

## **AN ABSTRACT OF THE THESIS OF**

Emily A. Pickering for the degree of Honors Baccalaureate of Science in Biology presented on May 18, 2012. Title: Social Aspects of Federal Fisheries Management in the Pacific Islands Region: Stakeholder Perspectives and an Informal Gap Analysis of Current Data.

Abstract approved: \_\_\_\_\_  
Mark D. Needham

Information about social and economic attributes of fisheries, fishing communities, and fishery participants is important for marine resource management because the focuses of agency efforts are on managing society's impacts to the marine environment. This thesis addresses two questions. First, what are the perspectives of managers, scientists, and commercial and recreational fishers regarding the importance of social information in helping to manage fisheries? Second, what gaps in knowledge about social aspects of fisheries and its management do these stakeholders feel require further research, especially in the Pacific Islands Region? Data were obtained from semi-structured interviews with 57 fishers, managers, and scientists in this Region. All of these stakeholders considered social information to be critically important to fisheries management. An informal gap analysis identified four primary gaps with regard to social information in the Pacific Islands Region, supported by 15 interviewees or more (in descending order): (a) fisher perspectives, behaviors, and motivations; (b) baseline participation and catch data for the recreational fishery; (c) culture, customs, and values; and (d) economics. This study identified social information needs according to stakeholders in the Pacific Islands Region, which can aid in developing management objectives to inform relevant future social science research efforts.

Keywords: fisheries management, gap analysis, social research

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Social Aspects of Federal Fisheries Management in the Pacific Islands Region:

Stakeholder Perspectives and an Informal Gap Analysis of Current Data

by

Emily A. Pickering

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I understand that my project will become part of the permanent collection of Oregon State University, University Honors College. My signature below authorizes release of my project to any reader upon request.

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Emily A. Pickering, Author

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## **DEDICATION**

To my mom and dad, for your endless support, love, and encouragement.



## **TITLE**

Social Aspects of Federal Fisheries Management in the Pacific Islands Region: Stakeholder Perspectives and an Informal Gap Analysis of Current Data

## **INTRODUCTION**

Information about socio-cultural and economic attributes of fisheries, fishing communities, and fishery participants (i.e., fishers) is important to natural resource managers because so much of an agency's efforts are focused on managing people rather than some direct manipulation of nature. In addition, fisheries tend to be public trust resources, and their proper stewardship is therefore of no small concern to a wide array of stakeholders.

Social information can be used to understand and increase stakeholder participation, incorporate society's perceptions and concerns into management decisions, improve public education and outreach, and increase the effectiveness of regulations and enforcement by understanding human motivations, values, and strategies (Gilden, 2005). In addition, social information has gradually become a more prominent aspect of fisheries management and decision-making as evidenced by the increased number of social scientists employed over the last 10 years and management measures requiring considerations of social and economic impacts (e.g., Abbott-Jamieson and Clay 2010; Gilden, 2005).

Given its conceptual and statutory importance to fisheries management, social data should be collected in a thoughtful and systematic manner. One approach for understanding and prioritizing policy relevance, information needs, and research is to assess current knowledge gaps. A gap analysis, which is the focus of this thesis, reveals information needs and aids in developing management objectives for conducting future research in the National Marine

Fisheries Service's Pacific Islands Region. An effective gap analysis also helps to provide a coordinated approach and direction for future research.

This thesis presents an informal gap analysis, which focuses on presenting and describing the gaps most frequently identified by the three stakeholders interviewed (i.e., scientists, managers, and fishers), yet does not incorporate a formal assessment and prioritization of gaps by the author. The scope of this analysis encompasses the socio-cultural and economic data available for fisheries in the NOAA Fisheries Service's Pacific Islands Region, which includes the State of Hawaii and the U.S. territories of American Samoa, Guam, and the Northern Mariana Islands. From this perspective, the term fishery denotes a distinct sector, such as the Hawaii Bottom-fish Fishery or the American Samoa Pelagic Longline Fishery. There are approximately 20 such fisheries in the Region.

This analysis is an extension of work that was conducted as part of an internship for the National Oceanic and Atmospheric Administration (NOAA) during the summer of 2011. The author was a NOAA Hollings Scholar for the National Marine Fisheries Service's (NMFS) Pacific Islands Regional Office (PIRO) in Honolulu, Hawaii. The purpose of the internship project was to identify and compile current knowledge of social, cultural, and economic attributes of the various fisheries in the Pacific Islands Region. Agency, peer-reviewed, and other literature regarding economic and social research related to fisheries in this Region were reviewed and key informants were identified and interviewed. The resulting document provides PIRO and Western Pacific Fishery Management Council (WPFMC) staff a comprehensive and concise source regarding social and economic information pursuant to the Region's fisheries (Pickering et al., 2011).

This thesis extends this literature review by developing an informal gap analysis with specific attention to questions addressing what social research needs to be conducted in order to best benefit fisheries management. The literature-based approach to gap analysis is augmented in this thesis by incorporating interviews with three distinct stakeholder groups: fisheries managers,

social scientists, and fishers. These stakeholders were asked questions about their perspectives on the importance of social information in fisheries management and what they think are knowledge gaps related to social information about fisheries issues in the Pacific Islands Region. Data from these interviews were analyzed and compared by group affiliation to create a comprehensive gap assessment. Common themes arising in these interviews were analyzed in comparison to the literature review by Pickering et al. (2011). Based on these analyses, recommendations for future research are made.

This thesis begins with a review of the most relevant literature. An explanation of the study's methods is then provided, including a description of the sampling methods, participants, interview protocol, and analytical approaches. Results of the study are then presented in two sections. First, results addressing questions about the importance of social information in fisheries management are presented. Second, the top 12 knowledge gaps identified by interviewees are identified and described. This thesis concludes with a summary of these main findings followed by a discussion of the top knowledge gaps and recommendations for management actions and future research.

## **Review of the Literature**

Federal regulations such as National Standard 8 require that fishery management strategies consider the importance of relevant resources to participants and communities, as well as assess the social impacts of fishery regulations. These social impacts and data are included when changes are made to federal policy, when that information is available. Where no research-based data exist, policy analysts often must make their best judgments regarding social impacts. This can be accomplished by compiling public comment and testimony collected as part of the rule-making process and/or by seeking the perspectives of representatives of potentially-affected sectors and communities. This is often the only practical avenue in light of various constraints

(e.g., time, funding, legal) that face the Agency and the Councils in terms of real-time social data collection (Hawkins, pers. com.).

In the Pacific Islands Region, most social science data that has been collected has focused on historical dependence and participation; sociodemographic characteristics; attitudes, beliefs, and values; sociology; perceptions of current policy; and economics (see Pickering et al. 2011 for a review). According to Pickering et al. (2011), it appears pelagic fisheries in the Pacific Islands Region have enjoyed the most social research compared to other fisheries, such as the bottomfish fishery or the coral reef fishery. When looking at data based on territory, fisheries in Hawaii are the most thoroughly studied compared to other territories, such as American Samoa, Guam, and the Northern Mariana Islands. The following literature review is a summarized inventory of the information presented in Pickering et al. (2011).

### ***Historical Dependence and Participation***

Many research studies have focused on historical dependence and participation in fisheries in the Pacific Islands Region. The most fully researched subjects appear to be those pertaining to current and past participation estimates, target species, and historical harvest rates. Other major themes of research include information on past and current fishing methods, historical importance of fishing both culturally and socially, vessel and gear descriptions, and general descriptions of typical fishing trips. Subject areas with only a few references each include research on tournament participation, charter fishing, and fisher experience and skill.

Historical and current fishing participation have been the most frequently studied issues in the Pacific Islands Region (Pickering et al., 2011). Most studies provided participation estimates, referenced permitting data, and offered a general picture of participation in various fisheries in this Region (e.g., Amesbury and Hunter-Anderson, 2008; Eads, 2001; Ito and Machado, 2001; Lumsden et al., 2007; NMFS, 2009; O'Malley and Pooley, 2001; Van Beukering

et al., 2006; Walker, 1997; WPFMC, 2009c, 2011a, 2011b). A few additional studies have gone beyond the scope of estimating the number of participants in fisheries the Pacific Islands Region. Allen and Bartram (2008), for example, focused on charter and tournament fishing, and provided information about the percent of visitors who are attracted to charter fishing, the number of participants currently engaged in tournament fishing, and how many previous commercial fishers are now switching to the charter industry. An early study by Orbach (1980) details cultural involvement and the circumstances under which people participate in fishing activities in the CNMI.

Current knowledge of target species and historical harvest has also received some research attention in the Region (Pickering et al., 2011) and most of the information on target species is found in WPFMC documents (e.g., WPFMC, 2006, 2009a, 2009b, 2009c, 2009d, 2010, 2011a). In addition, a study by Helvey (1987) identified target species for the Hawaii recreational fishery and methods utilized for harvest. Knowledge about historical fisheries harvest is also largely based on information compiled by the WPFMC (e.g., WPFMC, 2009a, 2009b, 2009e, 2010, 2011b). Information in these documents includes general trends in take, impacts to fish stocks, and locations where fishing harvest occurs. A few additional studies have focused on these issues (e.g., Amesbury et al., 2003; Craig et al., 1993; Grigg and Eldredge, 1975; Grigg, 2002; Kelly and Messer, 2005). Amesbury et al. (2003), for example, examined improvements in fishing gear and associated effects on harvest and catch efficiency. Craig et al. (1993) discussed the increasing importance of tournament fishing in American Samoa and the increasing harvest due to this expansion in the recreational fishery.

The remaining themes in historical dependence and participation in fisheries in the Region include information on fishing methods, cultural and social significance of fishing, vessel and gear descriptions, trip details, and charter and tournament information. Several studies in this Region, for example, have examined new fishing techniques and equipment (Itano, 1987; Kelly and Messer, 2005; Moffit et al., 2007; WPFMC, 2009b, 2010, 2011b), differences between part-

time and full-time fishers (Miller, 2001), and historical accounts describing the evolution of fishing methods based on archaeological findings (Amesbury et al., 2003). Likewise, a handful of studies have also examined the cultural and social significance of fishing in the Pacific Islands Region throughout history (e.g., Amesbury and Hunter-Anderson, 1989; Hamnet et al., 1998; Orbach, 1980; Severance and Franco, 1989; WPFMC, 2009b). Some studies provide specific information such as the oral traditions and proverbs related to fishing (Severance and Franco, 1989), the cultural importance of certain species and their ceremonial uses (Severance and Franco, 1989), and the historical use and importance of fishing as supported by archaeological findings (Amesbury and Hunter-Anderson, 1989).

Several recent studies in this Region have examined information on fishing vessel descriptions (e.g., Eads, 2001; Hamilton et al., 1996; Miller 2001; WPFMC, 2006, 2009a) such as size and type, gear utilized, and capabilities to fish far from port. Other studies have also focused on general trip information on these vessels (e.g., Allen and Bartram, 2008; Itano, 1987; WPFMC, 2011c), charter and tournament fishing (e.g., Allen and Bartram, 2008; Craig et al., 1993; NMFS, 2009) and fisher experience (Hospital et al., 2011).

### ***Sociodemographic Characteristics***

Current information on sociodemographic characteristics of fishers in the Pacific Islands Region primarily includes information about their residence, household status, gender, ethnicity, age, fishing experience, marriage status, income, and education (e.g., Allen and Gough, 2006; Hamnett et al., 1998; Hoffman, 1972; Hospital, 2010; Hospital et al., 2011; O'Malley and Pooley, 2000; O'Malley, 2001; Miller, 1995, 2001; Pan and Griesmer, 2006; Ponwith, 1991; Rubinstein, 2001; Severance, 1996; Walker, 1997). Studies that researched household status collected information about the number of dependents, children, total residents, and who is identified as head of the household (e.g., Allen and Gough, 2006; Hamnett et al., 1998; Hoffman, 1972;

O'Malley and Pooley, 2000; Rubinstein, 2001; Severence, 1996). Studies examining fishing experience included data on years spent fishing locally (Miller, 2001), average years of combined fishing experience (Miller, 2001), and number of years spent in the commercial fishery and how many of those years were on the same vessel (Allen and Gough, 2006). Research on fishers' residence typically collected data on the location of current residence (e.g., Hamnett et al., 1998; Rubinstein, 2001; Severence, 1996), mean length of residence (e.g., Hamnett et al., 1998; Rubinstein, 2001), and the location where fishers were raised (e.g., Hospital, 2010; O'Malley, 2001).

### ***Attitudes, Beliefs, and Values***

The scientific definition of an 'attitude' is a tendency to evaluate a specific object, situation, or issue with some degree of favor or disfavor (Ajzen and Fishbein, 1980). A 'belief' is an expression of basic values that an individual holds regarding specific situations or issues (Manfredo et al., 2004). 'Values' are basic modes of thinking shaped early in life by family or other peers, few in number, relatively stable over time, change slowly, guide life decisions, and transcend situations and objects (Fulton et al., 1996). According to the literature review by Pickering et al. (2011), information on fishery participants' attitudes, beliefs, and values is both lacking and inconsistent. The limited number of studies that have been conducted on fisher attitudes, beliefs, and values are generally outdated and as such, provide little specific guidance to contemporary management activities.

A few studies have examined the value and importance of fishing as perceived by fishers (e.g., O'Malley, 2001; Miller, 1995; Samples, 1985; Walker, 1997). O'Malley (2001) and Samples (1985), for example, describe the satisfaction and decision making of charter industry patrons. Miller (1995) described the value and importance of fishing as both an activity and symbol. Walker (1997) focused on fisher satisfaction with the working environment, fishing success, and

their job as a whole. This study also examined fisher and captain attitudes about feeling underappreciated or disrespected by patrons in particular and society in general. One additional study focused on fishers' cognitions such as their value orientations and found that they value a healthy ecosystem (Kilarski et al., 2006).

### ***Sociology***

Sociology is the scientific study of society (Comte, 2005). Sociological characteristics describe human social behavior and attempt to draw conclusions about populations that are very large. This can be viewed in contrast to social-psychology, which examines whole societies via the examination of individual thoughts and emotions (Stolte et al., 2001). A number of studies have addressed sociological aspects of fisheries in the Pacific Islands Region (e.g., DMWR, 2009; Glazier, 2002; Hamnett et al., 1998; Hospital, 2010; Hospital et al., 2011; Kilarski et al., 2001; Miller, 1995, 2001; Orbach, 1980; Pan and Griesmer, 2006; Rubinstein, 2001; Walker, 1997). Many of these studies have examined interactions among fishers such as cooperation, passing down of knowledge, social dynamics among crew members, and general behavior (e.g., Glazier, 2002; Hospital et al., 2011; Miller 1995, 2001). Miller (1995), for example, focused on social interactions involved in fishing trips, fish selling and sharing, and talking about fish, and found that fishing extends beyond the actual fishing trip into the domains of information sharing and discourse. A couple of other studies found that small vessel captains rarely fish alone and in many cases families are involved in aspects of the operation (e.g., Glazier, 2002; Hospital et al., 2011).

### ***Perceptions of Policies***

A number of studies have focused on fisher satisfaction with current management, concerns with specific policies, suggested improvements, and perceptions about classification of



various fishing activities in the Pacific Islands Region (i.e., commercial, recreational, subsistence; see Pickering et al., 2011 for a review). Fisher concerns with specific policies have been among the most heavily studied issues in this Region (e.g., Allen, 2007; Allen and Bartram, 2008; Hospital et al., 2011; Hamnett et al., 1998; Miller, 1995, 2001; O'Malley and Pooley, 2001, 2003; Van Beukering, 2006; Walker, 1997). Some examples include concerns about general fishing markets (Miller, 2001), the sashimi market (O'Malley and Pooley, 2001), near-shore marine reserves and the regulation of recreational fisheries (Allen and Bartram, 2008), and the observer program (Allen, 2007).

Studies have also examined suggestions made by fishers for improvements to the industry (e.g., O'Malley and Pooley, 2001; Miller, 2001; Rubinstein, 2001; Tulagi and Green, 1995; Van Beukering et al., 2006). Some suggestions included alternative management approaches (e.g., Rubinstein, 2001; Miller, 2001), improvements for further development and future research (Miller, 2001), and specific policy amendments such as a limited entry program in American Samoa's pelagic fishery (O'Malley and Pooley, 2001). Some studies, however, have documented information about fisher satisfaction with current management approaches, thoughts on the state of specific fisheries, and agreement with various regulations (e.g. DMWR, 2009; Hospital, 2010; Kilarski et al., 2006; Rubinstein, 2001).

Two studies examined fisher perceptions on how best to classify their activities (i.e., commercial, subsistence, recreational, expense; Hamilton, 1998; Hospital et al., 2011). Fishers commonly expressed frustration with the Maguson-Stevens Act definition of "commercial" because many who sell their catch as a means of covering trip costs do not consider themselves to be commercial fishers given that they do not make a profit. Hamilton (1998) found that fishers and other industry members generally considered a commercial fisher to be one who depends on profits derived from fishing for at least a portion of his or her income. According to Federal and Hawaii law, however, any individual who sells at least one fish in a year is considered to be a commercial fisher.

## ***Economics***

Three main themes associated with the economic literature regarding fisheries in the Pacific Islands Region are revenue, operating costs, and other fisher economics. There is significant overlap among studies. Revenue has been a consistently studied topic and includes information about landings, pounds sold, price per pound, values of stocks, production efficiency, harvest capacity, and estimated total revenue for specific fisheries (e.g., Grigg, 2002; Hamnett et al., 1998; Hamilton and Huffman, 1997; O'Malley, 2001; Pan and Griesemer, 2006; Pooley and Pan, 2006; WPFMC, 2009a, 2009d, 2010, 2011a, 2011b). In terms of fisher economics, studies have examined their expenses, wages, break-even points, average annual fixed costs, and cost-earnings information (e.g., Arita et al., 2011; Hamilton and Huffman, 1997; O'Malley and Pooley, 2001, 2003; Miller, 2001; Pan and Griesemer, 2006; Pan et al., 2006; Pooley and Pan, 2006; Rubinstein, 2001). Some studies provided economic information that is specific to particular fishing groups within a fishery, such as crew income (Pan and Griesemer, 2006), tournament angler trip expenditures (Pan et al., 2006), and differences between part-time and full-time fishers (Miller, 2001). Additional economic studies have examined impacts of specific fisheries with relation to transshipment (e.g., Kleiber, 2002; Hamnett and Pintz, 1996), number of fishery associated jobs (NMFS, 2009), the seafood market (Radtke and Davis, 1995), exports (WPFMC, 2009c), and non-sale economic impacts, such as subsistence fishing and the sharing of fish (Hospital et al., 2011) or the economic valuation of coral reefs (e.g., Cesar et al., 2002; Spurgeon et al., 2004; Van Beukering et al., 2006).

## ***Research Questions***

This thesis builds on this body of literature and addresses two research questions. First, what are the perspectives of managers, scientists, and commercial and recreational fishers regarding the importance of social information in helping to manage fisheries? Second, what

gaps in knowledge about social aspects of fisheries and its management do these stakeholders think require further research, especially in the Pacific Islands Region?

## METHODS

### *Study Area*

The focus of this study was on the Pacific Islands Region, which includes the U.S. territories of Hawaii, American Samoa, Guam, and the Northern Mariana Islands (Photo 1). The exclusive economic zone (EEZ) of the entire Pacific Islands Region equals approximately 1.7 million square nautical miles.

Photo 1. Map of the Pacific Islands Region



### *Populations of Interest*

Fisheries managers, scientists, and participants (i.e., fishers) were the target populations for this study. These three stakeholder groups were targeted in this study, because each are

intimately involved in various aspects of the fisheries in the Pacific Islands Region. In addition, each represents unique perspectives and values in comparison to one another (i.e., a fisher understands the hardships of catching fish for a living, while a scientist understands the difficulty of gathering enough accurate data to describe and understand the impact fishers are having on fish populations).

An attempt was made to conduct an equal number of interviews for each of these categories, but some groups proved more difficult to contact and schedule interviews with than others. Many fishers, for example, were busy fishing or preparing for fishing trips during many of the daylight hours, so did not have as much time available to schedule an interview. To address this constraint, a few fishers were interviewed over the telephone during their lunch break or in the evening. In addition, only so many representatives were available for each stakeholder group. For example, under NOAA many more scientists are employed than there are managers in the Pacific Islands Region. Given these constraints, more interviews were conducted with scientists than both managers and fishers. In total, 57 individuals participated in this study, including 33 scientists, 14 managers, and 10 fishers.

### ***Identification of Study Participants***

Purposive and snowball sampling techniques were used to identify participants. A purposive sample helps to gain insight about perceptions and phenomena rather than empirical generalization from a sample to a larger population (Patton, 2002; Rubin & Rubin, 2005). Given that information-rich sources are targeted when using this sampling technique (Patton, 2002), a purposive sample often ensures the inclusion of certain individuals representing a particular attribute (e.g., a scientist focusing on fisheries issues in the Pacific Islands Region), but any broader generalization of a purposive sample may be limited (Berg, 2007). A purposive sample was used for this study, because the desired participants had predetermined and defined

characteristics (i.e., scientist, manager, fisher). In addition, the purpose of this study was not to generalize results to larger populations, but instead gain insight from stakeholder representatives, thus making a simple, random sample undesirable and unnecessary.

Snowball sampling (i.e., chain referral, respondent driven sampling; Berg, 2007) involves asking participants to identify other potential participants not initially included in the sample frame (Patton, 2002). Snowball sampling is often one of the most useful ways of locating subjects with attributes necessary for a particular study, especially when there is no listing of people of importance to the researcher (Berg, 2007). Snowball sampling was employed in this study by asking participants at the conclusion of each interview to suggest potential scientists, managers, or fishers that would be willing to participate in the study.

### ***Sample Size and Data Collection***

Data were obtained from semi-structured interviews, which can capture complexity and depth of contextual meanings and provide rich and detailed understanding of issues through the structure and responsiveness of the research process (Berg, 2007; Leedy & Ormrod, 2005; Patton, 2002; Rubin & Rubin, 2005). These semi-structured interviews were of a conversational and flexible nature, structured around eight main questions that served as a framework and helped to guide and focus the topics of discussion (Appendix A). The semi-structured nature of interviews allowed interviewees the time and freedom to talk in further detail and depth about their opinions on any particular subject. The interviews also allowed for new questions to be asked in response to what was being said by the interviewee. A primary benefit of semi-structured interviews is that they allow for this type of flexibility and comparability (Patton, 2002; Rubin & Rubin, 2005). In total, 57 semi-structured interviews were conducted with 33 scientists, 14 managers, and 10 fishers (Table 1).

Table 1. List of interviewees <sup>1</sup>

#	Pseudonym	Description	Category	Duration (Hrs.)
1	Jerry	Fishery biologist	Scientist	1
2	Gordon	Fishery biologist	Scientist	1.5
3	Melissa	Fishery biologist	Scientist	1
4	Julee	Biologist	Scientist	2
5	Kyle	Biologist	Scientist	2.5
6	Sarah	Biologist	Scientist	1.25
7	Matthew	Biologist	Scientist	1
8	Charles	Oceanography	Scientist	1
9	Daniel	Social scientist	Scientist	1.5
10	Robert	Social scientist	Scientist	2
11	Darrel	Social scientist	Scientist	2
12	Samantha	Social scientist	Scientist	.5
13	Nick	Social scientist	Scientist	1.5
14	Jeremy	Social scientist	Scientist	1
15	Dane	Social scientist	Scientist	1
16	Rachel	Social scientist	Scientist	1.25
17	Cooper	Socioeconomics	Scientist	1.25
18	Garnie	Socioeconomics	Scientist	1.75
19	Arial	Economist	Scientist	1.25
20	Patrick	Economist/management	Scientist	1.5
21	Walter	Protected species	Scientist	1.5
22	Karen	Protected species	Scientist	1
23	Linda	Stock assessments	Scientist	2
24	Dylan	Stock assessments	Scientist	2
25	Cameron	Stock assessments	Scientist	1
26	Shannon	Stock assessments	Scientist	1.5
27	Britney	Stock assessments	Scientist	.75
28	Carl	Stock assessments	Scientist	1.25
29	David	Public outreach	Scientist	1.5
30	Alex	Fishery management specialist	Scientist	1
31	Dorothy	International fisheries	Scientist	1.5
32	Paul	Scientist/ fisher	Scientist	1.25
33	Curtis	Scientist/ fisher	Scientist	2
34	Alex	Management/ Fishery biologist	Manager	.5
35	Amanda	Management/ Fishery biologist	Manager	1
36	Luke	Management/ Scientist	Manager	1.75
37	Anne	Management/ Scientist	Manager	1.5
38	Timothy	Policy analyst	Manager	1
39	Jake	Policy analyst	Manager	1.25
40	Joey	Policy analyst	Manager	1
41	Brandon	Policy analyst	Manager	1
42	Lou	Policy analyst	Manager	1.25
43	Kevin	Management	Manager	1
44	Ian	Management	Manager	2
45	William	Management	Manager	1.25
46	Kase	Management	Manager	1
47	Josh	Public outreach/ policy analyst	Manager	1.25
48	Jennifer	Bottomfish, full-time commercial	Fisher	1
49	Preston	Bottomfish, full-time commercial	Fisher	1.25
50	Natasha	Bottomfish/ Spearfishing	Fisher	1.5
51	Collin	Longline, full-time commercial/ biologist	Fisher	1.5
52	Peter	Longline, full-time commercial	Fisher	1.3
53	Anthony	Commercial all-around	Fisher	1.5
54	Mark	Recreational	Fisher	1
55	Tylor	Recreational	Fisher	1
56	Stanley	Recreational	Fisher	1
57	Dustin	Recreational	Fisher	1

<sup>1</sup> Contents based on category and further ordered based on descriptions. The sequence of the interviewees in the table is not correlated with the order that interviews were conducted.

Contacts for initial interviews were made following recommendations from those participating in the project or by searching staff directories. Interview scheduling typically began through email and telephone correspondence. Almost all interviews occurred on the island of Oahu, Hawaii and only a few were conducted over the telephone due to participants being unable to meet in person. Only one interview was conducted entirely via email correspondence. Interviews occurred in locations usually determined by the interviewee (e.g., their office, central location such as a coffee shop) and at times convenient for interviewees. Interviews lasted between 30 and 120 minutes, and were conducted between July 11, 2011 and October 24, 2011. In most cases, there was no time limit set for the interviews and there was never a feeling of being rushed through questions, with the exception of only a few cases where interviewees were able to participate for only a predetermined amount of time. Interviews always began with the assurance that everything said during the interview would be reported anonymously because responses would be used in reference to larger groups and themes. A few standardized questions were always asked during the interviews such as “do you feel that social information is generally important when it comes to managing fisheries in the Pacific Islands Region” and “what areas in our knowledge about socio-cultural and economic attributes of fisheries do you think are lacking, if any?” In some instances, questions were repeated and sometimes rephrased for the interviewee’s benefit and comprehension, but there was a conscious effort to keep questions unbiased and as close to the original phrasing as possible. Questions were also generated during the course of the interview and were used to further probe, discuss, and understand the interviewee’s perspectives and thoughts.

Data were recorded by handwritten notes during the interview. In some instances, interviewees were asked to clarify statements that were unclear or repeat comments that the interviewer was unable to write down quickly enough. Immediately following the interviews, notes were further expanded by recording details the interviewer specifically remembered that were not present in these notes. Shortly after the interview (i.e., usually the same day and no later

than the day after), the written notes were transcribed verbatim into a computer. Respondents were given pseudonyms to preserve their anonymity and all pseudonyms and their links to the real names of interviewees were kept separate and secure from the interview notes, and were accessible only to the interviewer.

### ***Development of Questions***

Responses for the following two interview questions were the primary focus of the analysis: (a) “do you think social information and data is generally important when it comes to managing fisheries in the Pacific Islands Region,” and (b) “what areas in our knowledge about socio-cultural and economic attributes of fisheries do you think are lacking, if any?” The decision to focus analysis on these two main questions was based on the direct relevance of these interview questions to the goals and objectives of this thesis. Answers to the first question about the importance of social information validate future fisheries research in social science and demonstrate the support from the three stakeholder groups interviewed. Answers to the second question addressing gaps in current social knowledge identified the gaps discussed in this thesis.

### ***Analytical Procedures***

The focus of this study was to conduct an informal gap analysis focused on presenting and describing the gaps most frequently identified by the three stakeholders interviewed (i.e., scientists, managers, and fishers). A formal gap analysis is a method used for identifying and assessing discrepancies between current and desired states (Graham et al., 2006). One method for identifying gaps between ideal and current states is to assign a gap-level to indicate the magnitude or priority of the gap (Research Data Strategy Working Group, 2008). A comparison is then made between the current state and the desired or ideal states, based on input from sources such as interviews and a review of current literature. A gap analysis may also include a discussion of



how these desired or ideal states can operationally be achieved. In summary, a formal gap analysis entails: 1) a description of the current situation, 2) a discussion and listing of factors required to achieve future objectives and filling of gaps, and 3) a highlight of the gaps that exist and need to be filled.

The informal gap analysis presented in this thesis provides a description of the current state of our knowledge by summarizing the main points in the literature review by Pickering et al (2011) and highlighting the gaps that currently exist and need to be filled according to stakeholders. The analysis is lacking an assessment of the factors required to operationally fill these gaps. It is also missing a critical assessment and prioritization of the identified gaps, in order to assign a gap-level to indicate the magnitude or priority of the gap. Due to these absences in the analysis, the gap analysis presented in this thesis is described as an informal gap analysis.

The identification of gaps for use in this informal gap analysis was accomplished by organizing responses from the 57 interviews into emergent themes. Emergent themes were identified in the data using thematic analysis. Thematic analysis is a search for themes that emerge as being important and applicable to the description of the phenomenon (Daly et al., 1997). The process involves the identification of themes through “careful reading and re-reading of the data” (Rice & Ezzy, 1999). Thematic analysis is a form of pattern recognition within the data, where emergent themes become categories for analysis.

The emergent themes (i.e., knowledge gaps) in this study, were identified by first summarizing the gaps identified and described by each interviewee. These summaries were manually separated from their respective interviews and then grouped and organized with results from other interviews into themes based on key words and overall meanings, using a thematic analysis approach. Themes that emerged were then prioritized (i.e., given priority numbers) based on the number of participants that identified each of the knowledge gaps. Each type of interviewee (i.e., scientists, managers, fisher) was given the same weight when tallying the number of participants and determining priority.

Following identification and prioritization of main themes, each knowledge gap was carefully analyzed and segmented into further subgroups and subthemes based on the specific research needs identified within each gap and group affiliation, but only if these subgroups and subthemes were apparent and appropriate. The bulk of the analysis was interpretive and based on the researcher's ability to relate responses from various respondents in a logical and organized way.

## RESULTS

### *Importance of Social Information in Fisheries*

The first question in the interviews addressed whether scientists, fishers, and managers perceive social and economic information to be important in fisheries management. The main trend observed in the 57 responses to this question was clear – social information is important for managing fisheries in the Pacific Islands Region. Only one respondent stated that at least certain categories of social information do not have a role in fisheries management; the remaining 56 interviewees expressed that social information was valuable in fisheries management for several reasons, especially: economics, managing people, understanding and incorporating public perceptions, and cultural sensitivity. *Ferdinand*, a commercial fisher, for example, said "yes, definitely. It shows that fishermen are a viable part of the economy." Likewise, *David*, a scientist involved in public outreach exclaimed that social science is "definitely important because in my opinion, if something doesn't have economic value, it won't have the attention of politicians and legislators, who really drive fisheries management. [We] need that dollar value for valuation." *Jake*, a policy analyst said that "yes, because everything we do when you [*sic.*] manage a fishery has to do with people. It affects the participants. If we don't consider people and their situations, how it's going to affect their livelihoods, social structures, ability to access resources, then that's

poor management." Similarly, *Robert*, a social scientist emphasized that "social information is the most important to fishery management because fisheries management is people management."

*Tylor*, a recreational fisher stated "very much so in particular for the Pacific Islands Region because we really, truly are different. Our motivations, customs, and culture are different from continental US. We are not European centered." Finally, *Dylan*, a scientist working in stock assessment claimed that:

"We don't manage fish, we manage people and how they interact with fish. Understanding socioeconomics is really important because it really defines the interactions with the fish. It comes down to the socioeconomics to how you're going to actually go about managing something effectively, which is the biggest challenge. I think we're too focused on our management tools and less on the problem and how to fix it. We need to think from the perspective of the resource users and how to make them want to comply."

Only *Collin*, a full-time, longline commercial fisher with a biology background, thought that at least the demographic aspect of social information did not have a role in fisheries management. For example, he said, "I don't think ethnographics or demographics affect one iota the business of commercial fishing. I don't understand why managers care about who catches the fish." However, later in the conversation, *Collin* emphasizes the importance of economic information (a specific category of social information) and its use in fisheries management.

Another frequent comment expressed by all three categories of respondents (i.e., scientists, managers, fishers) was that social information is not perceived as always being used in the decision-making process, despite the fact that many people acknowledge its value. Some respondents felt that fisheries management is focused solely on biology and / or driven primarily by politics, whereas others believed that social information is not incorporated into the management process because it is less accessible to managers and not as well trusted compared to physical science. Most interviewees, therefore, believed that fisheries management could be doing a better job at incorporating social information. For example, *Cooper*, a scientist working in socioeconomics claimed that "obviously it's my job, so I think it's important, but I don't think

it's used. I think it could be more important. For economics, we need to do a better job of framing analyses and providing information in a way people understand and managers can use." Likewise, *Amanda*, a manager with a fishery biologist background, said that "I think it's really, really important; undervalued in the past, but its growing. [It is] hard to add on to something people don't trust as much as hard science." *Gordon*, a fishery biologist also explained that "social information is one of the trickiest things to deal with and we have the fewest data on it. It's understaffed, underfunded, and undervalued." Finally, *Dustin*, a recreational fisher claimed that:

"Emphasis of fisheries management a lot of times is more heavily weighted away from human aspects. The social intertwining of fishing in the community is not taken into consideration. [We] have to remind the managers that fishermen need to be taken into account. Management tools need to look at fishermen and the community in order to balance viewpoints, so correct options are chosen. Usually, managers and scientists get together about a fishery in trouble and they decide what to do about it. Including the fishermen is all about creating a balanced view and making balanced decisions about proper management tools to use."

There were no apparent trends suggesting that certain groups of stakeholders were expressly more keen on the importance of social information than others. One minor trend was that a handful of scientists expressed their lack of knowledge about the status of current social science research, yet all still emphasized the importance of social information to fisheries management.

### ***Knowledge Gaps in Socio-cultural and Economic Aspects of Fisheries***

The next research goal was to determine what future social and economic research is most needed in the Pacific Islands Region. Interviewees were asked "what areas in our knowledge about socio-cultural and economic attributes of fisheries do you think are lacking (if any), and how would you prioritize filling these gaps?" In response, all 57 interviewees provided and described gaps that they believed were deserving of further research and important for improving fisheries management in this Region. From these 57 responses, a variety of gaps were identified

that grouped into 42 different subject areas. Table 2 summarizes the range of knowledge gaps identified by interview participants.

Table 2. Knowledge gaps identified by interviewees <sup>1</sup>

Priority #	Knowledge gap identified	# of times each gap was identified	Specific gap as proportion of all gaps identified (%)
1	Participant/community perspectives, behaviors, and motivations	21	12
2	Social attributes of non-commercial fisheries- "recreational" fishery	20	11
3	Culture, customs, and values	17	10
4	Fisheries economics	15	9
5	ACG <sup>2</sup> social issues	10	6
6	Number and characteristics of participants	9	5
7	Social attributes of coral reef fisheries	8	5
7	Social attributes of non-commercial fisheries- subsistence fisheries	8	5
7	Social attributes of adaptive management	8	5
8	Human dimensions of stock assessments	6	3
8	Demographics of fishery participants and communities	6	3
9	Impacts on fishing communities	5	3
10	Updated baseline information	4	2
11	Social attributes of imports and exports	3	2
11	Fish flow	3	2
11	Social attributes of international fisheries	3	2
12	Creel data	2	1
12	Data specific to main Hawaiian Islands	2	1
12	Social attributes of bottomfish fisheries	2	1
NA	Other 23 miscellaneous gaps	1 ea.	< 1% ea.
Total	42 gaps	175	100

<sup>1</sup> Gaps identified are presented in order of importance based on the number of different interviewees who identified them. In some instances, gaps were mentioned by an equal number of participants, in which case the order in the table does not mean greater priority. Instead, priority is indicated by the priority number in the first column (gaps with the same number of participants who identified it have the same priority number). Some gaps were mentioned by only one individual, whereas others were mentioned by up to 20 respondents. Gaps discussed in this section will only focus on the top 12 priorities. Note that some of the gaps identified are more specific than others. Table formatting is based on Allen and Gough (2007).

<sup>2</sup> ACG stands for American Samoa, the Commonwealth of the Northern Mariana Islands (CNMI), and Guam.

Group affiliation was considered when compiling trends. In many instances, the gaps identified were mentioned primarily by scientists, which could be attributed to the greater number of scientists interviewed during the course of this study (31 of 57 interviewees). Table 3 provides a summary of categories of participants who identified each gap.

Table 3. Percent of scientists, managers, and fishers who identified each knowledge gap <sup>1</sup>

Knowledge gap identified	Scientists (n = 33)	Managers (n = 14)	Fishers (n = 10)	Total (n = 57)
Participant/community perspectives, behaviors, and motivations	62	24	14	21
Social attributes of non-commercial fisheries- "recreational" fisheries	65	20	15	20
Culture, customs, and values	53	29	18	17
Fisheries economics	53	27	20	15
ACG <sup>2</sup> social issues	80	10	10	10
Number and characteristics of participants	56	11	33	9
Social attributes of coral reef fisheries	63	38	0	8
Social attributes of non-commercial fisheries- subsistence fisheries	75	25	0	8
Social attributes of adaptive management	50	50	0	8
Human dimension of stock assessments	67	16	16	6
Demographics of fishery participants and communities	67	33	0	6
Impacts on fishing communities	40	60	0	5
Updated baseline information	0	100	0	4
Imports and exports	67	33	0	3
Fish flow	100	0	0	3
International fisheries	100	0	0	3
CREEL data	50	0	50	2
Data specific to main Hawaiian Islands	0	0	100	2
Social attributes of bottomfish fisheries	50	0	50	2

<sup>1</sup> Cell entries are percentages (%). Near the bottom of the table, the total number of participants who identified the gap gets as low as two individuals. Gaps that were identified by only a single individual are not shown. Table formatting is based on Allen and Gough (2007).

<sup>2</sup> ACG stands for American Samoa, the Commonwealth of the Northern Mariana Islands (CNMI), and Guam.

## ***Priority Knowledge Gaps According to Stakeholders***

### ***Priority 1: Participant/Community Perspectives, Behaviors, and Motivations***

The most frequently identified knowledge gap encompassed three themes that collectively referred to the population of fishers in the Pacific Islands Region: their motivations, behaviors, and perspectives. This identified gap is broad with respect to both location and fishery. A few participants specifically identified the Commonwealth of the Northern Mariana Islands (CNMI) and Guam as lacking this information, but most referred to a lack of knowledge about fishers in all political jurisdictions in the Pacific Islands Region.

Twenty-one interviewees believed that data about fisher motivations, behaviors, and perspectives are lacking (13 scientists, five managers, three fishers) and these three themes were mentioned in nearly equal frequencies and across all three interviewee categories (Table 4). The most mentioned theme was fisher motivations (10 interviewees), followed by behavior (9 interviewees) and perspectives (8 interviewees).

Table 4. Identified information needs for the participant/community perspectives, behaviors, and motivations knowledge gap <sup>1</sup>

Specific information needs	Scientists	Managers	Fishers	Total
Fisher motivations	7	1	1	10
Fisher behavior	5	3	1	9
Fisher perspectives	5	2	1	8

<sup>1</sup> Cell entries are numbers of interviewees.

Participants who identified fisher motivations as a knowledge gap commonly mentioned wanting to know more about their decision-making process and what variables have the greatest influence on that process. Common questions that arose during the interviews included: (a) why fishers participate in the activity, (b) how they decide where to go and what species to target, and (c) what variables influence fishers and the decisions they make? For example, *Garnie*, a scientist

working on socioeconomic issues identified "choice modeling. We need more specific information about fishermen, both recreational and commercial, and how they decide on target areas, species caught, travel, expense they're willing to pay for a bundle of goods, value of fishing trip, value of target species. This is called discrete choice modeling. We don't have these modelers here. This could primarily be used for recreational, but it applies commercially as well." In addition, *Kase*, a manager identified the need for "profiling of fishermen activity and the decision making they go through. For example, do they want to go full time versus part time as a recreationalist?"

Many respondents also expressed the importance of being able to anticipate fisher behavior, such as when they switch target species, fisheries, gear, or location. There was also a common emphasis on the importance of incorporating fisher perspectives into the management process. For example, *Sarah*, a biologist stated "we need to know what's on fishermen's minds about management." Similarly, *Darrel*, a social scientist said that:

"Every time we want to work on something big, we have no representative understanding of perspectives and values of the people who will be affected...so little up-to-date information about people's attitudes, perspectives, and values in general about topics of the day: MPAs, catch shares, limited entry programs, etc. There are times when specific information is needed. We are always dealing with the same things and we are just not gaining the information that we need. Every time I read these documents, I see that the Council is guessing on social considerations. The document will say, "There are a number of social and economic reasons...', but these are big issues we don't know anything about. 'Here are some technical fixes for those problems we know nothing about...' It just drives me crazy; they have no specific information. There are no people out there gathering data to try to specify these things."

In addition, *Patrick*, an economist claimed that:

"We need an understanding of fishermen's behavior and fishing effort. We have tried to address these gaps with the pelagics. For example, we learned Vietnamese fish collectively. But really we've never been successful at filling this gap... We keep wanting to hire someone with experience in behavior economics. Social scientists need to focus on why fishermen do what they do. Why they go where, when, and for how long. Why most are male? Why they choose this lifestyle? How do they make these choices? Why people like what they do? For example, some fishermen might like drawing for catch shares. I personally hate leaving things to chance, so I am hampered by my own preference when trying to decide on distribution methods for catch shares. The



biggest gap is our lack of understanding the motivations and the behaviors of fishermen. Filling this gap could lead to improving stock assessments and forecasting, CPUE and different motivations, catch share and ITQ design, distribution of fishing rights."

Taken together, these opinions of interviewees suggest that it would be beneficial for fisheries management in the Pacific Islands Region to improve understanding and prediction of fisher motivations and behaviors. In addition, respondents believed that it is important to incorporate this information into fisheries management.

*Priority 2: Social Attributes of Non-commercial Fisheries- "Recreational" Fisheries*

The second most often identified gap was general lack of knowledge about recreational fisheries and participants in the Pacific Islands Region. (The term "recreational" is placed within quotes for the title of this gap, because what may be considered "recreational" in the continental U.S. does not accurately describe all non-commercial fishing activities in the Pacific Islands Region. Many fishers in the Pacific Islands Region do not consider themselves to be recreational fishers, because they may catch fish for cultural purposes, to cover expenses of fishing, or for subsistence.) In total, 20 interviewees identified the lack information about recreational fisheries as a serious knowledge gap. These 20 interviewees consisted of 13 scientists, 4 managers, and 3 fishers. No apparent trends affiliated with the groups of stakeholders emerged. In total, 10 of the 20 individuals who identified recreational fisheries as a gap specifically expressed the need for more data on recreational harvest and its impact on fish stocks (Table 5). This specific issue was identified across all three categories (i.e., five scientists, three fishers, two managers). Another commonly mentioned research need was the collection of information on current participation in recreational fisheries. Six interviewees identified this specific gap, including four scientists, one manager, and one fisher. Other information needs related to recreational fisheries included

economic information, cultures and customs, establishing baseline information, and recreational fisher motivations.

Table 5. Identified information needs for the social attributes of non-commercial fisheries- "recreational" fisheries knowledge gap <sup>1</sup>

Specific information needs	Scientists	Managers	Fishers	Total
Impact to fish stocks	5	2	3	10
Number of participants	4	1	1	6
Economic information	1	1	1	3
Culture and customs	2	0	0	2
Baseline information	2	0	0	2
Recreational fisher motivations	1	0	0	1

<sup>1</sup> Cell entries are numbers of interviewees.

Overall, respondents believed that some of the major issues that need answering with respect to recreational fisheries in the Pacific Islands Region include the: (a) number of people currently fishing recreationally and factors affecting this number, (b) impact of these fisheries on local fish stocks, (c) economic impacts of recreational fisheries, (d) various cultures and customs involved in recreational fisheries, and (e) importance of fish to various groups. For example, *Stanley*, a recreational fisher stated that a "major gap right now that is really a roadblock to good management is knowledge of the recreational fishery. We don't know the number of fishermen, the impact they're having, or how much they're spending. How do we manage a fishery if we don't know these things?" Likewise, *Darrel*, a social scientist acknowledged that "with respect to recreational fishing, we don't know what even the universe is that we are working within. We don't have a sampling frame without licensed users. How many recreational boats are on the water? How many on a consistent basis? How many people who don't have boats go out with people who do? We have no starting point. As a result, we have very little information about recreational fishing." More generally, *Timothy*, a policy analyst argued that the "recreational sector of any fishery is a gap, because they don't report anything."

Without required licensing of recreational fishery participants or the mandatory reporting of harvests, it is difficult to gather information that would help address these issues related to recreation participation and harvest rates. Potentially as a result of these challenges, issues regarding participation and impacts to fish stocks were one of the most obvious and highly prioritized knowledge gaps in this study. In general, respondents believed that little is known about recreational fisheries in the Pacific Islands Region and that many of the scientists, managers, and fishers interviewed in this study believe that research is needed to examine participation in recreational fisheries and its impact on fish stocks.

### *Priority 3: Culture, Customs, and Values*

A lack of data regarding people's culture, customs, and values in the Pacific Islands Region was a knowledge gap identified by 17 interview participants (nine scientists, five managers, three fishers). The primary theme that emerged from comments across all three groups (i.e., scientists, managers, fishers) was the need to improve understanding of cultural values. A secondary theme was the need for research focusing on sub-cultures and communities within the four main territories in the Pacific Islands Region (Table 6).

Table 6. Identified information needs for the culture, customs, and values knowledge gap <sup>1</sup>

Specific information needs	Scientists	Managers	Fishers	Total
Cultural values	6	2	2	10
Sub-cultures within territories	5	2	1	8

<sup>1</sup> Cell entries are numbers of interviewees.

Learning more about cultural values was said to be important to fisheries management for reasons such as understanding cultural preference or avoidance of certain species, the importance of fishing to various cultures, and values associated with catching, consuming, and sharing fish. *Gordon*, a fishery biologist, said that "it is very important to know any cultural or type of belief

that makes you [*sic.*] target or avoid certain species. Fishing performance is used to gauge stock health and when there's these preferences or avoidance, it's important to understand. There's a lot of targeting, for example species used for ceremonies. This is important in all territories in the Pacific Islands Region, but especially in the outlying islands, where that effect is more dominant." Similarly, *Rachel*, a social scientist claimed that "there is a lack of understanding of cultural mixes, especially here in Hawaii. They have different connections to fishing, different ways of disseminating fish, consuming fish, catching fish, and values of fish. I don't think people consider that in management. Customary exchange is part of it, such as giving and bartering, or not selling fish."

Many interviewees also emphasized the need to garner respect for local cultures and suggested that there is currently a lack of cultural sensitivity in fisheries management in the Pacific Islands Region. For example, *Alex*, a fisheries management specialist, said that "the biggest gap with respect to management and funding is the lack of respect for local culture amid constant change. There is an assumption that economic value is the most important aspect of fisheries. But, when there is resistance to management changes, it is rarely due solely to economics. Culture (a dynamic mixture of ethnicity, history, demography, education, tolerance, and other factors), is what causes outrage when policies are inconsistent with accepted norms." In addition, *Peter*, a full-time, commercial longline fisher, said that:

"There are big frustrations as Council members talking about management decisions that are made 8,000 miles away and applying them to areas such as American Samoa, Guam, CNMI, and Hawaii without the recognition of the social aspects. American Samoa, Guam, and CNMI are much more culturally sensitive. There is not nearly enough sensitivity in my opinion from regulators and NGOs who advocate for a position such as no more taking of sharks. Taking of sharks has been going on for 100 years and for them to come in and say it's not OK anymore is insensitive to the culture and community. Managers will say they're culturally sensitive because they have scoping meetings. They have these scoping meetings to go to the community and "listen" to them. Nothing is more frustrating when you go to a scoping meeting to "hear from the community," where three hours are supposed to be designated for this, but the managers, spokespeople, and panel members' presentations take up two and a half hours of it."

A secondary theme was the need to understand sub-cultures and communities within each jurisdiction. Interviewees believed that this information could provide a more detailed picture of the various sub-communities within an area who have their own specific values, concerns, behaviors, and needs. Two scientists and two managers stated that understanding these differential aspects within communities is important. *Charles*, an oceanographer, emphasized that "the fishing community is heterogeneous. We have this big area with lots of islands and different areas within them with different cultures. I'm sure there is a need for more information." Likewise, *Robert*, a social scientist, argued that "what really needs to be done in Hawaii is to identify the different fishing communities within the state; between different islands and maybe the Big Island split into east and west fishing communities. We also need to distinguish between fishing communities and fishing dependent communities because the level of analysis for impact assessments is different for each."

#### *Priority 4: Fisheries Economics*

Economics was the fourth most frequently mentioned knowledge gap; it was mentioned by 15 interviewees (eight scientists, four managers, three fishers). Of primary concern was developing a more detailed understanding of fishery economics and non-market valuation, followed by government spending (Table 7). The importance of gathering more economic data was usually linked to use of such information in management and gaining the attention of politicians and / or other decision makers. *Ian*, a manager, stated that "understanding monetary value is what's looked at and it's the most powerful tool. It's what's missing. Lack of economic data and ability to incorporate it into Council process is a problem."

Table 7. Identified information needs for the fisheries economics knowledge gap <sup>1</sup>

Specific information needs	Scientists	Managers	Fishers	Total
Specific and accurate fishery economics	3	3	2	8
Non-market valuation	5	2	0	7
Government spending	0	1	1	2

<sup>1</sup> Cell entries are numbers of interviewees.

The general need for more specific and accurate fishery economic information was the only research need within the economic gap in which all three categories (scientists, managers, fishers) were in nearly equal agreement (Table 7). Those who wanted more research focusing on fishery economics were concerned with issues such as maximizing economic yield, fishers' expenses, and the difficulties with collecting quality economic data that fishers seldom want to provide. For example, *Jerry*, a fishery biologist claimed that:

"People never want to give the correct information about what's in their wallet. It would have to be required by law to improve the data. It's just human nature. A fisherman is more likely to tell you how many kids are in his family than how much money is in his wallet."

*David*, a scientist involved in public outreach said that "fishermen don't want to give information because they're afraid it will get to the IRS. We need to build trust ... convey the importance of having accurate economic data for communicating and getting on politicians' agenda. Economics is a way to get the upper politicians' attention. But we need the fishermen to cooperate. If we can boil things down into economic importance; say this fish is worth this many thousands of dollars, it gives fishermen importance and to the constituents as a group. We need fishermen to understand this." *Natasha*, a part-time bottomfish/spear fisher, said that "I think it would be interesting to know if fishermen are able to make fishing their sole source of income, or if they use it to supplement." *Collin*, a full-time, commercial longline fisher with a biology background, also acknowledged that "we need to focus on economics; maximizing stock MSY on whatever is currently acceptable. Maximize utilization and don't kill babies when you only get a quarter of what they're worth as adults."

Non-market valuation was mentioned by only scientists and managers who emphasized the importance of collecting data on non-market valuation of coral reefs, marine protected areas (MPAs), protected species, and other monetary values associated with fishers' contribution to the economy. For example, *Arial*, an economist, stated that "direct value is easy to understand and data is available. The indirect part, such as social benefits, are non-market valuation. It exists even for the fish."

Government spending was of least concern, with only two interviewees mentioning this issue. For example, *Joey*, a policy analyst, suggested that "we're ignoring the amount of money the government is spending on research. If we were to stop and look at it we might decide we are spending more than we should. It's economic information we should be keeping track of, such as the cost of management and money we pour into research. Agency cost benefit analyses ... when I look at them I notice we tend to forget to look at those costs the government is putting in and therefore we are inflating the benefits. Just a huge amount of money being poured in and I know some things aren't worth that much."

#### *Priority 5: ACG Social Issues*

A dearth of information about fisheries issues in American Samoa, the Commonwealth of the Northern Mariana Islands (CNMI), and Guam (ACG) was mentioned by 10 interviewees (eight scientists, one fisher, one manager) (Table 8). This perception is perhaps driven by the fact that Hawaii tends to receive a solid proportion of fishery management attention because of its proximity to the Regional Office, as well as the relative economic importance of its fisheries and its more substantial population. American Samoa was mentioned slightly more frequently (8 interviewees) than CNMI and Guam (6 interviewees each).

Table 8. Identified information needs for ACG social issues knowledge gap <sup>1</sup>

Specific information needs	Scientists	Managers	Fishers	Total
American Samoa	7	0	1	8
CNMI	4	1	1	6
Guam	4	1	1	6

<sup>1</sup> Cell entries are numbers of interviewees.

Most provided little specific information, but there were some common comments about the lack of infrastructure to support consistent and high-quality data collection in the ACG island territories, as well as a general lack of funding and enforcement. For example, *Jeremy*, a social scientist, said that "data are limited because there's only so much jurisdiction and resources we have in areas such as American Samoa, Guam, and CNMI. Overall, there is far less funding, trained personnel, and consistent data." *Josh*, policy analyst and public outreach coordinator, emphasized that:

"Data collection is a general and ongoing need in Guam and CNMI. We didn't have good creel surveys going until the 1980s I think. Data collection is important and always will be because we need that information to enact regulations. We need to better understand the capacity for management in these areas (Guam and CNMI). What resources do they need? It usually comes down to funding. Another very interesting document would be the culmination of all the opinions of various stakeholders (old Chamorro, young Chamorro, Micronesians). We need to include other perceptions."

*Dylan*, a scientist working in stock assessment, also suggested that:

"There's a lack of resources in other territories besides Hawaii, therefore available data in these areas is much less, as well as of a poorer quality. There's a conflict between local and non-locals, and it becomes difficult when non-locals are proposing regulations to be put on local people. There are also historical tensions coming into play. We need more sociologists to help sculpt relationships from the bottom up, rather than this top down management approach we're currently in."

#### *American Samoa*

Two gaps specific to American Samoa were identified by interviewees: (a) social and economic data about fishery participants, and (b) understanding various cultures and customs. The need for



more social and economic information about American Samoa fishers was mentioned by two scientists. One social scientist, *Darrel*, specifically identified the American Samoa long-line limited entry program as an ongoing issue that comes up regularly and that information should be collected to help inform future decision making processes. He said that "for the American Samoa long-line fishery, we need social and economic information about participants. We need to understand why the people who were class A are no longer. Why does the permit program work like it does? What are the social and economic drivers?" Understanding cultural customs and values in American Samoa was an equally important research need also mentioned by one scientist and one fisher. For example, *Robert*, a social scientist said that "there is a continuing importance of fish in ceremonial and cultural uses that are not well understood."

#### *The Commonwealth of the Northern Mariana Islands*

A lack of cultural information was the only research gap specific to CNMI that was identified by more than one interviewee (one scientist, one manager, one fisher). The manager was concerned about addressing and describing all of the different cultural perspectives, whereas the scientist specifically mentioned the need to learn about cultural resistance to reporting and the importance of fish to Chamorro and Chamolinian communities. The fisher, *Tylor*, said:

"We need to better grasp what the baseline is for these areas [Guam, CNMI, American Samoa]. We need to understand the host cultures. One size does not fit all. The Western culture is more likely to show up and say, "Here! Take this, use this." They are very direct and more assertive. Eastern culture is more in the background and speaks-up when invited. This is done to be respectful, but is interpreted by Westerners as a lack of assertiveness. This is the wrong perception and understanding of this cultural custom. We need to be respectful. In order to be respectful, we need to understand the customs, beliefs, and value system of a specific culture."

Other specific comments related to CNMI were provided by interviewees, such as the need to understand the capacity for management in CNMI, addressing under representation of

Rota and Tinian communities, and gathering more information about fishing activities and participation. These gaps were mentioned by only one individual and no trends emerged.

### *Guam*

Similarly, a couple of interviewees mentioned the need for further research on local cultures, fishery participation, and fishing activities in Guam. One scientist and one manager believed there was a need to gather information about the military increasing its presence in Guam and its impacts on local communities and fish stocks. For example, *Robert*, a social scientist, said that "military buildup and the construction bring in other languages and ethnicities, which could lead to some ethnic tension. What is the impact of military on fish stocks and communities? Will we have access to military recreational catch and effort data? Will military closures of offshore banks for exercises affect fishermen?"

Taken together, responses seem to indicate that data about fisheries-related social issues in American Samoa are of higher priority than those for Guam and CNMI. Data quality and quantity was commonly mentioned, and interviewees attributed such issues to untrained personnel, a lack of resources and infrastructure, and insufficient funds. There was some degree of consensus among many interviewees that fisheries management in the Pacific Islands Region is focused largely on Hawaii, which may contribute to lack of knowledge about specific information needs within other territories. Knowledge gaps specific to these territories included fishery participation and culture in American Samoa, more cultural information on CNMI, and the impacts of military presence in Guam, as well as further research on both participation and cultures.

*Priority 6: Number and Characteristics of Participants*

The sixth most commonly referenced knowledge gap regarded the number of people engaged in fishing activities in the Region; mentioned by nine interviewees (five scientists, three managers, one fisher) (Table 9). This issue is not redundant with the recreational fisheries gap discussed above, because who identified this gap did so in reference to fisheries in general (not just recreational) and in the entire Pacific Islands Region. The only logical division of the comments was based on who provided a specific research need and who referred to participation as a general knowledge gap (Table 9). Four of the nine interviewees provided specific research directives with respect to the participation gap.

Table 9. Identified information needs for the number and characteristics of participants knowledge gap <sup>1</sup>

Specific information needs	Scientists	Managers	Fishers	Total
Participation (general gap)	2	2	1	5
Participation (specific gap)	3	1	0	4

<sup>1</sup> Cell entries are numbers of interviewees.

Of these interviewees who had specific concerns about participation, one wanted to know more about the number of boat fishers compared to those fishing from shoreline. A scientist also thought that it would be helpful to know more about the number of recreational fishers versus competitive sport fishers and commercial fishers. A social scientist thought that participation estimates should be improved on a fishery by fishery basis, and other respondents were concerned with participation gaps such as private workers, night fishing, coral reef fishing, and other areas that may be more difficult to access. Finally, other interviewees wanted more information on participation in the territories rather than the Hawaiian Islands. In general, this knowledge gap could be summarized as a need for a more complete and detailed picture of fishery participation in the Pacific Islands Region, with special emphasis on these issues that are perceived to be poorly understood, such as the number of boat and shoreline fishers, participation estimates on a

fishery by fishery basis, and the number of participants who are night fishing, coral reef fishing, or fishing as a private worker.

#### *Priority 7: Social Attributes of Coral Reef Fisheries*

In total, eight individuals identified the coral reef fishery as a knowledge gap (five scientists, three managers). Interestingly, no fishers identified the coral reef fishery as a knowledge gap. A probable explanation is that fishers in this study focused on the fisheries they claimed to participate in at the beginning of the interview. For example, most fishers claimed to participate in the commercial longline, bottomfish, and pelagic recreational fisheries. It is likely that these same fishers participate in other fisheries as well, such as the shoreline and coral reef fisheries, however, they may have overlooked this aspect of their fishing activity, especially if involved in a commercial fishery. Information about all fishing endeavors in which an individual participates was not requested from interviewees and not always volunteered during the interview. Only a couple fishers mentioned their participation in shoreline, spearfishing, lay-net, or other potential reef fishing activities.

Table 10. Identified information needs for the social attributes of coral reef fisheries knowledge gap <sup>1</sup>

Specific information needs	Scientists	Managers	Fishers	Total
Impacts to fish stocks	3	2	0	5
Participation	2	1	0	3
Gill / Lay net fishery	2	0	0	2

<sup>1</sup> Cell entries are numbers of interviewees.

Specific information regarding coral reef fishery knowledge gaps that interviewees expressed was mostly related to human impacts on reef fish populations, current numbers of participants, and the gill/lay net fishery (Table 10). Other comments regarding coral reef fisheries were either vague, general, or mentioned by only a single individual, and included coral reef

economics, public values of coral reef ecosystems, fish flow, land based pollution effects, and researching options for community based management associated with reefs. Knowledge gaps related to human impacts to reef fish stocks were of greatest concern and mentioned by five individuals, including three scientists and two managers. This issue was described as a lack of data limited by difficulties accessing information about catch and participation rates. These difficulties were the result of the lack of documentation of catch rates due to no licensing process, and the accessibility of the shoreline to a wide variety of local and visiting participants.

Unreported catch was a specific concern raised in some interviews because, by definition, this is unknown. For example, *Paul*, a scientist and recreational fisher, stated that one reason we should improve our understanding of human impacts to coral reefs is because these ecosystems may be more sensitive to overfishing and less likely to recover from prolonged and intense fishing effort: "It takes a lot of fishing pressure to out-fish pelagic species because they move more and it takes considerable fishing effort as the population goes down. This does not apply to near-shore fisheries. You [*sic.*] will wipe-out a population and it will not bounce back. It is super sensitive."

Current participation in the coral reef fishery was also a knowledge gap mentioned by two scientists and one manager. Again, accessibility of the shoreline results in coral reef fishery participants not being concentrated at ports and thus difficult to access for data collection. *Lou*, a policy analyst, said:

"For all territories, we have a limited and poor understanding of the coral reef fishery. We don't have a grasp of the participants in the fishery and because everyone has access to the shoreline, it makes it very difficult. There's no management system in place to obtain this information. No licensing. Nothing is required to be documented. Coral reefs are important because we still care whether fish are taken, even if they don't fit into our imaginary lines that separate state and federal waters, such as with fish that have lifecycles that span both. The [coral reef] ecosystem doesn't fit nicely into management boundaries. Everyone has an effect on the fish stocks through pollution and stuff, because it's all linked. But what is easier? Tell fishermen not to fish? Or tell people we need to stop using toilets or take out all the roads? It just gets messy and difficult when thinking about ecosystems."

Gathering more information on the gill/lay net fishery was also identified as an important research need by two scientists. Both of these scientists emphasized this gap because of the unreported catch, lack of regulations, and because they perceived that people are basically getting away with catching and selling fish that are too small in addition to causing destruction to the coral reef and marine life by leaving their gear that gets tangled. For example, *Paul*, a scientist and recreational fisher, emphasized:

"Pulse fisheries are a big gap. They are unique and need to be addressed by the feds. These include people selling on the side of the road, going door to door, to Filipino camps, laying net, and other unreported catch and sales. The barter system is still strong here and these fisheries aren't included in economic surveys. Small parrot-fish go for more in Chinatown, which is unregulated. The lay net guys really need to be banned out here. They will argue it is a traditional technique. I argue back that if it is "traditional" then make [the net] yourself like the Hawaiians before you, and I bet they won't leave it out on the reef to get tangled and then cut and left there. Those take almost a year to weave and tie."

Conservation of the coral reef ecosystem and improved management of the fishery were the two main themes for why interviewees thought that more information on the coral reef fishery should be collected. According to several scientists and managers, human impacts, participation, and the gill/lay net fishery in coral reef areas are the research foci deserving of the most attention.

#### *Priority 7: Social Attributes of Non-Commercial Fisheries- Subsistence Fisheries*

A need for more information about the subsistence fisheries in the Pacific Islands Region was also identified as a knowledge gap by six scientists and two managers, giving it equal ranking to coral reef fisheries issues. Four of the six scientists who identified this gap were social scientists. Similar to the coral reef fisheries issues, no fishers identified this issue as a knowledge gap. Again, this could be a result of the majority of fishers who participated in this study having a pelagic and/or commercial focus. Reasons put forth for researching subsistence fisheries included understanding categories of fishers, knowing the number of individuals who are relying on fishery resources to feed themselves and their families, and understanding the subsistence

fishery's impact on fish populations. *Robert*, a social scientist, explained that we "need a clear understanding of recreational and subsistence components of commercial fishing. Categories of fishermen are more of a continuum rather than putting people into strict boxes. They need to include more about why people fish."

The most commonly mentioned research needs for this issue were subsistence information specific to Hawaii (one scientist, one manager), human impacts to fish stocks (one scientist, one manager), and participation in the subsistence fisheries of the Pacific islands Region (two managers). All three should be considered equally important as they were each mentioned by two interviewees. The remaining comments were general and basically referred to the lack of data about subsistence fishery issues. *Dane*, a social scientist emphasized that "we don't have a good understanding of the extent of the subsistence fishery in Hawaii. No fishing license is currently required. We need to better understand extent and importance of subsistence fishing."

The focus of this knowledge gap appeared to be centered on understanding the subsistence fishery in terms of impacts to fish stocks and participation, with an emphasis on Hawaii in general. Social scientists who were interviewed seemed to be especially aware of this gap in data that was not mentioned by fishers interviewed and by most other managers and biological scientists. Like several of the knowledge gaps mentioned earlier, the primary concern was managing fisheries when there is little knowledge about fishing pressure and participation.

#### *Priority 7: Social Attributes of Adaptive Management*

Another knowledge gap identified by interviewees was a need to research and assess social attributes relevant to adaptive management strategies. According to most interviewees, the purpose of collecting this information was to improve and modify current management strategies, which was specifically described by some interview participants as "adaptive management." Four scientists and four managers identified this adaptive management knowledge gap. There were no

obvious differences between comments of scientists versus those of managers; both groups were concerned with assessing why some regulations work and others do not appear to work. They were also interested in alternative strategies and learning from other fishery mistakes.

Three scientists and one manager believed that culture was an important consideration when adapting management to different areas. Two scientists were also concerned with exploring alternative management approaches, and one scientist and one manager emphasized the importance of assessing why various methods did or did not work. The four interviewees who identified incorporation of culture in the management process as a specific research need emphasized the importance of cultural practices, values, and customs in helping to advise management strategies. Most of these interviewees believed that management should be considered on the local and cultural level to be effective. For example, *Alex*, a fishery management specialist, stated:

"The biggest problem in dealing with mainland politics in Pacific Island fisheries management and monitoring is probably the assumption of a cultural foundation consistent with mainland traditions. Trying to force-fit Pacific Island fisheries into a mainland US perspective is often a mismatch. This affects "creel" surveys (even the word "creel" is a mainland concept), classification of the catch (nobody fishes for "recreation" in the Pacific except tourists... it is a way to feed the family), the idea that individual catch limits are desirable, and many other aspects of monitoring and management. "Fishing" is a cultural art and fishermen are among the most creative and adaptive group of hunters on the planet. Perhaps the failure of management to adapt at the speed of fishing is the largest gap in the understanding of fisheries governance. Fisheries management happens best at the local cultural level and economics is only one measure of the pulse of fisheries. I would place a high priority on a "reverse cultural education" effort, with top-down management looking at an opportunity for its own cultural education."

Researching alternative management tools and assessing these methods were also identified, each mentioned by two interviewees. *Dorothy*, a scientist involved in research on international fisheries, believed that it was important for managers to use alternative tools besides catch limits or closures when trying to reach their goals of reducing catch: "We should be considering alternative management methods. What options are people open to? What are



people's opinions or acceptability? Are there other ways such as modifying gear that could help managers reach their goal of limiting catch? Also, we need to consider implementation and if a regulation is feasible and acceptable." One interviewee also mentioned the importance of not forcing Western ideals and methods into management of fisheries in the Pacific Islands Region because such approaches "simply don't work." Overall, most interviewees who identified this knowledge gap emphasized the importance of trying new management strategies and assessing these methods to determine whether they are working and if their continued implementation would be effective and beneficial.

#### *Priority 8: Human Dimensions of Stock Assessments*

Comments related to stock assessments were provided by six interviewees (four scientists, one manager, one fisher). Stock assessments tend to be viewed primarily from a biological science perspective. However, several interviewees suggested that there are human dimensions of stock assessments, and that NMFS should look to incorporate those dimensions into the process to produce more robust and trusted data. Several suggestions were provided in relation to this issue, but only one comment was mentioned by more than one person. This information gap was related to the incorporation of fisher skill levels into stock assessments. The remaining comments were either too dissimilar to group into themes or too vague. For example, "we need to incorporate more social data into stock assessments" was evaluated as too general to do much with. Two interviewees, however, identified fisher skill and ability to successfully catch fish as an important variable missing in current stock assessments. *Gordon*, a fishery biologist, claimed that "the biggest uncertainty is our stock assessments. We need to include fishermen's skill and gear into stock assessments." *Shannon*, a scientist in stock assessment, stated that "stock assessments are very difficult to standardize effort. Catch is not a good way to assess stocks. The

hours fishermen spend fishing does not equal their experience. [We] need a quality of fishermen index or something."

A comment made by *Cameron*, a scientist in stock assessment, recommended the incorporation of people's values into stock assessments so that management of fish stocks can best benefit the community. For example, some people may value small-to-medium sized fish because they fit well in their freezer. Those involved in fishing tournaments, however, are typically targeting the biggest fish. According to this scientist, management of stocks needs to consider these differences in people's values:

"What we need is a "green curve" that incorporates everyone's values. Some value size, others want small because of handling the fish (artisanal fishery). What social values should we put into this and how should it have an effect on MSY? Currently, social information can only bring [MSY] down further... How do we evaluate the information we have in a way that can have the most benefit to people? How to best make use of what we have and the stock we are "given?" Is it better to fish young fish or old fish for the greatest social benefit?"

In summary, at least one scientist, one manager, and one fisher thought it was important to improve stock assessments by incorporating some aspect of social and/or economic data. The only research suggestion mentioned more than once was the incorporation of fisher skill level into stock assessments. Another suggestion was the incorporation of people's values when managing a stock of fish. Other comments were more general, suggesting the need for more stock data, the incorporation of data on restricted areas, or cross checking and reassurance of stock estimates.

#### *Priority 8: Demographics of Fishery Participants and Communities*

Demographic information was identified as a gap by six interviewees (four scientists, two managers). Two sub-themes emerged; improving knowledge on changing demographics (one manager, one scientist), and using demographic information to predict and prevent conflict (two scientists). The remaining comments mentioned by single individuals concerned crew make-up,

understanding the size and relation of indigenous and non-indigenous populations, researching the role of immigration, and comparing demographics of participants in various fisheries.

Information on changing demographics was considered to be important for knowing when different fish species dominate the market, and for predicting when these trends shift. This topic also has management implications, similar to those discussed above in the cultural knowledge gap. Having a more complete understanding of demographics could advise management decisions to be more respectful of local culture and people's values. Another benefit was conflict resolution, as stated by a social scientist, *Darrel*, who said that "demographics are important because they illustrate the different ethnic values we're dealing with. Each culture has different normative standards about income, money, and equality, each with their own social operation systems. Better demographic information might help to better predict where conflicts are going to arise." The main message that should be gleaned from this knowledge gap is that demographics are important for understanding people most likely to be affected by management decisions, and can also shed light on what people value or prefer and where some of these differing values or beliefs might create conflicts.

#### *Priority 9: Impacts on Fishing Communities*

The final gap that will be described is in regard to the perceived need to improve understanding about impacts on communities and the tradeoffs inherent in managing for both ecological and societal benefits. Five interviewees mentioned this gap (three managers, two scientists) and all five comments followed the same general theme of needing to understand more about how policy decisions affect the community.

A couple of comments indicated need for proactive research into community stability and public dependence on marine resources before any management decisions are made. For example, *Ian*, a manager, called the collection of this information a "socioeconomic impact assessment"

and said that having this information before decisions were made would be a powerful tool in management. Likewise, *Julee*, a fishery biologist, suggested that "it is important to understand tradeoffs with harms that we may inflict on the environment versus the potential social and economic benefits that may result." *Timothy*, a policy analyst asked "what are the impacts to fishing communities? Often times, there is no information to help answer these questions."

The primary message derived from this knowledge gap is that it would be beneficial for management to have information about potential impacts to communities before fisheries management decisions are finalized and implemented. This information could help managers and other decision makers make more informed decisions. Some specific suggestions included understanding community stability, tradeoffs among environmental and societal benefits of management actions, and dependence of various communities on fishing.

## **DISCUSSION AND RECOMMENDATIONS**

This study described perspectives of scientists, managers, and fishers regarding the importance of social information in fisheries management, and presented their perceptions of knowledge gaps in information needed to more effectively manage marine fisheries in NMFS's Pacific Islands Region. This was done to address the main research questions: (a) what are the perspectives of managers, scientists, and commercial and recreational fishers regarding the importance of social information in helping to manage fisheries, (b) what gaps in knowledge about social aspects of fisheries and its management do these stakeholders think require further research, especially in the Pacific Islands Region? Interviews across 57 scientists, managers, and fishers illustrated that the vast majority of these interviewees believed that social information is important for management of fisheries in this Region. The most commonly identified knowledge gaps associated with social information in fisheries management in this Region were fisher

perspectives, behaviors, and motivations; recreational fishing; culture, customs, and values; and economics. Each of these knowledge gaps was identified by at least 15 interviewees with at least one representative from each group. Social information was deemed to be important and it was frequently asserted that future research should focus on these research priorities.

A nearly unanimous trend resulted in response to inquiries about the importance of social and economic information in fisheries management; 56 of the 57 participants in this study expressed that social information is important in the Pacific Islands Region. With only one interviewee expressly in opposition to using social information in the fisheries management process, the high level of agreement among interviewed scientists, managers, and fishers suggests that accurate and updated social and economic information would be both beneficial and desirable. A logical question that arises, however, is where should future research efforts be focused?

Results from the interviews revealed common themes and research needs. Of the 42 total subject areas and knowledge gaps identified by participants, the most frequently suggested gap was associated with better understanding fishery participant/community perspectives, behaviors, and motivations. Other commonly identified gaps included (in descending order): social attributes of recreational fisheries; culture, customs, and values; fisheries economics; ACG social issues; number and characteristics of participants; social attributes of coral reef fisheries; social attributes of subsistence fisheries; social attributes of adaptive management; human dimensions of stock assessments; demographics of fishery participants and communities; and impacts on fishing communities. The four most frequently identified gaps (i.e., each mentioned by 15 or more interviewees and by all three groups [i.e., scientists, managers, fishers]) and their implications are discussed in this section.

*Participants/Community Perspectives, Behaviors, and Motivations*

The most frequently identified knowledge gap in this study was the need to know more about fisher perspectives, behaviors, and motivations in the Pacific Islands Region. Interview participants who identified these motivations as a knowledge gap were commonly interested in wanting to know more about fishers' decision-making processes influencing their participation and what variables have the greatest influence on these processes. Many respondents also emphasized the importance of understanding and anticipating fisher behaviors such as switching target species, fisheries, gear, or locations. Incorporating fisher perspectives into management was another frequently mentioned knowledge gap. These results suggest that it would be beneficial for fisheries management in this Region to improve understanding and prediction of fisher motivations and behaviors, as well as incorporate their perspectives into management.

In comparison to the literature review by Pickering et al. (2011), relatively similar gaps emerged. As indicated by this literature review, there is little information available on fisher perspectives in the Pacific Islands Region, with the exception of the pelagic fishery. It appears that pelagic fisher perspectives in the four territories have been relatively consistently studied with current (i.e., studies between 2001 and 2011) available data on overfishing concerns, limited entry programs, the observer program, fisher success, and market concerns (e.g., Allen, 2007; Allen and Bartram, 2008; Hospital 2010; Miller, 2001; O'Malley and Pooley, 2001). Fisher perspectives about non-pelagic fisheries in all territories, however, have received limited attention except for a couple of studies (Kilarski et al., 2006, and Allen and Bartram, 2008) on coral reef fisheries in American Samoa and Guam, respectively, and one study on recreational fisheries in CNMI (Van Beukering et al., 2006).

With a few exceptions, Pickering et al. (2011) also found little information on fisher behaviors in the Pacific Islands Region. Information on historical dependence and participation, for example, were available for all four territories, but most did not specifically address behaviors

(e.g., Allen and Bartram, 2008; Eads, 2001; Hamilton et al., 1996; Hospital et al., 2011). Recent studies that are available addressed coral reef fisheries in American Samoa (Kilarski, 2006), differences in behavior of full and part time fishers in CNMI (Miller, 2001), and a few papers on cooperative fishing in the Hawaii small boat pelagic fishery and the sharing of fish in the main Hawaiian Islands hand and troll fishery (Glazier, 2002; Hospital et al., 2011; Miller, 1995). Overall, some limited information on fisher behavior in the Region does exist, but little information specific to why fishers switch target species, fisheries, gear, or location was found in the literature review, so these are knowledge gaps that appear to be supported by both the literature review by Pickering et al. (2011), as well as this gap analysis.

With a few important exceptions, information on knowledge of fisher motivations was also generally lacking in the Pacific Islands Region. Fisher motivations have been studied for the pelagic fishery in Guam (Rubinstein, 2001), the bottomfish fishery in Hawaii (Pan and Griesemer, 2006), the Hawaii charter industry (O'Malley, 2001), and the main Hawaiian Islands handline and troll fisheries (Miller, 1995). This information, however, may be considered somewhat out-of-date given that the most recent study was from 2006.

In total, 20 different interviewees believed that addressing this knowledge gap would benefit and enable more proactive fisheries management in this Region. Understanding fisher motivations and behavior could help anticipate events such as when they decide to change fisheries, gear types, or target species. If a resource management agency can better understand the variables that affect these decisions and behaviors (i.e., weather, holidays, cultural practices, values, beliefs), management could arguably be more proactive, rather than reacting to changes in the fisheries. Another potential benefit of addressing this knowledge gap that was mentioned by interviewees was the inclusion of fisher perspectives into policy development and decision-making. When participants and communities are included in the management process and policies are developed with their perspectives in mind, regulations are arguably more effective, due to increased compliance and self regulation. Overall, it was emphasized by interviewees that further

research in this area is important because it is people who are being managed and fisheries management would benefit from an improved understanding and prediction of their motivations, behavior, and perceptions.

Taken together, slightly more information in the Pacific Islands Region exists on fisher perspectives than it does for behaviors and motivations. This information on fisher perspectives, however, is mostly specific to pelagic fisheries. Recommendations according to this informal gap analysis would be to focus future research efforts on examining fisher motivations and behavior in areas that could help management to be more proactive, such as data that could be used to help anticipate changes in gear, location, target species, and fishery, and more effective, by increasing compliance and self-regulation. The analysis also suggests that further research should address non-pelagic fisher perspectives. These recommendations were emphasized by 20 interviewees, can provide benefits to management (i.e., increased policy effectiveness and more proactive decision-making), and are consistent with literature gaps found in Pickering et al. (2011), with only a few specific exceptions.

#### *Social Attributes of Non-Commercial Fisheries- "Recreational" Fisheries*

The general consensus among participants who identified recreational fisheries as a knowledge gap was that little information exists about recreational fisheries on a general scale. Without required recreational fishing licensing or mandatory reporting in the Pacific Islands Region, managers and scientists have little reference information when studying or understanding the status of local fish stocks and the impact of policies on recreationists. Various research needs specific to recreational fisheries were identified by participants, including (in descending order): the impact of recreational fisheries on local fish stocks, number of people currently fishing recreationally and factors influencing this number, economic impacts of recreational fisheries, various cultures and customs involved in recreational fisheries, and importance of fish to various



groups. According to the stakeholders interviewed, the recreational fishery should be a high priority and these specific research needs should be a focus of future research efforts attempting to address social information needs in the Pacific Islands Region.

In comparison to these results, the literature review compiled by Pickering et al. (2011) suggested similar gaps, as they also found a general lack of information available on recreational fisheries throughout the Pacific Islands Region. Except for a few studies each (e.g., Craig et al., 1993; Van Beukering et al., 2006; Miller, 2001; Allan and Bartram, 2008; Eads, 2001; WPFMC, 2010; WPFMC, 2011b), territories such as American Samoa, Commonwealth of the Northern Mariana Islands (CNMI), and Guam have the least information available on recreational fisheries. By comparison, Hawaii has the most human dimensions information on recreational fisheries issues. As indicated by Pickering et al. (2011), Hawaiian recreational fisheries are primarily lacking social information describing shoreline and non-charter offshore fishing activities. With the exception of the Hawaiian charter industry, however, little socio-economic information exists on recreational fisheries in the Pacific Islands Region. Even the Hawaii charter industry, however, has information gaps including public perceptions and sociological information. In addition, it could be considered outdated given that its most recent information is from a study by O'Malley (2001).

Another finding consistent across both interview results and the literature review by Pickering et al. (2011) is that information on impacts to local fish stocks and fishery participation in the Pacific Islands Region is generally unavailable. One discrepancy, however, was Hawaiian recreational fisheries, for which the literature review suggested that there is at least some information available on participation and catch rates (e.g., NMFS, 2009). Multiple stakeholders interviewed in this study, however, claimed that nothing is known about recreational fishery participation and catch rates both in the Pacific Islands Region in general and Hawaii in particular. One possible reason for this inconsistency may be that interviewees do not trust the information that was available. Only a few interviewees, for example, mentioned the current

program in Hawaii that is being used for estimating statewide total effort and catch by species, mode, and country (i.e., “Hawaii Marine Recreational Fishing Survey” [HMRFS]), but those who did mention HMRFS felt that the data were unreliable and that methods could be improved. In addition, some interviewees pointed out that participants in the recreational fisheries are difficult to contact and sample, because of the huge number of shore line fishers that are not concentrated in a single port. Overall, needing to know more about participation in recreational fisheries and the potential impacts to fish stocks were emphasized by interviewees who identified recreational fisheries in the Region as a knowledge gap. This gap is mostly supported by the literature review (Pickering et al., 2011), but some information is available on Hawaiian recreational fisheries (e.g., HMRFS).

According to many interviewees who participated in this study, recreational fisheries constitute a knowledge gap in the Region that is important to study because many wondered how a fishery could be managed without knowing much about the phenomenon. Without required licensing of recreational fishery participants or the mandatory reporting of harvests, it is difficult to gather information that would help address these issues related to recreation participation and harvest rates. Interviewees also raised the concern that participation and catch data that is currently available, may be unreliable due to research methods and/or because the population of shoreline and offshore boat fishers difficult to sample. It is also important to acknowledge the connection between the two most frequently identified research needs within this recreational fisheries knowledge gap – impacts to fish stocks and fishery participation – because each has obvious implications that impact each other. For example, as the number of fishery participants increases, it is likely that impacts to fish stocks will increase.

Taken together, results from this study coupled with the literature review (Pickering et al., 2011) both suggest that little information exists on recreational fisheries in most territories in the Pacific Islands Region. Recommendations for future research according to this informal gap analysis would be to increase efforts focusing on fishery participation and potential impacts to

fish stocks. These recommendations were emphasized by 20 interviewees, can provide benefits to management (i.e., baseline data on current participation and more accurate fish stock estimates), and are fairly consistent with literature gaps in Pickering et al. (2011), with the exception of participation data, which may be unreliable according to some stakeholders interviewed.

### *Culture, Customs, and Values*

According to 16 interviewees, more information needs to be collected on people's culture, customs, and values related to fisheries in the Pacific Islands Region. Results suggest that specific attention should be given to researching cultural values and sub-cultures within each of the territories.

The literature review by Pickering et al. (2011) found that information on cultural values was available for at least one fishery in all four territories, but the data were by no means extensive. Only one study, for example, addressed the cultural use and importance of the coral reef fishery in American Samoa (Kilarski et al., 2006), and no other study was found providing data on cultural values for any other American Samoa fisheries. For Guam, only a single study by Rubinstein (2001) provided information about the sense of cultural identity that Chamorros and Micronesians derive from fishing in the Guam pelagic fishery, and no further studies were found for other fisheries in Guam. No studies on cultural values were found for fisheries in CNMI. Cultural values have been studied slightly more in Hawaii with information on the bottomfish and MHI handline and troll fisheries (Pan and Griesemer, 2006; Miller 1995). Overall, fishery-specific data on cultural values is lacking and potentially outdated. The secondary research need to understand sub-cultures within territories was completely supported by Pickering et al. (2011) because no information related to sub-cultures was found.

Interviewees believed that learning more about cultural values was important for understanding participant/community preference or avoidance of certain species, the importance

of fish to various cultures, and values associated with catching, consuming, and sharing fish. The need to garner respect for local cultures was also emphasized as a way to improve fisheries management. Policies that are culturally sensitive and that work with local cultures, beliefs, and values, rather than against, are likely to be more effective and increase community involvement, compliance, and self-regulation. Understanding sub-cultures and communities within each territory was believed to be important for providing a more detailed understanding of fisheries in each territory in the Region. Because the Pacific Islands Region is so heterogeneous and encompasses so many different cultures, communities, as well as sub-cultures and sub-communities, it would benefit management to develop and apply regulations with these differences in cultures, beliefs, and values in mind

Taken together, the knowledge gap related to culture, customs, and values was identified by many interviewees and was generally supported by the literature review. Recommendations for future research according to this informal gap analysis would include collecting data that helps to develop a more in-depth understanding of cultural values, specifically fisheries for which no information currently exists or the data available are outdated. Some examples of specific fisheries in need of in-depth and contemporary cultural research include the American Samoa bottomfish, crustacean, pelagic, and recreational fisheries; the CNMI bottomfish, coral reef, crustacean, pelagic, and recreational fisheries; the Guam bottomfish, crustacean, and recreational fisheries; and the Hawaiian bottomfish, coral reef, and crustacean fisheries. These fisheries were specifically identified, because for each, no studies on cultural values have been conducted to date, according to the literature review by Pickering et al. (2011). Another recommendation would be to conduct research that provides a more detailed understanding of culture on community and sub-cultural levels. These recommendations were emphasized by 16 interviewees, can provide benefits to management (i.e., cultural sensitivity, improve management effectiveness by increased compliance, participation, and self-regulation, and better informed management decisions based on a more detailed picture of cultures, values, and customs in the

Pacific Islands Region), and are consistent with the literature review by Pickering et al. (2011), which suggests that current cultural knowledge is non-existent, too general, or outdated for many fisheries in the Pacific Islands Region.

### *Economics*

The lack of comprehensive information about fishery economics and non-market valuation of fisheries in the Pacific Islands Region was identified by 15 interviewees as a major knowledge gap. Government spending on fisheries issues was another specific research need, but was only identified by two interviewees. Those who identified fishery economics as a knowledge gap were interested in issues such as maximum economic yield, fisher expenses, and the difficulty of collecting accurate economic information on fisheries in this Region. Those interested in non-market valuation were interested in research on monetary values of things such as coral reefs, marine protected areas (MPAs), and protected species. There were also concerns among interviewees that current economic information about fisheries in this Region is difficult to collect and in some cases may be unreliable.

The literature review by Pickering et al. (2011) identified common trends in the current economic data on fisheries in the Pacific Islands Region. In general, most of the Arita et al., 2011; economic data available focuses on the pelagic fisheries in all four territories and these data include information from several studies (e.g., O'Malley and Pooley, 2001; Kleiber, 2002; Miller, 2001; Hamnett et al., 1998; Rubenstein, 2001; O'Malley and Pooley, 2003) in addition to landings and revenue information provided by the Western Pacific Fisheries Management Council (WPRFMC) or the Western Pacific Fisheries Information Network (WPacFIN). This was especially true for non-Hawaiian territories such as American Samoa, CNMI, and Guam where the most recent economic information for non-pelagic fisheries was provided by the WPRFMC using data from 2009. In Hawaii, more extensive economic research has been conducted on the

longline fishery and charter fishing industry. Information on other fisheries addressed landings and revenue, but little else. With regard to non-market valuation, no such information was found by Pickering et al. (2011).

Gathering more reliable and detailed economic information was considered to be important for its use in management, such as better understanding the economic impacts on fishing communities. Economic information, particularly non-market valuation was considered a valuable research endeavor for gaining the attention of politicians and/or other decision makers. For example, describing the value of coral reefs in terms of ecosystem services and economic value may help to grab the attention of decision makers and thus aid in its conservation and protection. Gathering more detailed economic information may also be helpful for more proactive management decisions, such as predicting breaking points (i.e., fuel costs, other fisher expenses) that cause individuals to leave a fishery, change target species, and increase/decrease fishing pressure.

Taken together, these findings suggest that more economic information about fisheries in this Region is needed, particularly studies that go beyond landings and revenue information for non-pelagic fisheries. Recommendations for future research according to this informal gap analysis would be to focus on developing a more in-depth economic knowledge base of non-pelagic fisheries in the Region that are important economically and still active. Additional studies addressing non-market valuation of coral reefs, MPAs, and other economic contributions provided by fisheries could also be important because little or no information is currently available. It is also recommended that consistent and rigorous research methods be adapted and implemented so that economic information becomes more valid and reliable. Improving the validity and reliability of economic information, however, may not improve as a result of different methods because as mentioned by multiple interviewees, some stakeholders such as fishers may not be inclined to provide accurate information due to a lack of trust in agencies. . These recommendations were emphasized by 15 interviewees, can provide benefits to

management (i.e., more accurate and detailed understanding of economic information and impacts on communities, better informed management decisions, gaining the attention and support of decision-makers, more proactive management decisions), and are consistent with the literature review by Pickering et al. (2011).

## CONCLUSION

This thesis examined attitudes towards the use of social science information to support fisheries management activities in NMFS' Pacific Islands Region and sought to understand important gaps in socio-cultural and economic data with which to do so. To obtain this information, interviews were conducted with nearly 60 knowledgeable informants across science, policy/management, and fishery participants. There was a strong support for the inclusion of social and economic information in decision-making among almost all (i.e. 56 of 57) of those interviewed.

Obviously, the ideal state is for managers and decision makers to have comprehensive social, economic, and biological information from which to make informed and scientifically-grounded decisions that adequately consider impacts of policies on both the environment and society. Limited funding, however, is available to address all knowledge gaps that currently exist. The information gaps presented here were of highest priority according to interview participants and these were generally consistent with the literature review by Pickering et al. (2011). The four knowledge gaps of highest priority according to stakeholders interviewed and consistent with the literature review included fisher perspectives, behaviors, and motivations; social attributes of non-commercial fisheries- "recreational" fisheries; cultures, customs, and values; and fisheries economics. Recommendations suggested here were based on these interview responses coupled with the literature review by Pickering et al. (2011) in addition to the consideration of potential

benefits to management. The results from this informal lays the foundations for a social scientist currently working in the Pacific Islands Region to apply their professional knowledge, experience, and skills to critically assess and prioritize the knowledge gaps identified by this research.

Potential limitations of this research include the sample of interviewees, who may not be in a position to knowledgeably identify what is currently missing from our social science knowledge base. Multiple participants interviewed were not aware of the current social science literature available pertaining to the Pacific Islands Region and a couple even admitted to making guesses as to what research was the most needed. Another potential constraint may be the limits of the interviewer's ability to fully and accurately express ideas of interviewee responses using handwritten notes, because without audio recordings to reference verbatim, the interviewer was dependent on these notes as the primary source of data.

Multiple research opportunities arise when considering the results of this informal gap analysis. The next obvious step would be to develop a more detailed and formal gap analysis that considers additional prioritizing variables and that incorporates a critical assessment of how these gaps can operationally be filled. Another research opportunity would be to focus on filling and mitigating gaps in current management processes (i.e. non-information gaps) that were frequently suggested by interview participants. Some of these suggestions include addressing issues with communication, gaining trust and support from the community and fishery participants, exchanging information between agencies, and improving enforcement of regulations.

What makes this study important is to the identification of specific areas of interest and importance according to scientists, managers, and fishers currently involved in fisheries in the Pacific Islands Region. By going beyond the inventory of current literature and speaking directly with these stakeholders whom are intimately involved in theses fisheries, a unique and valuable insight was gained about the importance and need for social information. This insight can help to provide a diverse perspective on what future social research should be done and why. The results



from this informal gap analysis provide a framework for prioritizing future research efforts and it is hoped that the knowledge gaps identified in this study can be further analyzed and prioritized to help the data better serve as a guide for future social and economic fisheries research efforts in the Pacific Islands Region.

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## APPENDIX A

### *List of Interview Questions*

1. Do you think social information and data is generally important when it comes to managing fisheries?
2. Why do you believe this?
3. What specific socio-cultural and economic fisheries information do you think is important for managers and policy-makers to consider when it comes to managing fisheries?
4. What areas in our knowledge about socio-cultural and economic attributes of fisheries do you think is lacking, if any?
5. Do you think other managers, scientists, and fisheries participants share similar views on what social information is important in managing fisheries?
6. What potential and specific benefits to fisheries management do you see as a result of improving our understanding of fisheries from a social perspective, if any?
7. How much trust do you have in information collected by scientists?
8. How frequently do you interact and communicate with fisheries managers? With anglers? With fisheries scientists?