] without putting it on the line (TWS1).

TWS5 also provided support for the value of increased participation in research.

> [T]his is probably the ultimate kind of collaboration. Of external peer review and the bringing together a whole range of value sets…[Y]ou know the more diversity that there's been in that scenario, the…more diversity maybe in the peer review…[T]hey'd be coming at it [the research results] from such different angles…it's been reviewed more critically from those value chains or value systems that inherently you'd think the results have to be robust because they've come out the other end of that. You know, my guys are in there so they're not letting it out the other end until they're happy with it…and you know certainly with the conservation mob, they're not going to let anything go under their name they're not happy with. So yeah, it's a pretty interesting collaboration. It would be pretty amazing to be part of. So again, it's probably – pretty up-there…[S]o would I be more likely to change my mind? Probably – absolutely.

TWS3 provided support for the value of increasingly diverse groups. In terms of the most diverse group TWS3 said,

> I think that's a good mix, and they'd be able to look at the pros and cons of it from a – from their own perspective, and study. And that I believe they've come up with a – good mix. It might take a while, but I think that if they sat round a table with me and started bringing these things together, they would be able to convince me…to change my mind on things.

However, TWS3 added a caveat by saying, "I'd still have to go back and look at what data [there'd be] from the local people."

Recreation stakeholders also saw a benefit to more diversity in groups conducting research.

> I would say that all of those bigger groups, I'd trust them more. I'm thinking that it's maybe going to be less biased – I think it will be coming from a clearer, purer perspective perhaps. I'm a little bit cynical [that] science can also give results that they want to give, but I know science shouldn't do that. It should be exactly not that. But if I was presented with something at a group [MPA forum] like these [research] groups, because they're coming from a broader group, really, of thinkers, then I probably [would] think, 'Well if these people have combined and this is what they've found', I think I would probably trust that (RS5).

> [In more diverse groups] there's more chance we're getting it right. The more you have in the mix, the less chance of corruption. Well, less chance of inaccuracies. Because what I'm saying is there's checks and balances in that system. Because it's not swayed one way, where it can be in those other ones (smaller groupings). There's checks and balances in there, there's each group with their barrow to push and they're just going to make sure that it is – each grievance or each bit of science is peer reviewed much better because it's been peer reviewed by each group, if you understand what I mean?... [W]ith the right mix in the group, the right questions are asked and they have to be clarified clearly before anyone supports it (RS2).

RS4 put it more succinctly when he said, "You can't have that many liars in the room at one time."

Management stakeholders were also major supporters of research that combined as many different interests as possible.

> It's the largest group. It's got the most internal tension if you like. Less likelihood of manipulation of the hypotheses that were being tested or the questions being answered, the research, protocol, probably – probably more trust in the interpretation of the data, assuming everyone's in agreement about the outcome of the research. So I would probably be pretty convinced by that…[When] you've got that many people involved, it would be hard for me to understand – conceive why I would still not change my mind other than sheer bloody-mindedness, stubbornness. So that sets the benchmark (MS3).

> [T]he more parties the more checks there are on things not going down a particular [direction] or getting pushed down a particular track or another. With more parties involved, so more than one [single-source research] or probably more so than the two pairings from last time as well, that having three – [or more] parties involved in the research is going to ensure that it's more robustly carried out, just as completely objective as it could be. Yeah and I guess if I had any concerns before about government and fishing or extractive ones together, then – in terms of political pressure and benefit for the economy or something that might be pushing things down a particular path, then having the involvement or another group [or groups] in that research would alleviate those concerns a bit…Having people involved in the work that are coming from three [or more] different angles, those parties are keeping [each] other in check then it should make for good research and good outcomes of the research (MS4).

> If you've got conservation and fishing, which basically are the two poles, together, then nothing – they're both going to be watching each other like a hawk, and nothing – nothing is going to get through there, I don't think, that's not 100 percent true (MS1).

MS5 revisited the concept that all science and scientists should be the same and that results should be independent of the research source.

> In theory I should be scoring it [all groups] exactly all the same [because science is science]…On a perfect day, you would like [to] see and like to be able to make sure that confidence in scientists, in an individual sense, is exactly the same. But you are probably influenced by experience…[T]hat grouping (most diverse groups) in some respects [is] a balance between all those groups …So, once again, a grouping of very different interests together can create balance.

MS5 identified another reality for managers in terms of the potential for multi-source research to produce agreed upon information and reduce conflict over decisions when he observed that, "[I]t would make life for government a lot easier, too."

Scientists also supported the concept that more diverse research sources could provide more informed and better trusted results.

> As an overall comment, the more people you can get to agree and get in a room to agree on something, then perhaps the more likely I am to believe the results. Bigger groupings, bigger collaborations I tend to be more likely to

> believe because more people have had an input in the process…Especially if they're kind of opposing groups…[I]f all the groups were standing there all agreeing on presenting a piece of research – it's not going to get much better. I'm not going to be more convinced by any other group than all of those groups standing there if they're agreeing on what they're saying. I still couldn't believe everything that I heard (SS5).
>
> I think for me, and probably for most people, the more people who are – and in particular when they represent the different interest groups that we tend to have around the table – when they all singing the same song you tend to naturally have greater confidence in what you're hearing. I would be much more prepared to accept what the fishing industry is saying when conservation interests and independent academics and government scientists are also saying similar things. That will give me much greater confidence (SS1).
>
> The fact that all these groups got together and produced a result is a big strength…[I]t has more different angles… more viewpoints come in to the discussion and the report or whatever comes out of it. So I think just in the fact that that's happened adds robustness to the information…does help to provide a good and believable result (SS4).

SS3 focused on the value of the broader prospective and knowledge-base that increased participation and diversity can bring to research, saying,

> And things come out of the woodwork that you've never thought of before. If you're – if you're in a narrow disciplined type position you can be an expert in that and have great confidence in the things that you're saying and somebody says, 'But you know if you go into the water it's actually yellow. It's not blue that you're talking about.' And you all of a sudden you say, Oh, &*%#.' You know? And – and that's what can come out of the multi-stakeholder [participation] (SS3).

While Commercial Fishing and Conservation stakeholders provided high GAVs for groups with increased diversity conducting research (as long as it included them), their support was sometimes more reserved.

> Well, if they're all together and they…present something to you and they've got a consensus on it you'd have to say it would change my mind. I mean the extraction people wouldn't be able to buy everyone off, you know? – Even if the real radical ones [Conservation] were involved because I think they'd – the other guys would sort of cancel [them] out a bit (CFS5).
>
> Because they – there's – if Extraction, Conservation and Iwi [are] working together [with Government and Non-government] and were presenting findings, I would have faith that they would be true and correct (CFS2).
>
> Well, there's more people looking for it to make sure the science is correct, I'd presume, yeah (CFS1).
>
> Government, Non-government Scientists, Tangata Whenua, Extraction and Conservation. *&%# – now if you put the whole lot together and they all agreed – oh well I'd go pretty bloody high, to be honest. I mean if you can get that lot to agree – that particular group to agree I'd go – yep I'd go up there…

> [I]f you've got agreement amongst everybody with all their different agendas I would think that – in our research – they've all agreed that the research that's been done is kosher, I'd mark it high. Because you've got competing groups saying – agreeing with that data (CS3).

> [B]ecause of the mix of views, the balancing in terms of priorities. If you had all of the key interests involved then you'd have a huge amount of debate about what the research priorities should be, how it should be conducted, what the key questions were, how it should be reported back. And so there is collaboration in terms of the science which then should influence collaboration in terms of the management and recommendations. Because it should circumvent some of the discussion that happens around the table (CS1).

Both Commercial Fishing and Conservation stakeholders also left open a wider door that might allow them to reject the results of such a group. For example, CFS3 stated that such grouping would provide powerful information, if he was open to it.

> Yes, so if they're all agreeing, and *if I was open to it*, then I would have to put that very high, because of – if you, well, it's essentially a collaborative approach, again, across a range of stakeholders, and if they are in agreement, then I think that that provides a very powerful statement (CFS3).

CS4 stated the increased participation and diversity in the broader research grouping would be valuable, but was unsure how much it would change her position,

> Because the perspectives that were being put forward – would be really well-considered and well thought through. But again, the issue of, where the points of commonality are and the points where there is no agreement or the interpretations are different, I'd be particularly interested in; as interested in as in the points of commonality. So whilst this would inform my – my perspective, I'm not sure how much it would change my mind (CS4).

RS3 also questioned if the results would change his mind, but decided that they would.

> [O]bviously the more people you have perhaps having input the more you would accept what they're telling you. Does it incline you to change your mind or are you going to defend your position against the un-defendable? Just because I want to still be able to go and dive on my rock. – I think you have to [change your mind] – the bigger the group obviously the more – not the – not necessarily the bigger the group but the more diverse the group that's put the research together, I think you should – that would be considered – you'd be more accepting of what they're telling you.

Not so fast…

There were also stakeholders that saw distinct problems with research being conducted by large groups composed of competing interests. A common concern was that while the diversity of the group would contribute to its ability to produce information that was robust, those same factors would inhibit its ability to function.

> I'm sure there would be too many people in this thing. You know, they [say] KISS – Keep It Simple [Stupid]. And with the amount of knowledge – the level of knowledge that's all in these here, somewhere along the line we're

> going to have a breakdown – amongst ourselves. But if I was to listen to them I would be thinking to myself, 'First of all, where does each one of these ones stand on this thing?…How does each one of these feel, separately, how they should go about it?' [And if they could agree] they would be confirming to me that – outside of each other, they're confirming, but they're all still talking, coming to the same conclusion… And you know you'd have more overarching thoughts on how we can get to the bottom of it [the problem solution] (TWS4).

> Now you might start to get into trouble with having too many… [T]he more groups you have, sometimes the harder it would be in terms of carrying out research and that research being presented…I guess it probably even strengthens it really because if its research on a particular issue and you've got… all the groups around the table have some – have an interest in that issue and you've got four of them that have done some research and presenting it to you, then yeah, I think that would probably have quite an influence on me…So I'd go higher than those three [3-source groupings]. And I'm going to say the same for these (5-source groupings) (MS4).

Both Commercial Fishing and Conservation stakeholders were concerned that the make-up of the group could be configured to be against them.

> [T]here's too many ganging up on that fisherman now, on the fishing man. So you'd come back to there (lower AV)… Because he's only – he's only one against a whole lot of buggers that possibly aren't [fishermen], you know? Although I believe that the extraction fulla would be on the same side as the commercial fisherman, you know, because he's extraction, which gets into as much strife with the Conservation and Government [interests]. Yeah, that's what I'm saying is, they may – they may have beat the fisherman down (CFS4).

> This assumes a whole lot of things though. It assumes that the appointment of people to the group that negotiates what the research is to be has been well done. That there's not a loading in the group against conservation interests which often happens. So there's a whole lot of assumptions in here (CS1).

SS3 had two concerns relating to the most diverse groups conducting research. First he was concerned that some members of the group might not have a thorough enough understanding of the results to communicate them effectively to their stakeholder group. Second, he was concerned that if all those concerned about an issue were involved in the research, who could speak out against their findings?

> And I was just looking at that [his AV scores] as we spoke and I thought, 'Why didn't I put – if we've got everyone [in the research group] why didn't I do that [score most diverse group highest]. And – I'm not too sure why except – smaller groups that are more targeted possibly have more of an impact than a larger group that's got everybody in it. You may just have a consensus with a larger group without all the people in that group understanding the issues in a deep enough way to actually make a difference to other people. Whereas if you've got the people in the group that know a lot and are the ones that 'should' be there, in inverted commas, then the consensus that they've come to is from an informed position.

> Probably why these – these two things here [smaller multi-group and larger multi-group AVs] – differ. And it was just – I just looked at it as we were talking thinking 'Why the hell have I done that [scored smaller groups a bit higher]?' But yeah that's – that's probably why. You get – you get too many people in and they've all been bought if you like, to come up to some – to some sort of an answer. And because they've [the information purchaser] got everybody, there's no opposition so they [the information purchaser] can say whatever they like. [There is a situation right now] where it's a reasonably big company and they are actually sending out letters of engagement to a large number of scientists. And I think it's probably – so they can have them all on their side. Now the scientists aren't on anybody's side but of course the client thinks they're on their side. So if they've got them all [on their] side – but if they've got them all signed up they can't do evidence for the opposition… I mean the best lawyers want the best people. And if they can't get the best people they get all of them (SS3).

There was also the concern that multi-source research was just not done and couldn't be done in New Zealand. As stated by SS2,

> Research conducted by Government, Non-government scientists and extraction? I mean, they just don't work together. I mean, if an extraction industry wanted to get scientific information, they sure as hell wouldn't get it from both Government and Non-government…Because Government scientists, I've already told you, if it's a contract which has come through the Government, which a Government scientist would be doing, then they're constrained. A Non-government scientist is totally unconstrained and would have quite a different view. I can't imagine that a Government scientist and Non-government scientist would reach a consensus in dealing with an extraction company. All I can say is I just can't imagine in New Zealand such a group would come up – would even be working together. Nobody would believe them…Government, Non-government – Tangata Whenua and Conservation? Again – Government, Non-government, extraction and Conservation. No way. No way they will work together. I just can't imagine them working together. If an – organisation wants to get scientific information they'll go to the best source. They wouldn't go to two [or more] sources.

Discussion and Conclusions on Multi-source Research

The solving of contentious problems requires information that is accepted by a wide range of interests. This portion of the study suggests that research that is conducted by multiple interests, a "Team of Rivals" approach, produces information that is prone to acceptance. In addition, the sources that contained the greatest diversity of interests generated the highest levels of acceptance, indicating the most powerful impact on decision-making.

Transcript analysis provided important insights into why stakeholders were inclined to embrace the results of multi-source research, and their concerns with various groupings. A major factor for acceptance was the perception that the involvement of stakeholders was the best way to achieve the scientific ideal of objective neutrality. Fears that the research process was biased against them were a chronic concern of those who would be impacted by its findings. Theoretical assurances of scientific

objectivity did little to reduce such concerns, because the stakeholders own experiences and observations convinced them that the scientific process was riddled with conscious and unconscious forms of bias. Therefore, the inclusion of more interests was seen as a safeguard to objectivity, with each interest making sure their views and concerns were acknowledged and addressed.

The advantages of such inclusion were seen as far-reaching. In addition to real or perceived neutrality, research infused with multiple perspectives was seen as able to identify a more realistic set of problem definitions, generate a wider range of hypotheses for testing, ground data and interpretations in real-life experience, and maintain the problem-solving focus of the research. An important strength was seen as the ability of the more inclusive groupings to act as an extended peer review process, thereby increasing the reliability of findings. Therefore, the social and scientific quality of the information was enhanced by the inclusive nature of multi-source research

An important outgrowth of these advantages was greater influence in the policy setting. Increasing the acceptance of information was seen as a way of decreasing the conflict over its use. This was particularly important to managers because it directly related to their main goal: the crafting of non-controversial policy decisions. Therefore, managers could be more prone to implementing decisions based on multi-source research because it directly addressed their need to protect themselves from criticism.

However, multi-source research was not seen as a panacea, and numerous concerns were identified. Some groupings (triplets) were still seen as biased despite the increased level of participation. Even the most diverse and theoretically most robust groupings had important concerns associated with them. Paramount among them was the concern that the make-up of the groups could still be configured to work against specific interests and individuals could be coerced into accepting the group's position.

There were also concerns that the internal conflict within the larger groupings would paralyse them. If so, substantial time and funding could be expended without anything being produced. Additionally, policy would be reduced to a waiting game; with the status quo continuing while interest groups stalemated research. There was also the concern that these types of research just weren't done in New Zealand. A final truth was the realisation that policy measures that directly contradicted the values or well-being of special interests would never be graciously accepted by them, regardless of the social and technical quality of the research used to make them.

Journal-published Research and Non-published Research Reports

In addition to research that is directly presented to them by scientists during the deliberative process, stakeholders are also provided with research that has been published in scientific journals or research reports that have been produced by scientists, but not published in scientific journals. To understand the influence of this information and its strength relative to single, paired and multi-source research, stakeholders were asked to score their level of acceptance for these information sources using the same 1 – 100 scale.

Overall Acceptance Values

Stakeholders provided journal-published research with a substantially higher OAV (73.5) than non-published research reports (55.3). While journal-published research reached levels capable of achieving considerable doubt in the mind of stakeholders concerning the preconceptions with which they entered the deliberative process, non-published research reports had little influence on the group as a whole.

Group Acceptance Values

All stakeholder groups provided substantially higher AVs for journal-published research results as compared to results that were contained in non-published research reports (Table 9). GAVs for published research ranged from a high of 82.6 (Conservation stakeholders) to a low of 66.4 (Commercial Fishing stakeholders). GAVs for non-published research reports ranged from a high of 58.4 (Science stakeholders) to a low of 51.0 (Commercial Fishing stakeholders).

Table 9. Overall Acceptance Values (OAVs) and Group Acceptance Values (GAVs) describing the influence to stakeholders of journal-published and non-published scientific information. Stakeholders represented commercial fishing, conservation, management, recreation, science and tangata whenua interests involved with deliberations in New Zealand's marine protection area process. A value of 1 represents total disregard of the research results, 100 represents total acceptance of the results (mind change) and 50 represents the tipping point where a stakeholder might experience doubt concerning a preconception or belief. The highest OAV and GAVs have been bolded.

		Source of Scientific Research Information	
		Journal-published Research	Non-published Research Reports
	OAV	**73.5**	55.3
Stakeholder Group	GAV: Commercial Fishing	**66.4**	51.0
	GAV: Conservation	**82.6**	51.6
	GAV: Management	**77.0**	55.8
	GAV: Recreation	**66.6**	57.6
	GAV: Science	**78.4**	58.4
	GAV: Tangata Whenua	**70.0**	57.6

Qualitative Explanation of Overall and Group Acceptance Values

The main themes emerging relative to the value of journal-published versus non-published research reports is the increased credibility that outside, independent review bestows on results and that the review inherent in multi-source research can be an important and credible type of peer review.

Peer review, such as that which occurs during the formal review process of scientific journals, was seen as providing a level of confidence and validity that was lacking from research reports, which had often undergone limited review or review only

within the interest group providing the report (e.g., government agencies reviewing the work of their own scientists or government agencies and fisheries industry scientists reviewing results together). As stated by SS4, information published in a scientific journal was assurance that the results had been vetted by an "objective… impartial process that's looked at the information that's provided without any influence from interest groups that might skew the results." For SS4,

> [T]here's definitely a difference between peer reviewed published scientific research and non-peer reviewed reports… so the peer review process adds a lot to the validity of the results.

SS1 agreed on the difference in credibility between results provided by journal review and that provided by internal review such as provided by government agencies for their work, saying,

> [T]here's a different scale in that one [journal publication versus report publication] to deal with. So there are a number of say Ministry of Fishery reports for example which are – sometimes are peer reviewed with – within NIWA, within Ministry of Fisheries. There are Department of Conservation reports. I've written these sorts of things and sometimes they're internally reviewed. I don't tend to place as much weight on those sorts of report as on the peer reviewed international literature (SS1).

Commercial Fishing stakeholders also had increased faith in research that had appeared in scientific journals, but with some caution. As noted by CFS4,

> [P]ublished scientific research? Yeah,…and it's peer reviewed and [then] someone comes up with a totally different answer. I mean we've had that many times over the millenniums. Some scientist years ago found that something – and then someone else comes up with new evidence and says, 'Oh no, he's totally wrong, this is what happened'. So it doesn't necessarily – it's not necessarily the whole truth…There's so many things that have happened over the years that we've found they have changed their mind on. And unless you get some – a number of people and from different – not all from the – if they're all conservation type scientists they'll all come up with the same answer and so unless you get a – the peer reviews are done by someone who is trying to discredit it and says well I can't discredit it, you know?

In terms of non-published research results CFS4 said,

> Non published? It's not worth the paper it's written on, unless its peer reviewed. So yeah, so the non-published, I wouldn't take any notice of it at all.

While peer review was seen as providing an improved level of acceptance for scientific information, some of the original concerns over whether or not researchers had asked the correct question, and issues relating to biases inherent in the research remained.

> The published stuff is a little difficult because you'll obviously appreciate there's a range of published work and quite often, at least in my experience, it's not always directly on point, whereas this sort of stuff [non-published 'grey' literature] is – in my experience anyway, it is usually tailored specifically to the questions that we've asked, because it's been funded in response to something that we're working on. But inherent in all that, are the

> questions that we've just dealt with here [in the interview] about where does it come from and who has done it and who funded it. So while the quality of their work may be good from a science perspective, it might be more difficult for me to – I might be less inclined to change my mind. Just because it's published I don't think it necessarily means it's going to be better work or more convincing work. Yeah, for me there's most uncertainty about that, because I don't know where it's come from and I don't have enough trust in the scientific peer review process to ignore that. For me, I want to know where the work's come from and who has funded it, because to me that says who asked the question, who phrased the question, who framed the work, who conducted it, who chose the scientists, who – you know – so to me I think while I'm happy to operate on the assumption that science is impartial and objective, I know it's not always true so I'd like to delve a little deeper. Having said that I'm still obviously much more convinced by published than grey literature (MS3).

TWS1 also felt that published scientific literature was lacking:

> Published scientific research without the stakeholders, I don't have a very high opinion of that. I think the stakeholders are where the information needs to be collected from. So scientific research is fine, in combination with all the stakeholders would have been the optimal. But without the involvement of the stakeholders, then I would sit it in the neutral zone here. And I would rate this [non-published] less.

SS3 summed up the relationship between published, non-published and multi-source research saying,

> I would need to read it to evaluate it [the research]. Just because something is published – there are some fantastic papers published out there and there are some absolutely awful bits of research that should never have been published and – and somehow find themselves into really good journals. So I think just because something is published doesn't mean that it's any good, and I think just because something isn't published doesn't mean that it isn't any good. If the scenario is that we're in a room and there's a group of people trying to convince us with what they're saying as right. In that situation to me it's – there is no kudos for one of them standing up and saying, 'I know about whales and dolphins because I've just had this paper published in Conservation Research.' To me if there's Tangata Whenua beside them, Conservation Interests, Government, Non-government Scientists all saying, 'We did this research, we're – we're giving – we're giving it to you now and here is the report that we have done for this.' I think in today's – in the modern day and in that scenario around the table there is as much kudos in the non-published thing as there is in the published.

Discussion and Conclusions on Journal-published Research and Non-published Reports

The external peer review process that allows research results to appear in established scientific journals was seen by stakeholders as providing a substantially higher level of credibility, and having a substantially higher level of acceptance, than research that was provided from technical reports or other forms of "non-published' literature.

However, stakeholders also understood its limitations. Commercial Fishing stakeholders identified the fact that science is a self-correcting enterprise and that, historically, many of the things scientists believed to be true are invalidated by further research. In that case, why should they accept results that are detrimental to their well-being when those findings might ultimately be proven false? In addition, journal research was also seen as potentially less helpful to problem-solving because it often lacked a direct connection to the place or problem being debated by the group. Finally, the acceptance of peer reviewed information was still hampered by perceptions of bias that are not part of the normal peer review process, which focuses on technical aspects of research. Many stakeholders believed that the peer review inherent in multi-source research produced a review process that was as good as, or better than, that produced by scientific journals because it could focus on the social and technical concerns of the stakeholders. In addition, the use of multi-source research allowed science to be targeted at the questions most important to the group.

Comparison of Overall Acceptance Values from All Sources of Research.

A comparison of OAVs derived from anecdotal, single-source research, paired-source research, multi-source research, published research and non-published research information provided a general means of evaluating the strength of information delivered to stakeholders involved in contentious deliberations such as those characterised by the formation of multi-stakeholder working groups (Table 10). There were major differences in how stakeholders accepted information originating from different sources. Anecdotal and non-published research information were seen as having the least ability to challenge the preconceptions and beliefs of stakeholders (55.0 and 55.3, respectively). Journal-published research and multi-source research were identified as the most powerful sources of information (73.5 and 72.8, respectively).

Table 10. Overall Acceptance Values (OAVs) comparing the influence to stakeholders of information derived from anecdotal, single-source research, paired-source research, multi-source research, published research and non-published research origins. Stakeholders represented commercial fishing, conservation, management, recreation, science and tangata whenua interests involved with deliberations in New Zealand's marine protection area process. A value of 1 represents total disregard of the research results, 100 represents total acceptance of the results (mind change) and 50 represents the tipping point where a stakeholder might experience doubt concerning a preconception or belief.

	Source of Information used for Problem-solving					
	Anecdotal Information	Single-source Research	Paired-source Research	Multi-source Research	Journal-published Research	Non-published Research Reports
OAV	55.0	60.2[25]	62.3	72.8	73.5	55.3

[25] Scores for the "You" category were not included in this calculation.

DISCUSSION

The contentious and complex nature of debates involving environmental issues has led to the increasing use of multi-stakeholder working groups to develop consensus solutions to problems. In the case of marine protected areas, these groups are often composed of people with different, and often conflicting, goals and values. For such groups to solve problems and resolve conflict they must agree on the validity of the information provided to them for problem-solving, and groups spend considerable time and energy debating the credibility of information. This study provided a mechanism for evaluating the credibility or "acceptance value" of information derived from the sources that typically present information to such groups. In addition, it provided a mechanism for understanding why information was accepted or rejected as credible. By doing so, it identified techniques that could increase the ability of information to be accepted by stakeholders as credible and therefore resolve the knowledge conflicts that can stalemate group decision-making, i.e. increase the 'social power' of the information.

The study investigated six different types of information and their social power, i.e. their ability to change the mind of stakeholder's involved in high-stakes debates. Each type of information varied by its source. Sources of information were: anecdotal, single-source research, paired-source research, multi-source research, journal-published research, and non-published research reports. Results indicated that these sources could be placed into three tiers of social power. The lowest tier was occupied by anecdotal and non-published research report sources. OAVs for these sources (55 and 55.3, respectively), indicated that information from them would cause only minor doubt in the mind of stakeholders and contribute little to the resolution of conflict.

The next tier was occupied by single-source and paired-source research. OAVs for these sources (60.2 and 62.3, respectively) indicated that they were capable of causing substantially more doubt in the minds of stakeholders concerning the preconceptions and beliefs with which they entered the decision-making process. Of these sources, the highest OAV was for single-source research that the interviewed stakeholders actually conducted themselves (85), followed by paired-source research that combined oppositional interests (Commercial Fishing or Minerals & Energy) and Conservation interests (73.7 and 71.1, respectively) and Government/Non-government interests (72.3).

The top tier of social power was occupied by multi-source research and journal-published research. OAVs for these sources (72.8 and 73.5, respectively) indicated that results provided by them were capable of making stakeholders seriously question the preconceptions and beliefs with which they entered the decision-making process. Of these sources, the highest OAVs were attributed to the most diverse multi-source categories containing all stakeholder interest groups (Government/Non-government/Tangata Whenua/Commercial Fishing/Conservation and Government/ Non-government/Tangata Whenua/Minerals & Energy/Conservation; 80.8 and 79.3 respectively). These diverse groupings received AVs almost as high as that provided for research conducted by the stakeholders themselves (85).

The identification of journal-published research and multi-source research as the two categories with the highest AVs is interesting because each evaluates research results from a different perspective. The peer review provided for scientific publication

typically focuses on technical aspects of the research, and the high value stakeholders placed on such review relates to the need for research to be judged technically credible. In contrast, the high value stakeholders associated with multi-source research relates to its ability to offset concerns relating to various types of bias and, by doing so, be judged socially credible. The closely matched OAVs provided by stakeholders for journal-published results and multi-source results (73.5 and 72.8, respectively), indicates that stakeholders judged the technical and social aspects of research to be equally important.

CONCLUSIONS AND RECOMMENDATIONS

Environmental problem-solving in the 21st century has moved away from the techno-rational approach that dominated past decision-making and management. Modern decision-making is increasingly viewed as deliberative and participatory, characterised by multi-stakeholder processes such as those convened to inform decisions in New Zealand's marine protected areas. Information provided to stakeholders for decision-making contains both social and technical components. Traditionally scientists have focused on the technical aspects of problems and counted on confidence in the scientific process to eliminate social concerns, such as research bias or the vested interests of scientists affecting their results. However, this study demonstrates that social aspects of research are a high-order concern and invariably used by stakeholders to invalidate information that is counter to their preconceptions or desires. Therefore, research that ignores social concerns has substantially reduced impact on problem-solving and decision-making. As a result, such research is not efficient or cost effective.

This study indicates that one way scientists can reduce the social concerns that invalidate their results is to increase the inclusive aspect of their research. Stakeholder involvement in research can take many forms and I provide a "Ladder of Scientific Participation" (Figure 6) that can help identify ways that scientists might interact with stakeholders, and the potential outcome and results of each.

Rungs 1 – 3 of the ladder are "first-order" methods, which are typical of traditional forms of stakeholder participation. Traditionally stakeholder participation has been relegated to reading written scientific information or listening to scientific information summarised by managers. First-order participation has low social power because the numerous barriers to accepting information that have been identified in this study are ignored. The outcome of first-order participation is that stakeholders selectively accept information that bolsters their position and reject information that could undermine it. Therefore, such levels of participation lead to stakeholders becoming increasingly entrenched in their positions instead of using information to promote problem-solving and consensus decisions.

Rungs 4 – 6 of the ladder consist of "second-order" methods, demonstrating increased participation. Second-order techniques would consist of scientists presenting their research design to stakeholders prior to initiating an investigation, providing stakeholders with updates on research as it is being conducted and with the opportunity to visit and observe the research as it is being conducted. The outcome of second-order participation is that scientists and stakeholders are educated about the research and the conditions under which it will occur. This would include the ability of stakeholders to identify unexpected deficiencies and concerns that could invalidate the research's final results and the ability of scientist(s) to adapt design changes while it is still possible to do so. Therefore second-order methods add substantial social power to the research by increasing stakeholder confidence that their concerns are being addressed.

Rungs 7 – 9 of the ladder are "third-order" methods, incorporating maximum levels of participation. Rung 7 involves stakeholders participating in the selection of scientists conducting the research, allowing the research to be conducted by scientists with whom opposing interests have confidence (i.e., Research by Champion). Increased

participation (rung 8) would involve stakeholders contributing to the selection of the scientists conducting the research and the research design that they would use. This could involve stakeholder participation in the review and selection of grant proposals or reviewers placing a positive emphasis on proposals that demonstrated stakeholder involvement. The outcome of these types of participation is the collaboration of scientists with a diversity of views, a robust problem definition and research design, and increased social power of the results.

The top rung of the ladder (rung 9) would have stakeholders or stakeholder scientists directly participating in the research (i.e., Team of Rivals). This would assure that the greatest diversity of interests and perspectives were included in the research and that the concerns of all were being addressed. As such, it would provide maximum social power to the results. However, such large collaborations could become expensive, logistically difficult, and paralysed by infighting.

In summary, the traditional perception that scientific research is viewed as providing credible and unbiased information because research is conducted in isolation from those most impacted by its results (i.e., stakeholders) is invalidated by this study. Such research contributes to stakeholder entrenchment by allowing stakeholders to construct myriad reasons to reject it, rather than contributing to problem-solving by providing agreed-upon information for decisions. Research that is inclusive, balanced by a diversity of interest and demonstrates a full set of problem definitions and potential solutions, as identified by those impacted by them, is shown to provide results that are seen as more credible and more likely to be accepted by stakeholders for consensus decisions. Attention to such aspects of research will increase the social power of results and help scientists achieve the scientific ideal of producing information that is judged unbiased and defensible. Ultimately, increasing the social power of scientific research will increase its efficacy and cost effectiveness as a problem-solving tool, thereby increasing its ability to conserve biodiversity and protect the resources and economies on which we depend.

Figure 6. Ladder of scientific participation by stakeholders, showing ways that stakeholders can be included in the scientific process, and the outcomes of particular types and levels of stakeholder participation.

Third-order Participation

Rung 9: Stakeholders directly participate in the research (*Team of Rivals*)

Objective:	Direct stakeholder participation in research
Outcome:	Collaboration among diverse perspectives
	Stakeholder participants ensure appropriate problem definition
	Stakeholder participants ensure robust research design
	Stakeholder participants convey results to their own interest groups
	Stakeholder participants can be personally criticized by own interest group
Result:	Maximal social power of results
	Increased expense and logistic difficulties

Rung 8: Stakeholders participate in selection of scientists conducting the research and the research design (*Review and selection of grant proposal*)

Objective:	Stakeholders select scientists and design in which they have the most confidence
Outcome:	Collaboration among scientists with diverse perspectives and who have the confidence of stakeholders
	Stakeholders ensure appropriate problem definition
	Stakeholders ensure robust research design
Result:	Maximise social power of results

Rung 7: Stakeholders participate in selection of scientists conducting the research (*Research by Champion*)

Objective:	Allow stakeholders to select scientists in which they have the most confidence
Outcome:	Collaboration among scientists with diverse perspectives and who have the confidence of stakeholders
Result:	Maximise social power of results

Second-order Participation

Rung 6: Stakeholders visit the research as it is being conducted

Objective:	Increased opportunity to educate scientists and stakeholders about the issue and the research's ability to provide a solution
Outcome:	Stakeholders directly observe techniques and methods
Result:	Ability to adapt design to meet concerns prior to completion
	Increased social power of results

Rung 5: Research design presented to stakeholders and preliminary finding reported as study progresses

Objective:	Educate scientists and stakeholders about the issue and the research's ability to provide solution
Outcome:	Stakeholders identify unexpected deficiencies or concerns
	Improve relationship between scientists and stakeholders
Result:	Ability to adapt design to meet concerns prior to completion
	Increased social power of results

Rung 4: Research design presented to stakeholders for input prior to study

Objective:	Educate scientists about the issue
Outcome:	Stakeholders provide broader problem definition
	Stakeholders identify potential pitfalls and solutions
Result:	Improved research design
	Stakeholder "buy in" to design
	Increased social power of results

First-order Participation

Rung 3: Scientific results presented to stakeholders by researchers that conducted the research

Objective:	Educate stakeholders about the issue
	Stakeholders make rational consensus decision
Outcome:	Stakeholders selectively use information to bolster predetermined position
Result:	Entrenchment

Rung 2: Scientific results presented to stakeholders by managers or scientists that did not conduct the research

Objective:	Educate stakeholders about the issue
	Stakeholders make rational consensus decision
Outcome:	Stakeholders selectively use information to bolster predetermined position
Result:	Entrenchment

Rung 1: Review of written scientific results relating to the issue

Objective:	Educate stakeholders about the issue
	Stakeholders make rational consensus decision
Outcome:	Stakeholders selectively use information to bolster predetermined position
Result:	Entrenchment

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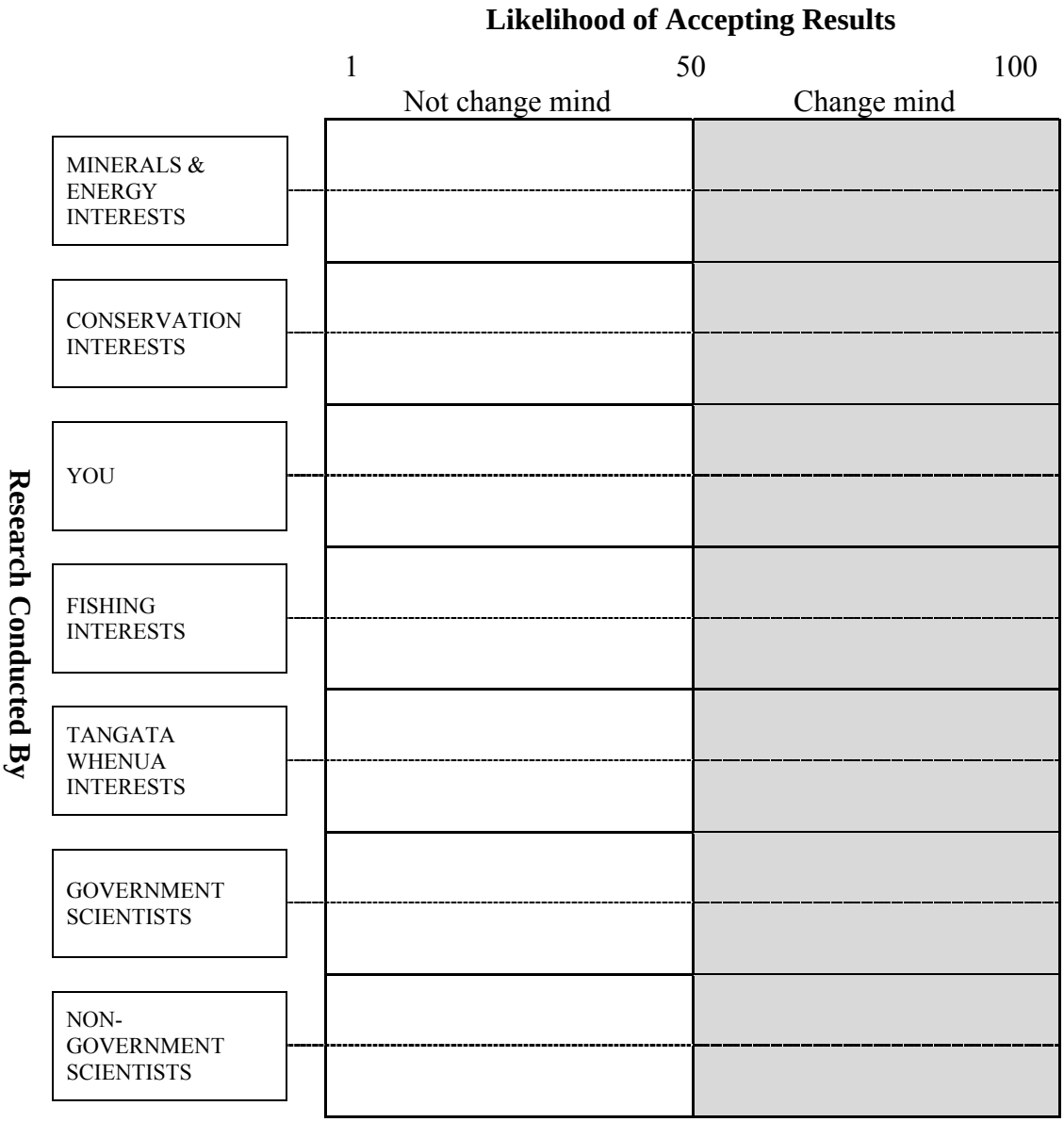
APPENDIX 1: INTERVIEW SHEETS

Worksheet #2 used during stakeholder interviews relating to the acceptance of single-source research information by stakeholders involved in multi-stakeholder deliberative groups relative to decisions about New Zealand's marine protected areas. The actual worksheet also had tick marks at 10 unit intervals.



Worksheet #3 used during stakeholder interviews relating to the acceptance of paired-source research information by stakeholders involved in multi-stakeholder deliberative groups relative to decisions about New Zealand's marine protected areas. "F" denotes Commercial Fishing as an extractive activity and "M" denoted Minerals & Energy as an extractive activity. The actual worksheet also had tick marks at 10 unit intervals.

Likelihood of Accepting Results

Research Conducted By	1 Not change mind	50	100 Change mind
NON-GOVT SCIENTISTS & CONSERVATION INTERESTS			
EXTRACTION* & TANGATA WHENUA INTERESTS	F		
	M		
GOVT SCIENTISTS & EXTRACTION INTERESTS	F		
	M		
EXTRACTION & CONSERVATION INTERESTS	F		
	M		
GOVT SCIENTISTS & TANGATA WHENUA INTERESTS			
GOVT SCIENTISTS & CONSERVATION INTERESTS			
GOVT & NON-GOVT SCIENTISTS			
NON-GOVT SCIENTISTS & EXTRACTION INTERESTS	F		
	M		
NON-GOVT SCIENTISTS & TANGATA WHENUA INTERESTS			

Worksheet #4 used during stakeholder interviews relating to the acceptance of multi-source research information and journal-published versus non-journal-published information by stakeholders involved in multi-stakeholder deliberative groups relative to decisions about New Zealand's marine protected areas. "F" denotes Commercial Fishing as an extractive activity and "M" denoted Minerals & Energy as an extractive activity.