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MANAGING DATA-POOR FISHERIES

CASE STUDIES, MODELS & SOLUTIONS

FINAL REPORT

DATA-POOR FISHERIES WORKSHOP

1-4 DECEMBER 2008

SPONSORED BY

RESOURCES AGENCY CALIFORNIA DEPARTMENT FISH&GAME

Sea Grant California

Managing Data-Poor Fisheries Workshop: Case Studies, Models and Solutions

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Final Project Report to the California Department of Fish and Game

by

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Executive Summary

University of California Sea Grant Extension Program and the California Department of Fish and Game (CDFG) convened a fisheries management workshop December 1-4, 2008, in Berkeley, CA. The workshop, entitled "Managing Data-Poor Fisheries: Case Studies, Models and Solutions," was designed to provide ideas to CDFG about ways to manage California fisheries when available data are insufficient for single species or ecosystem-based management.

The workshop included 36 contributed manuscripts and selected presentations from invited national and international experts in designing techniques and strategies for managing data-poor fisheries. The majority of the time, however, was spent in facilitated discussions among workshop participants. These discussions included staff from state and federal agencies, academic scientists, and representatives from stakeholder groups. The purpose of the workshop was to develop ideas that could be considered more thoroughly at a later date by CDFG, the California Fish and Game Commission, and interested and affected groups. Although the workshop convened a broad range of participants, the total number was limited to facilitate in-depth discussions. Thus, the results of the workshop are not a mandate for CDFG to pursue a specific course of action, but provide constructive ideas for CDFG to investigate more thoroughly with stakeholders.

The 100 people who participated in the workshop were affiliated with the following groups:

- Resource management (44%)
- Academia (30%)
- Fishing community (commercial and recreational) (13%)
- Other organizations (e.g., consulting firms) (8%)
- Non-governmental organizations (NGOs) (5%)

About 74% of the attendees were from California, 12% from other parts of the US West Coast (including Alaska), 7% from other parts of the US, and 8% from other countries (Australia, Canada, New Zealand and South Africa). The majority of participants have been involved in fisheries for more than 20 years.

Workshop participants were divided into five work groups of about 15 members each that were charged with providing ideas related to the development of:

1. Alternative strategies for managing fisheries without the need for additional data
2. New analytical techniques to inform management using available data
3. New techniques to collect and integrate biological and socioeconomic data

Discussions were facilitated and ideas were transcribed into notes each day. Each group discussed the three topics with respect to a specified set of fisheries. Several fisheries that the state has primary management authority for were discussed. State-managed fisheries were the primary focus of the workshop; discussion of federally managed or jointly managed fisheries such as salmon, tuna, and groundfish was limited to the nearshore groundfish fishery.

Over the course of the workshop, participants generated more than 400 specific ideas about ways to address data-poor fisheries. Near the end of the workshop, these ideas were distilled into 21 overarching ideas related to the workshop themes; nine related to management alternatives, four related to analytical techniques and eight related to new ways to collect and integrate data:

Topic 1: Management Alternatives

- S1. Develop a process to clearly define fishery management goals and strategies.
- S2. Develop a strong system of co-management that integrates user groups into all aspects of the goal setting, data collection and analyses, management, and enforcement.
- S3. Increase the use of explicit area-based management.
- S4. Integrate management approaches with federal fishery management, marine protected areas (MPAs), and other spatial management tools.
- S5. Increase the monitoring of stock size-structure for fished species.
- S6. At a minimum, obtain an index of abundance and an index of replacement for fished species.
- S7. Explore dedicated access privileges to align individual economic incentives with conservation goals.
- S8. Integrate recreational fishery management with commercial fishery management.
- S9. Develop a process for adaptive fisheries management.

Topic 2: Analytical Techniques

- S10. Explore using MPAs as an assessment tool.
- S11. Complete standard biological and social scientific analyses using existing data to better understand the status of California fisheries.
- S12. Develop simple indicators (biological, social, economic) of fishery status.
- S13. Use existing data-rich fishery scenarios to inform which data should be collected for data-poor fisheries.

Topic 3: New Techniques to Collect Data

- S14. Inventory, evaluate, and use, as appropriate, existing data sets for management.
- S15. Develop collaborative fisheries research programs using standardized protocols, science-based design, and fishermen's expertise, with a process for analyzing the data and integrating it into management.
- S16. Conduct full economic valuations of recreational and commercial sectors at the port level using comparable measures.
- S17. Collect the basic biological and human dimensions data needed to conduct standard analyses for those fisheries where these data are lacking.
- S18. Move data collection towards a finer geographic scale.
- S19. Develop collaborative relationships with the fishing and research communities to collect additional socio-economic and biophysical information.
- S20. Increase the understanding of recreational fisheries.
- S21. Establish a data repository to make fishery-related data publicly available.

Following the workshop, participants completed a survey to evaluate the workshop and the overarching ideas. Additionally, a cross-section of people involved in commercial and recreational fisheries who did not attend the workshop were asked to complete the survey regarding the overarching ideas developed at the workshop.

More than 80% of survey respondents agreed with five of the nine ideas related to management alternatives (Topic #1); S1, S2, S5, S9 and S8. Opinions regarding the remaining four were more mixed, with at least one-third of commercial and recreational fishermen disagreeing with S3 and S4, and two-thirds of recreational fishermen disagreeing with S7.

Only one of the four ideas related to analytical techniques (S12, Topic #2) was agreed to by more than 80% of the respondents. More than 65% of the respondents agreed with two other Topic #2 ideas (S11 and S13). One analytical technique, exploring the use of MPAs as an assessment tool (S10), was agreed with by just less than half of respondents, and had the highest level of disagreement (26%) for all ideas.

All survey respondents agreed with two (S14 and S15) of the eight ideas related to new techniques to collect and integrate biological and socioeconomic data (Topic #3). Two additional suggestions under this topic (S19 and S20) were agreed to by more than 80% of survey respondents.

The survey also asked respondents (through an open-ended question) to specify three ideas (i.e., new ones or from among the 21 overarching ideas generated at the workshop) that should be of highest priority for CDFG to pursue. Among the 21 overarching ideas, the most frequently cited, S15 and S1, were cited by about 20% of respondents; only S15 was supported similarly by both attendees (23%) and non-attendees (17%). A broad array of new ideas was also suggested as high priority for CDFG to pursue, including items related to the three workshop topics and general policy and principles. These ideas warrant further exploration through focus group discussions and/or other assessments.

Overall, the post-workshop survey results suggest that implementation of some of the ideas provided would be widely accepted, whereas others would be strongly supported only by specific interest groups. Before moving forward with any of the ideas, we encourage the CDFG to evaluate the support for the various ideas among a larger and more representative group of stakeholders. The CDFG will greatly benefit from engaging in additional discussions with those who are interested and/or will be affected by changes in management. Following such discussions, participants suggested the development of pilot programs to assess the potential usefulness of the remaining feasible ideas.

Acknowledgements

This workshop was accomplished with generous support from California Department of Fish and Game, California Sea Grant College Program, and the Resources Legacy Fund Foundation. We thank Kimberly Beaird, Rachel Davis, and Jennifer Smyrnos of the California Sea Grant Extension Program for their help with travel and workshop logistics. We are grateful to those who gave presentations and for all of those participants who submitted papers to help us garner information about strategies for managing data-poor fisheries. We are thankful for the excellent hard work put in by Facilitators: Jim Brenner, Flaxen Conway, Pete Nelson, Paul Olin, and Sunny Rice; Synthesizers: Debbie Aseltine-Neilson, Carrie Culver, Chris Dewees, Carrie Pomeroy, and Rick Starr; Notetakers: Michele Buckhorn, Jon Budrick, Karen Carlson, Kristen Honey, Kristin Hunter-Thomson, Angela Louie, Kirk Lynn, Jerry Moxley, Debbie Marshal, Shauna Oh, and Noëlle Yochum; and all other participants who contributed in the open discussions during the workshop. For the workshop proceedings document, we thank Marsha Gear and Joann Furse for their help in assimilating, editing and producing the California Sea Grant publication.

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Introduction

The 1998 California Marine Life Management Act prescribed management of California fisheries to be based on scientific information. The critical lack of biological and socio-economic information about marine species and fishery participants, however, is hindering the development of quantitative measures for fisheries management. This situation is being confronted around the world, with managers, fishery participants and other stakeholders wondering what fishery management options are feasible given the diversity of fisheries and budgetary constraints. To begin to answer this question, the University of California Sea Grant Extension Program and the California Department of Fish and Game (CDFG) convened a workshop from December 1-4, 2008, in Berkeley, CA. The workshop, entitled "Managing Data-Poor Fisheries: Case Studies, Models and Solutions," was designed to gather suggestions about ways in which CDFG could manage fisheries that are data-limited. State-managed fisheries were the primary focus of the workshop; discussion of federally managed or jointly managed fisheries such as salmon, tuna, and groundfish was limited to the nearshore groundfish fishery.

The workshop included plenary sessions and facilitated discussions with small groups of people (Appendix 1). The primary purpose of the discussion sessions was to stimulate dialogue and the best thinking possible to generate specific suggestions for CDFG about promising ways to manage data-poor fisheries. Desired outcomes included: 1) an understanding of specific characteristics and challenges of individual data-poor fisheries in California; 2) identification and initial evaluation of particular management strategies, analytical techniques, and data collection/integration methods applicable and feasible for specific fisheries; and 3) discovery of specific recommendations for managing individual data-poor fisheries. The results of these small-group sessions were used to identify information gaps and generate suggestions for managing California fisheries.

Participants were selected based on their experience with managing data-poor fisheries or their knowledge of California fisheries (Appendix 2). Although participants included a broad array of people, the total number was limited to facilitate in-depth discussions within small groups during the workshop. Following the workshop, an online survey was conducted to evaluate support for the overarching ideas resulting from the workshop. The survey was administered to workshop attendees and extended to a selected group of non-attendees to engage a larger and more representative set of stakeholders.

Prior to the meeting, participants were provided online access to 36 manuscripts prepared for the workshop by invited international and national experts (Appendix 3). These manuscripts described techniques and strategies for managing data-poor fisheries. Additionally, all participants were provided with a CD at the workshop that contained the submitted papers to help inform workshop discussions. Papers written for the workshop are being published by California Sea Grant as a proceedings document. Also, several will be published in *Marine and Coastal Fisheries,* an open access online journal (http://www.fisheries.org/mcf/) administered by the American Fisheries Society.

This report is organized into sections that correspond to the structure of the workshop. We describe the workshop design and presentations made at the workshop, summarize the

discussions in the plenary and break-out sessions, provide a list of the overarching suggestions provided by workshop participants, present results of the post-workshop surveys, and list the invitees and their affiliations. In total, the findings and suggestions described here and in the accompanying CD represent expert advice from knowledgeable people and serve as a guide towards identifying feasible options for managing data-poor fisheries in California. Importantly, the results are not a mandate for CDFG to pursue a specific course of action, but instead provide avenues and opportunities for CDFG to investigate more thoroughly with interested and affected groups.

Workshop Design

The challenges of managing data-limited fisheries are inherently multidisciplinary. Thus, the workshop was designed to include discussions about policy, management strategies, data collection, data analysis, and data synthesis. In order to feasibly discuss such a broad array of issues, we divided the workshop into sessions that covered three primary topics:

1. Alternative strategies for managing fisheries without the need for additional data
2. New analytical techniques to inform management using available data
3. New techniques to collect and integrate biological and socioeconomic data

Prior to the workshop, selected fishery scientists, managers, and fishing community members from around the world who are experts in strategies and analytical techniques for managing data-poor fisheries were asked to provide written manuscripts that addressed the three topics of the workshop. Of the 36 manuscripts submitted, 8 provided information on alternative management strategies (Topic #1), 13 provided information on new analytical techniques (Topic #2), 8 provided information on new techniques for collecting essential fisheries data (Topic #3), and 7 provided general background or crosscutting information about data-poor fisheries (Appendix 4). All participants were provided access to the papers and encouraged to read them before coming to the workshop (Appendix 5).

The workshop included a mix of presentations by invited speakers and small-group discussions about the information presented (Appendix 1). Each morning and early afternoon, a few speakers were chosen to introduce a major topic of discussion in a plenary session. After the plenary presentations and associated questions, participants worked in small groups to discuss the three main workshop topics with respect to a specific set of California fisheries. Individuals were assigned to a group based on their expertise, with consideration for balancing the group composition so it was representative of the different affiliations invited to the workshop (i.e., representatives from resource management agencies, commercial and recreational fishery participants, non-governmental organizations, academics, and private consultants), and to ensure that there were a variety of perspectives in each group. Each of these smaller breakout sessions was led by a trained facilitator, assisted by two note-takers and a session synthesizer, and was intended to capture the ideas and suggestions provided by workshop participants (Appendix 2). Workshop participants were assigned to one of five fishery-based groups:

1. Nearshore Invertebrates/Trap: California spiny lobster, spot prawn, rock crab fisheries
2. Nearshore Invertebrates/Dive: Sea urchin, abalone, small-scale invertebrate (snails, clams, limpets) fisheries
3. Other Nearshore Invertebrates: Dungeness crab, trawl (sea cucumbers, pink shrimp, ridgeback prawns), squid fisheries
4. Nearshore Commercial Finfish: Live, fillet fisheries
5. Nearshore Recreational Finfish: Spear, beach capture, hook & line fisheries.

Of the 100 people in attendance, about 13% were from the California fishing industry (both commercial and recreational), 44% were staff with resource management agencies, 30% were from academia, 5% were from non-governmental organizations, and 10% came from other

organizations, such as consulting firms (Figure 1A). The majority of participants have been involved in fisheries for more than 20 years (Figure 1B). About 64% of attendees were from California, 10% from other parts of the US West Coast, 10% from other parts of the US, and 18% from other countries (Australia, Canada, New Zealand and South Africa) (Figure 1C).

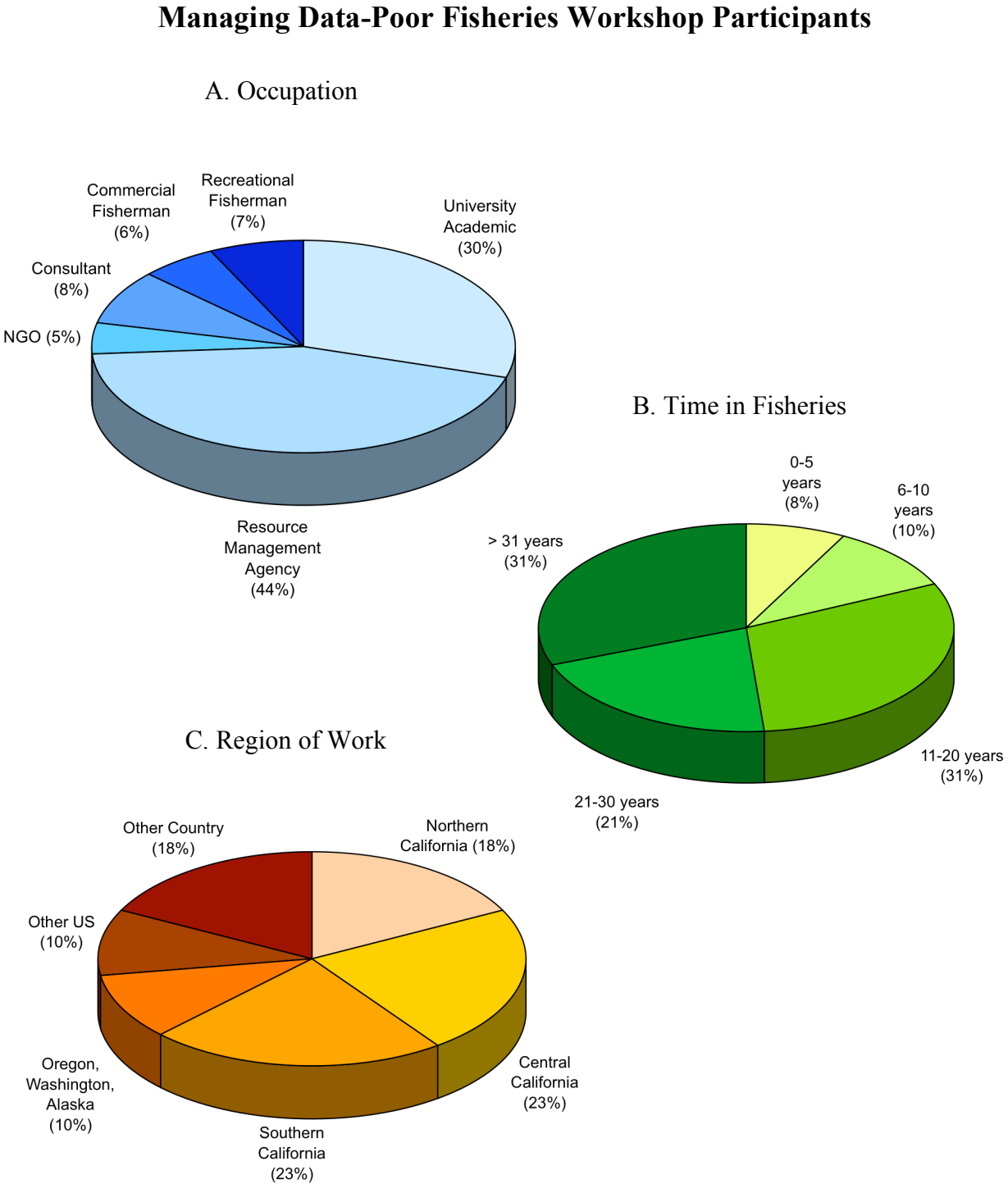

Figure 1. Characterization of workshop participants by A) occupation B) time involved in fisheries, and C) region in which individuals live and/or work.

Small Group Discussions

The primary purpose of the breakout sessions was to stimulate dialogue and thinking to generate suggestions for ways for the CDFG to manage data-poor fisheries in relation to the three workshop topics. Participants had about 2½ hours to address each of three objectives for each session.

Session 1
Objectives:

1) Identify specific characteristics and challenges for individual data-poor fisheries.
2) Identify and provide initial evaluation of potential management strategies (Workshop Topic #1) for given data-poor fisheries.
3) Identify possible suggestions for managing individual data-poor fisheries.

Session 2
Objectives:

1) Identify and assess currently available data for a given data-poor fishery.
2) Identify new analytical techniques (Workshop Topic #2) to inform managers using available data.
3) List revised emerging suggestions for managing individual data-poor fisheries.

Session 3
Objectives:

1) Identify new techniques to collect and integrate biological and socioeconomic data to inform management strategies for a given data-poor fishery.
2) Identify new techniques to collect and integrate biological and socioeconomic data (Workshop Topic #3) across data-poor fisheries to inform management strategies.
3) Refine the list of promising suggestions for managing individual and across various data-poor fisheries.

The breakout sessions were designed to explore ideas, and consensus was not required. Each session began with a review of the objectives, the specific fisheries to be addressed and the key features of each fishery. The majority of the session then focused on addressing the objectives for the session through the discussion of ideas and methods provided in the submitted papers and the experience and knowledge shared by participants. The synthesizer was charged with listening intently, asking questions to deepen his/her understanding of what was being said, and summarizing key suggestions for CDFG that emerged from the group. At the end of each session, these draft key suggestions were reviewed by group participants, and then provided in a handout to all workshop participants. Detailed notes were also taken during the breakout sessions. More than 400 ideas were generated for CDFG to consider when managing data-poor fisheries (Appendix 6). Following the workshop, we organized techniques presented in papers, presentations, and breakout sessions and presented them in this report by the following categories: data collection, stock assessment, socioeconomic, and analytical techniques (Appendix 7). We also distilled key suggestions made at the workshop into 21 overarching ideas (Table 1). These broad ideas included nine suggestions related to management alternatives, four related to analytical techniques, and eight related to new ways to collect and integrate data.

Table 1: Overarching suggestions distilled from key ideas developed by workshop participants during the workshop breakout sessions, organized by workshop topic. A list of the acronyms used below and throughout the report can be found in Appendix 8.

NUMBER	SUGGESTION
Topic 1:	**Management Alternatives**
S1	Develop a process to clearly define fishery management goals and strategies in California.
S2	Develop a strong system of co-management that integrates user groups into all aspects of goal setting, data collection and analyses, management, and enforcement.
S3	Increase the use of explicit area-based management approaches (i.e., smaller management units).
S4	Integrate state management approaches with federal fishery management, marine protected areas (MPAs), and other spatial management tools.
S5	Increase the monitoring of stock size-structure for fished species.
S6	At a minimum, obtain an index of abundance and an index of replacement (e.g., FLEP (fraction of lifetime egg production), SPR (spawning potential ratio)) for fished species.
S7	Explore dedicated access privileges (e.g., based on agency and community goals) to align individual economic incentives with collective conservation goals.
S8	Integrate recreational fishery management with commercial fishery management.
S9	Develop a process for adaptive fisheries management.
Topic 2:	**Analytical Techniques**
S10	Explore using marine protected areas (MPAs) as an assessment tool.
S11	Complete standard scientific analyses using existing biological and social data (e.g., landing receipts, logbooks, size frequencies, observer data, dive data, MPA monitoring data) to better understand the status of California fisheries.
S12	Develop simple indicators (biological, social, economic) of fishery status.
S13	Use existing data-rich fishery scenarios to inform which data should be collected for other areas/fisheries.

Table 1 (continued)

NUMBER	SUGGESTION
Topic 3:	**New Ways to Collect and Integrate Data**
S14	Inventory, evaluate and use, as appropriate, existing data sets (e.g., state, federal, university, private) for management.
S15	Develop collaborative fisheries research programs across the state using standardized protocols, science-based design, and fishermen's expertise, and develop a process for analyzing the data and integrating it into management.
S16	Conduct full economic valuations of recreational and commercial sectors at the port level using comparable measures.
S17	Collect the basic biological and human dimensions data needed to conduct standard analyses for those fisheries where these data are lacking. (This will require development or refinement of landings tickets and logbooks.)
S18	Move data collection towards a finer geographic scale. This may need to be done starting with simple or basic information and moving toward more complex information over time.
S19	Develop collaborative relationships with the fishing and research communities to collect additional socio-economic and biophysical information.
S20.	Increase the understanding of recreational fisheries.
S21	Establish a repository for fishery-related data that are publicly available.

Post-Workshop Survey

Following the workshop, we conducted an online survey to elicit opinions about the 21 overarching ideas distilled from the suggestions generated at the workshop, and to determine which ideas survey respondents felt were most important for the CDFG to explore. Two versions of the survey were developed. The first was for workshop participants (excluding workshop staff and CDFG steering committee members) and, because participation by fishing community members was limited, a second version was for additional commercial and recreational fishery participants who did not attend the workshop. We identified these "non-attendees" in an effort to gather input from representatives of a broader range of fisheries and areas throughout the state. The two versions differed only in that the survey of participants included questions about the quality of the workshop and their experience, whereas the "non-attendee" survey did not.

An invitation to participate in the survey was sent via email to 81 workshop participants and 47 non-attendees in February 2009; an e-mail reminder was sent two weeks later to further encourage participation in the survey. The initial e-mail provided background on the workshop and the purpose of the survey, assured individuals that their responses would be anonymous, and provided them with a link to the survey website.

Thirty-nine (48%) of the workshop participants and 15 (32%) of the non-attendees completed the survey, for an overall response rate of 42% (of 128). Thus, although the survey results help us ground truth the ideas generated at the workshop, they constitute only a sample of those invited to participate in the survey. Further, attendee and non-attendee responses to the survey were affected by the fact that attendees had been through the workshop, and had helped shape many of the ideas that were evaluated using the survey, while non-attendees were in the position of responding to ideas generated by others, and did not have the grounding of workshop presentations and discussions. As a result, their priorities and ideas, as well as their opinions are likely to differ from those of attendees. The 39 workshop attendees and 15 non-attendees represented six occupations/interest groups (Academics (12), Agency Staff (16), NGO Staff (1), Consultants (5), Commercial Fishermen (17), and Recreational Fishermen (3)).

Survey Results

Here we highlight the most notable survey findings for all respondents. For the combination of results from both attendees and non-attendees (***All respondents*****),** we have included tables presenting the percentages of respondents, by occupation (including recreational fishermen) that agreed or disagreed with each workshop suggestion.[1] We also summarize the results of the survey by the two responding groups, (attendees and non-attendees). Survey results are presented graphically in more detail for all respondents combined and attendees and non-participants individually in a separate document (Appendix 9).

All respondents

Topic 1: Alternative strategies for managing fisheries without the need for additional data

Ideas related to alternative management strategies that were generated by workshop participants were grouped into nine overarching suggestions (Table 1). At least 50% of the 54 survey respondents agreed with all nine suggestions under this topic (Table 2). More than 90% of those surveyed agreed with suggestions 1 and 2, and between 80% and 90% of those surveyed agreed with suggestions 5, 8, and 9. The opinions about the suggestions from Attendees and Non-Attendees as a function of the responder's occupation are shown below (Tables 2.1 – 2.9).

1 In presenting survey results here, we combine "Agree strongly" and "Agree" responses and "Disagree strongly" and "Disagree" responses into two summary categories, "Agree" and "Disagree." Here we report the results only for these two categories, and do not include "Neutral" and "No opinion" responses, which account for variable percentages of responses on the survey items and among groups Details on these other categories can be viewed in a separate document (CD).

Table 2: Support for overarching ideas regarding alternative management strategies. The suggestions are listed in order of those with the most support to those with the least.

Suggestion #	Agree	Disagree	Neutral/No Opinion
S1	94.4%	1.9%	3.7%
S2	94.4%	1.9%	3.7%
S9	88.9%	3.7%	7.4%
S5	81.5%	5.6%	13.0%
S8	79.6%	5.6%	14.8%
S4	66.7%	16.7%	16.7%
S6	66.7%	9.3%	24.1%
S3	57.4%	16.7%	25.9%
S7	57.4%	13.0%	29.6%

S1. Develop a process to clearly define fishery management goals and strategies in California.

More than 80% of respondents from all occupations agreed with this suggestion, and 100% of Academics, Agency Staff, NGO Staff, and Recreational Fishermen agreed.

Table 2.1

Occupation	Agree	Disagree
Recreational Fisherman	100.0%	0.0%
Commercial Fisherman	88.2%	5.9%
Consultant	80.0%	0.0%
NGO Staff	100.0%	0.0%
Agency Staff	100.0%	0.0%
Academic	100.0%	0.0%

S2. Develop a strong system of co-management that integrates user groups into all aspects of the goal setting, data collection and analyses, management, and enforcement.

More than 88% of survey respondents agreed with this suggestion, including all Academics, NGO Staff, Consultants, and Recreational Fishermen.

Table 2.2

Occupation	Agree	Disagree
Recreational Fisherman	100.0%	0.0%
Commercial Fisherman	88.2%	5.9%
Consultant	100.0%	0.0%
NGO Staff	100.0%	0.0%
Agency Staff	93.8%	0.0%
Academic	100.0%	0.0%

S3. Increase the use of explicit area-based management approaches (i.e., smaller management units).

More than 58% of respondents of all occupations except for Agency Staff agreed with this suggestion. More than 33% of both Recreational and Commercial Fishermen disagreed.

Table 2.3

Occupation	Agree	Disagree
Recreational Fisherman	66.7%	33.3%
Commercial Fisherman	58.8%	35.3%
Consultant	60.0%	0.0%
NGO Staff	100.0%	0.0%
Agency Staff	43.8%	12.5%
Academic	66.7%	0.0%

S4. Integrate state management approaches with federal fishery management, marine protected areas (MPAs), and other spatial management tools.

More than 66% of survey respondents of all occupations except for Commercial Fishermen agreed with Suggestion 4. More than 33% of both Recreational and Commercial Fishermen disagreed.

Table 2.4

Occupation	Agree	Disagree
Recreational Fisherman	66.7%	33.3%
Commercial Fisherman	35.3%	41.2%
Consultant	80.0%	0.0%
NGO Staff	100.0%	0.0%
Agency Staff	75.0%	6.3%
Academic	91.7%	0.0%

S5. Increase the monitoring of stock size-structure for fished species.

More than 64% of survey respondents of all occupations agreed with this suggestion, including all Agency Staff, NGO Staff, and Recreational Fishermen agreed.

Table 2.5

Occupation	Agree	Disagree
Recreational Fisherman	100.0%	0.0%
Commercial Fisherman	64.7%	17.6%
Consultant	80.0%	0.0%
NGO Staff	100.0%	0.0%
Agency Staff	100.0%	0.0%
Academic	75.0%	0.0%

S6. At a minimum, obtain an index of abundance and an index of replacement (e.g., FLEP (fraction of lifetime egg production), SPR (spawning potential ratio)) for fished species.

At least half of survey respondents of all occupations agreed with this suggestion. Although not shown in the table below, most of those who did not agree had no opinion or were neutral about this suggestion (see Data CD).

Table 2.6

Occupation	Agree	Disagree
Recreational Fisherman	66.7%	0.0%
Commercial Fisherman	52.9%	23.5%
Consultant	60.0%	0.0%
NGO Staff	100.0%	0.0%
Agency Staff	93.8%	6.3%
Academic	50.0%	0.0%

S7. Explore dedicated access privileges (e.g., based on agency and community goals) to align individual economic incentives with collective conservation goals.

The majority of Consultants, NGO Staff, and Academics agreed with this suggestion. However, less than 50% of survey respondents of all other occupations agreed and more than 66% of Recreational Fishermen disagreed.

Table 2.7

Occupation	Agree	Disagree
Recreational Fisherman	33.3%	66.7%
Commercial Fisherman	47.1%	17.6%
Consultant	60.0%	0.0%
NGO Staff	100.0%	0.0%
Agency Staff	43.8%	12.5%
Academic	91.7%	0.0%

S8. Integrate recreational fishery management with commercial fishery management.

Between 68% and 100% of all occupations agreed with this suggestion with the exception of Recreational Fishermen who disagreed (66%).

Table 2.8

Occupation	Agree	Disagree
Recreational Fisherman	0.0%	66.7%
Commercial Fisherman	94.1%	5.9%
Consultant	80.0%	0.0%
NGO Staff	100.0%	0.0%
Agency Staff	68.8%	0.0%
Academic	91.7%	0.0%

S9. Develop a process for adaptive fisheries management.

More than 81% of all respondents agreed with this suggestion.

Table 2.9

Occupation	Agree	Disagree
Recreational Fisherman	100.0%	0.0%
Commercial Fisherman	88.2%	5.9%
Consultant	100.0%	0.0%
NGO Staff	100.0%	0.0%
Agency Staff	81.3%	6.3%
Academic	91.7%	0.0%

Topic 2: New analytical techniques to inform management using available data

Ideas related to new analytical techniques for evaluating existing data that were generated by workshop participants were grouped into four overarching suggestions. More than 65% of those surveyed agreed with suggestions 11, 12, and 13. However, fewer than half (48%) agreed and 26% disagreed with the suggestion to "explore using MPAs as an assessment tool" (S10) (Table 3). Tables 3.1 through 3.4 provide the breakdown of opinions from Attendees and Non-Attendees (combined) for each of the suggestions for this topic.

Table 3: Support for overarching ideas regarding new analytical techniques. Suggestions are listed in order most supported to least supported.

Suggestion #	Agree	Disagree	Neutral/No Opinion
S12	88.9%	7.4%	3.7%
S11	77.8%	5.6%	16.7%
S13	66.7%	7.4%	25.9%
S10	48.1%	25.9%	25.9%

S10. Explore using marine protected areas (MPAs) as an assessment tool.

The majority of NGO Staff, Agency Staff, and Academics agreed with suggestion #10. Less than 40% of survey respondents of all other occupations agreed and more than 64% of Commercial Fishermen disagreed.

Table 3.1

Occupation	Agree	Disagree
Recreational Fisherman	33.3%	33.3%
Commercial Fisherman	29.4%	64.7%
Consultant	40.0%	20.0%
NGO Staff	100.0%	0.0%
Agency Staff	62.5%	6.3%
Academic	58.3%	0.0%

S11. Complete standard scientific analyses using existing biological and social data (e.g., landing receipts, logbooks, size frequencies, observer data, dive data, MPA monitoring data) to better understand the status of California fisheries.

For this suggestion, NGO Staff had no opinion. The majority (>58%) of survey respondents of all other occupations agreed with this suggestion, with strong (100%) agreement among Recreational Fishermen and Consultants.

Table 3.2

Occupation	Agree	Disagree
Recreational Fisherman	100.0%	0.0%
Commercial Fisherman	58.8%	17.6%
Consultant	100.0%	0.0%
NGO Staff	0.0%	0.0%
Agency Staff	87.5%	0.0%
Academic	83.3%	0.0%

S12. Develop simple indicators (biological, social, economic) of fishery status.

More than 66% of all occupations represented by survey respondents agreed with the suggestion above, with 100% agreement among Consultants, NGO staff, and Agency Staff.

Table 3.3

Occupation	Agree	Disagree
Recreational Fisherman	66.7%	33.3%
Commercial Fisherman	82.4%	17.6%
Consultant	100.0%	0.0%
NGO Staff	100.0%	0.0%
Agency Staff	100.0%	0.0%
Academic	83.3%	0.0%

S13. Use existing data-rich fishery scenarios to inform which data should be collected for other areas/fisheries.

Recreational Fishermen were split on this suggestion (33% agreed and 33% disagreed), while more than 52% of all other respondent groups agreed.

Table 3.4

Occupation	Agree	Disagree
Recreational Fisherman	33.3%	33.3%
Commercial Fisherman	52.9%	11.8%
Consultant	80.0%	0.0%
NGO Staff	100.0%	0.0%
Agency Staff	87.5%	0.0%
Academic	58.3%	8.3%

Topic 3: New techniques to collect and integrate biological and socioeconomic data

Ideas related to new ways to collect and integrate data that were generated by workshop participants were grouped into eight overarching suggestions. More than 65% of those surveyed agreed with all eight of these suggestions, and more than 80% agreed with suggestions 14, 15, 19, and 20 (Table 4). Tables 4.1 through 4.6 provide details about the opinions of Attendees and Non-Attendees of various occupations for each of these suggestions.

Table 4: Support for various overarching ideas regarding new data collection techniques. The suggestions are listed in order of those with the most support to those with the least.

Suggestion #	Agree	Disagree	Neutral/No Opinion
S15	94.4%	0.0%	5.6%
S20	88.9%	1.9%	9.3%
S14	85.2%	0.0%	14.8%
S19	83.3%	3.7%	13.0%
S18	77.8%	9.3%	13.0%
S21	74.1%	1.9%	24.1%
S17	68.5%	11.1%	20.4%
S16	66.7%	7.4%	25.9%

S14. Inventory, evaluate and use, as appropriate, existing data sets (e.g., state, federal, university, private) for management.

All survey respondents of the various occupations agreed with this suggestion, except for commercial fishermen, among whom about 60% agreed, and among NGO staff, who had no opinion. No respondents disagreed with this suggestion.

Table 4.1

Occupation	Agree	Disagree
Recreational Fisherman	100.0%	0.0%
Commercial Fisherman	58.8%	0.0%
Consultant	100.0%	0.0%
NGO Staff	0.0%	0.0%
Agency Staff	100.0%	0.0%
Academic	100.0%	0.0%

S15. Develop collaborative fisheries research programs across the state using standardized protocols, science-based design, and fishermen's expertise, and develop a process for analyzing the data and integrating it into management.

At least 80% of all respondents agreed with this suggestion, with no one in disagreement. All Academics, NGO Staff, and Fishermen (both Recreational and Commercial) agreed.

Table 4.2

Occupation	**Agree**	**Disagree**
Recreational Fisherman	100.0%	0.0%
Commercial Fisherman	100.0%	0.0%
Consultant	80.0%	0.0%
NGO Staff	100.0%	0.0%
Agency Staff	87.5%	0.0%
Academic	100.0%	0.0%

S16. Conduct full economic valuations of recreational and commercial sectors at the port level using comparable measures.

More than 58% of respondents of the various occupations agreed with the above suggestion except for Consultants.

Table 4.3

Occupation	**Agree**	**Disagree**
Recreational Fisherman	66.7%	0.0%
Commercial Fisherman	82.4%	5.9%
Consultant	40.0%	20.0%
NGO Staff	100.0%	0.0%
Agency Staff	62.5%	12.5%
Academic	58.3%	0.0%

S17. Collect the basic biological and human dimensions data needed to conduct standard analyses for those fisheries where these data are lacking. (This will require development or refinement of landings tickets and logbooks.)

All Recreational Fishermen agreed, but only 47% of Commercial Fishermen agreed (11.8% disagreed). At least 60% of respondents of all other occupations agreed. The one NGO staff respondent disagreed.

Table 4.4

Occupation	**Agree**	**Disagree**
Recreational Fisherman	100.0%	0.0%
Commercial Fisherman	47.1%	11.8%
Consultant	60.0%	20.0%
NGO Staff	0.0%	100.0%*
Agency Staff	87.5%	12.5%
Academic	75.0%	0.0%

* Only one individual for this group responded to this question.

S18. Move data collection towards a finer geographic scale. This may need to be done starting with simple or basic information and moving toward more complex information over time.

More than 68% of all respondents agreed with this suggestion, with 23% of Commercial Fishermen and 6% of Agency Staff disagreeing.

Table 4.5

Occupation	**Agree**	**Disagree**
Recreational Fisherman	100.0%	0.0%
Commercial Fisherman	70.6%	23.5%
Consultant	80.0%	0.0%
NGO Staff	100.0%	0.0%
Agency Staff	68.8%	6.3%
Academic	91.7%	0.0%

S19. Develop collaborative relationships with the fishing and research communities to collect additional socio-economic and biophysical information.

The suggestion for collaborative research was met with 75%-100% agreement from respondents of all occupations. Commercial Fishermen were the only group with disagreement (11.8%).

Table 4.6

Occupation	Agree	Disagree
Recreational Fisherman	100.0%	0.0%
Commercial Fisherman	76.5%	11.8%
Consultant	100.0%	0.0%
NGO Staff	100.0%	0.0%
Agency Staff	75.0%	0.0%
Academic	91.7%	0.0%

S20. Increase the understanding of recreational fisheries.

At least 80% or more from all groups agreed with the above suggestion.

Table 4.7

Occupation	Agree	Disagree
Recreational Fisherman	100.0%	0.0%
Commercial Fisherman	82.4%	5.9%
Consultant	80.0%	0.0%
NGO Staff	100.0%	0.0%
Agency Staff	93.8%	0.0%
Academic	91.7%	0.0%

S21. Establish a repository for fishery-related data that are publicly available.

For the last suggestion offered in the survey, at least 68% of all respondents agreed, with no disagreement except for Commercial Fishermen (5.9%). The majority of those who did not agree had no opinion about the suggestion.

Table 4.8

Occupation	Agree	Disagree
Recreational Fisherman	100.0%	0.0%
Commercial Fisherman	70.6%	5.9%
Consultant	80.0%	0.0%
NGO Staff	100.0%	0.0%
Agency Staff	68.8%	0.0%
Academic	75.0%	0.0%

Workshop Attendees

Topic 1: Alternative strategies for managing fisheries without the need for additional data:

More than 60% of the 39 workshop attendees surveyed agreed with all suggestions presented under this topic heading. More than 90% agreed with Suggestions 1 and 2, and between 75% and 90% of those surveyed agreed with Suggestions 4, 5, and 8.

Topic 2: New analytical techniques to inform management using available data:

More than 85% of workshop participants surveyed agreed with Suggestions 9, 11 and 12, however only 54% agreed with the suggestion to "explore using MPAs as an assessment tool" (S10), and 15% disagreed.

Topic 3: New techniques to collect and integrate biological and socioeconomic data:

More than 70% of survey respondents who attended the workshop agreed with seven of the eight suggestions for this topic. The one exception was the suggestion to "conduct full economic valuations of recreational and commercial sectors at the port level using comparable measures" (S16), with which only 59% of workshop participants agreed and 29% were neutral. More than 90% agreed with Suggestions 14 and 15, and 80-90% agreed with Suggestions 18, 19, and 20.

Non-Attendees

Topic 1: Alternative strategies for managing fisheries without the need for additional data:

Of the 15 respondents who attended the workshop, more than 90% agreed with Suggestion 1, and between 80% and 90% agreed with Suggestions 2, 8, and 9. For Suggestions 3 and 4, more than 40% of the people surveyed disagreed.

Topic 2: New analytical techniques to inform management using available data:

More than 60% of this group of respondents agreed with Suggestions 11, 12 and 13. However, only 33% agreed with the suggestion to "explore using MPAs as an assessment tool" (S10), while 53% disagreed.

Topic 3: New techniques to collect and integrate biological and socioeconomic data:

More than 60% of non-attendees surveyed agreed with all the suggestions under this topic. All agreed with Suggestion 15 and more than 80% agreed with Suggestions 16, 19, and 20.

Priority ideas

The last question of the survey was an open-ended one: “List three suggestions or ideas, either new ones or from those provided above, that you feel should be of highest priority for

CDFG to pursue" (Each response was limited to 250 characters). While many responses highlighted ideas generated at the workshop, others were new ideas (see ***New Ideas***), or specific management measures for particular fisheries (Some comments did not directly address the question). In some cases, respondents integrated multiple items in a single response, especially suggestions 3 and 18, 11 and 14, and 15 and 19.

There was not broad agreement among survey respondents on the priority of the ideas generated at the workshop (Table 5). Suggestions 15 and 1 were the most frequently cited as high priorities by 20% of survey respondents. Notably, S1 was identified only by workshop attendees, a mixed group of scientists, fishermen, and others, with none of the non-attendees – primarily fishermen - highlighting this item as a priority. In contrast, S15 was supported by similar percentages (21% and 20%, respectively) of both groups. Four other suggestions – S2, S2, S14, and S18 – were cited by about 15% of all respondents, with varying support between the two groups. All other suggestions were listed less frequently overall, although a few of the ideas were listed by up to 20% of respondents from one (but not both) of the groups. Importantly, non-attendees cited fewer of the workshop-generated suggestions than attendees, offering instead a number of new ideas.

Table 5: Overarching suggestions highlighted by workshop attendees and non-attendees surveyed as highest priority. Suggestions are sorted by total percentage of respondents.

Suggestions	Topic #	% Attendees (N=39)	% Non-attendees (N=15)	% Total (N=54)
S15. Develop collaborative fisheries research programs across the state using standardized protocols, science-based design, and fishermen's expertise, with a process for analyzing the data and integrating it into management.	3	21	20	20
S1. Develop a process to clearly define fishery management goals and strategies in California.	1	28	0	20
S2. Develop a strong system of co-management that integrates user groups into all aspects of goal setting, data collection and analyses, management, and enforcement.	1	18	13	17
S3. Increase the use of explicit area-based management approaches (i.e., smaller management units).	1	15	13	15
S14. Inventory, evaluate and use, as appropriate, existing data sets (e.g., state, federal, university, private) for management.	3	21	0	15
S18. Move data collection towards a finer geographic scale. This may need to be done starting with simple or basic information and moving toward more complex information over time.	3	18	7	15

Table 5 (continued)

Suggestions	Topic #	% Attendees (N=40)	% Non-attendees (N=18)	% Total (N=58)
S4. Integrate state management approaches with federal fishery management, MPAs and other spatial management tools.	1	8	20	11
S6. At a minimum, obtain an index of abundance and an index of replacement (e.g. FLEP (fraction of lifetime egg production), SPR (spawning potential ratio)) for fished species.	1	15	0	11
S11. Complete standard biological and social scientific analyses using existing data (landing receipts, logbooks, size frequencies, CPFV data, dive data, MPA data) to better understand the status of California fisheries.	2	15	0	11
S17. Collect the basic biological and human dimensions data needed to conduct standard analyses for those fisheries where these data are lacking. (This will require development or refinement of landings tickets and logbooks.)	3	10	11	11
S10. Explore using MPAs as an assessment tool.	2	5	20	9
S19. Develop collaborative relationships with the fishing and research communities to collect additional socio-economic and biophysical information.	3	10	7	9
S5. Increase the monitoring of stock size structure for fished species.	1	8	7	7
S12. Develop simple indicators (biological, social, economic) of fishery status.	2	10	0	7
S16. Conduct full economic valuations of recreational and commercial sectors at the port level using comparable measures.	3	5	13	7
S7. Explore dedicated access privileges (e.g., effort-based or whatever works best with agency and community goals) to align individual economic incentives with collective conservation goals.	1	8	0	6

Table 5 (continued)

Suggestions	Topic #	% Attendees (N=40)	% Non-attendees (N=18)	% Total (N=58)
S21. Establish a repository for fishery-related data that are publicly available.	3	3	0	2
S13. Use existing data-rich fishery scenarios to inform which data should be collected for other areas/fisheries.	2	0	0	0

New Ideas:

In addition to citing some of the 21 overarching suggestions, several survey respondents, especially those who had not attended the workshop, offered new ideas for consideration by CDFG. We assigned these ideas to one of four categories: the three workshop topics, general policy and principles, specific management measures for particular fisheries, and other comments not directly related to the question. We focus here on ideas related to the workshop topics and general policies and principles (Table 6).

Note that each of the items discussed below was offered by one or two respondents, although several items are clearly linked to one another. Because these were generated through an open-ended question rather than being asked of all survey participants, the low numbers are not an indication of broader support or disinterest. Rather, they warrant further exploration through focus group discussions and/or other assessments.

Several suggestions related to management alternatives for data-poor fisheries were offered (Table 6). Two items each focused on: 1) defining goals and performance standards for fisheries; 2) enforcement; 3) learning from and/or coordinating with fishery management in Oregon; and 4) standard measures (input and output controls). Only one suggestion addressed analytical techniques. Several responses suggested new ways to collect and integrate data, focusing on three themes: collaborative management, assessing fishing community needs and impacts, and developing understanding of the complexity and dynamics of fisheries ecosystems.

Table 6. New ideas suggested as highest priority for CDFG to pursue in managing data-poor fisheries (based on an open-ended question).

Workshop Topic 1: Management alternatives
- Define goals, etc., for specific fisheries. (Similar to S1) - Establish conservation and economic performance standards for fisheries. - Allow commercial and recreational fishermen to fish for un-assessed species at Oregon's harvest levels and monitor landings. - Evaluate California and Oregon management for consistency. - Enforce existing measures - Foster better relations with enforcement and the fishing community - Use input / output controls for fisheries that cannot support stock assessments. - Use seasons and quotas.
Workshop Topic 2: Analytical Techniques
- Use habitat quality paired with catchability studies to understand regional productivity rates of target species.
Workshop Topic 3: New Way to Collect and Integrate Data
- Conduct pilot projects to evaluate new, collaborative ways to manage fisheries. - Form an advisory group to develop, support, and evaluate collaborative management pilot projects. - Conduct needs assessments for fisheries and communities. - Conduct social and economic impact analysis of management decisions.
General Policies and Principles
Managing for sustainability - Focus on/promote sustainable fisheries. - Ensure sustainable harbor communities. - Modify California's management goals and objectives to allow sustainable harvest rather than preservation. - Mitigate management impacts. ***Financial considerations*** - Acknowledge funding and understanding limits, yet still need to manage. - Do long-term budgeting for fishery analysis so there are no data gaps - Use management styles that are affordable for a particular fishery. - Make self-financing of research and management by fisheries easier. ***Procedures and processes*** - Develop a process for evaluating stock assessments and FMPs. - Develop and evaluate alternative stock assessment approaches. - Improve data quality. - Seek understanding of the dynamic naturally occurring variables involved with the marine ecosystem. - Evaluate other factors affecting fisheries (e.g., marine mammals, water quality). - Conduct and release up-to-date analyses of fisheries data. - Disseminate accurate public information about fisheries. - Continue the open dialog between managers and commercial fishermen opened during this conference. - Provide more fishery management training opportunities for CDFG staff. - Separate CDFG as a stand-alone agency.

General Policies and Principles

The suggestions regarding general policies and principles addressed management for sustainability, financial issues, and general processes (Table 6). Four comments addressed management for sustainability of both fisheries and fishing/harbor communities, with a focus on sustainable harvest and mitigation of management impacts on communities. Four items addressed financial considerations for managing data-poor fisheries, and included suggestions for how to approach the inevitable challenges of funding management. Ten items addressed procedures and processes, and touched on a range of themes from ecosystem-based management to communications.

Next Steps

This workshop provided a first step toward identifying new approaches for managing data-poor fisheries in California. At the workshop, the participants generated a list of general suggestions to consider as California works toward refining management of marine fisheries. Some of the suggestions are applicable to a broad range of fisheries, whereas others apply to one or only a few fisheries. Implementation of the ideas will require actions that range from specific changes in legislation for particular fisheries to development of new processes and infrastructure that support the use of new techniques and methods. Workshop attendees expressed hope that the information and ideas generated will provide momentum to move forward with further and more focused discussions about managing fisheries when data are limited. Participants encouraged further discussion among stakeholders and CDFG representatives about the ideas generated here, including the potential for collaborative research to evaluate them.

We encourage the CDFG to consider the following ideas when planning their next steps:

- Review the techniques presented at this workshop (from the presentations, papers, and discussions) as well as other available data-poor techniques to determine which might be viable for inclusion in the management of California data-poor fisheries.
- Set goals for fisheries.
- Evaluate the support for the various suggestions generated at the workshop among a larger and more representative group of stakeholders. Whereas many different groups were represented at the workshop, participation was limited to facilitate productive and manageable discussions. The CDFG will greatly benefit from engaging in additional discussions with others who are interested and/or will be affected by changes in management.
- Assess the administrative/logistical practicality and feasibility of implementing the various suggestions related to the needs of CDFG and industry, and identify the pros and cons of each idea and the associated costs.
- Prioritize suggestions identified from previous steps using both internal assessments of specific fishery management needs and input from the industry.
- Develop pilot studies to assess the potential usefulness of the high priority suggestions.

List of Appendices

Appendix 1: Workshop Agenda

Appendix 2: List of Participants

Appendix 3: List of Papers Submitted

Appendix 4: List of Papers by Topic

Appendix 5: List of Acronyms

Appendix 6: Suggestions For Managing Data-Poor Fisheries–Summaries From All Workshop Sessions

Appendix 7: Specific Techniques Suggested at the Managing Data-Poor Fisheries Workshop

Appendix 8: Abstracts From Submitted Papers

Appendix 9: Supplementary Data CD

- PDF of Final Workshop Report
- Plenary Session Comments
- *Papers Presented at Workshop
- Presentation PowerPoint's
- Survey Results
  - Combined Attendees and Non-Attendees
  - Attendees
  - Non-attendees

Appendix 1: Workshop Agenda

Managing Data-Poor Fisheries: Case Studies, Models, and Solutions

Monday, 1 December 2008

5:00 - 7:00 p.m. Sign-in, Welcoming Reception

Tuesday, 2 December 2008

8:00 a.m. Convene –*Rick Starr, Carrie Culver, Carrie Pomeroy (California Sea Grant Extension)*

Welcome – *Sonke Mastrup (California Dept. Fish and Game)*

Workshop goals and objectives – *Rick Starr*

8:40 Data-poor fisheries in California –*Loo Botsford (UC Davis)*

9:00 More than one way to skin a fish**:** Alternative management strategies – *Chris Dewees (UC Davis)*

9:20 From Theory to practice: How to change California management – *Kristina Phipps (Environmental Defense Fund)*

9:45 – 10:15 BREAK

10:15 Examples of Management in Other Parts of the World – *Rick Starr moderator*

Managing data poor fisheries: Solutions from around the world – *Jeremy Prince (Murdoch University)*
On pre-testing the likely efficacy of suggested management approaches for data-poor fisheries– *Doug Butterworth (University of Cape Town)*
Engineering Management Procedures to achieve multiple objectives in data poor fisheries – *Kevin Stokes (New Zealand Seafood Council)*
Reconciling approaches to the assessment and management of data-poor species and fisheries with Australia's Harvest Strategy Policy–*David Smith (CSIRO)*

12:00 – 1:00 p.m. LUNCH

1:00 Alternative Management Approaches – *Rick Starr moderator*

Applying an ecosystem-based strategy used to restore Maine lobsters (*Homarus americanus*) to manage fish stocks – *Ted Ames (Penobscot East Resource Center)*

A case study in successful management of a data-poor fishery using simple decision rules: the Queensland spanner crab fishery – *Cathy Dichmont (CSIRO)*

Integrating social, economic and biological information in the management of data-poor fisheries – *Michael Harte (Oregon State University)*.

Moving from data poor to data sufficient fisheries: the costs of management versus the benefits of management— *Nokome Bentley (New Zealand Seafood Council)*

2:00 – 2:30 BREAK

2:30 – 5:30 Discussion of Alternative Management Strategies

Breakout Sessions

6:00 – 7:30 p.m. SOCIAL

Wednesday, 3 December 2008

8:00 a.m. New Analytical Techniques – *Carrie Pomeroy moderator*

Approaches for using MPAs in stock assessments and management of data-poor fisheries – *Carey McGilliard (UW)*

Application of an index method (AIM) to data rich situations: Can simple methods capture major features of complex assessments? – *Chris Legault (NMFS)*

Application of vulnerability evaluation criteria to data-poor species, a case study of California nearshore groundfish – *Jason Cope (NMFS)*

Using available data to integrate socioeconomic considerations into fishery regulatory analysis – *Cindy Thomson (NMFS)*

9:30 – 10:00 COFFEE BREAK

10:00 – 12:30 p.m. Discussion of New Analytical Techniques

Breakout Sessions

12:30 – 1:30 p.m. LUNCH

1:30 New Ways to Collect and Integrate Data – *Carrie Culver* moderator

Figuring out human dimensions: Illuminating models – *Madeleine Hall-Arber (MIT Sea Grant)*

Self-monitoring biological sampling by commercial fishermen in small-scale fisheries in New Zealand – *Paul Starr (New Zealand Seafood Council)*

Collaborative fisheries research: Working together to collect data on nearshore fisheries in California – *Dean Wendt (Cal Poly San Luis Obispo)*

Local-scale ecosystem-based fisheries in a Gulf of Maine estuary: managing for complexity, adapting to uncertainty – *Sherman Hoyt (Maine Sea Grant)*

2:30 – 3:00 COFFEE BREAK

3:00 – 5:30 p.m. Discussion of New Ways to Collect and Integrate Data

Breakout Sessions

6:00 – 7:30 p.m. SOCIAL

Thursday, 4 October 2008

8:30 a.m. Reports from Breakout Sessions
1) Alternative management strategies for data-poor fisheries
2) Analytical techniques for guiding management from minimal data
3) New ways to collect and integrate biological and socio-economic data

10:00 – 10:30 COFFEE BREAK

10:30 Discussion of Ideas Presented and Recommendations for California

12:00 – 1:30 p.m. LUNCH

1:30 – 3:00 Discussion of Ideas Presented and Recommendations for California

3:00 p.m. Adjourn

Appendix 2: List Of Participants

Facilitators:

- Jim Brenner (UC Cooperative Extension Sea Grant Program)
- Flaxen Conway (Oregon Sea Grant Extension)
- Pete Nelson (HT Harvey and Associates)
- Paul Olin (UC Cooperative Extension Sea Grant Program)
- Sunny Rice (Sea Grant Marine Advisory Program, University of Alaska, Fairbanks)

Notekeepers:

- Michele Buckhorn (Department of Wildlife Fishery Conservation Biology)
- Jon Budrick (California Department of Fish & Game)
- Karen Carlson (Friends of Moss Landing Marine Laboratories)
- Kristen Honey (EDF)
- Kristin Hunter–Thomson (UC Cooperative Extension Sea Grant Program)
- Angela Louie (California Department of Fish & Game)
- Kirk Lynn (California Department of Fish & Game)
- Jerry Moxley (EDF)
- Debbie Marshal (UC Cooperative Extension Sea Grant Program)
- Shauna Oh (California Sea Grant College Program)
- Noëlle Yochum (UC Cooperative Extension Sea Grant Program)

Synthesizers:

- Debbie Aseltine-Neilson (California Department of Fish & Game)
- Carrie Culver (UC Cooperative Extension Sea Grant Program)
- Chris Dewees (University of California, Davis)
- Carrie Pomeroy (UC Cooperative Extension Sea Grant Program)
- Rick Starr (UC Cooperative Extension Sea Grant Program)

Participants:

- Ted Ames (Penobscot East Resource Center)
- Jim Anderson (Fisherman)
- Tom Barnes (California Department of Fish & Game)
- Kristine Barsky (California Department of Fish & Game)
- Nokome Bentley (Trophia Ltd.)
- Loo Botsford (University of California, Davis)
- Briana Brady (California Department of Fish & Game)
- Liz Brooks (NOAA National Marine Fisheries Service)
- Doug Butterworth (University of Cape Town)
- Leesa Cobb (Port Orford Ocean Resource Team)
- Larry Collins (Crab Boat Owners Association)
- Jason Cope (University of Washington; NOAA National Marine Fisheries Service)
- Mike DeLapa (Environmental Defense Fund)
- Cathy Dichmont (CSIRO)
- Gavin Faye (University of Washington)
- Rod Fujita (Environmental Defense Fund)
- Ed Glazier (Impact Assessment Inc.)
- Jim Golden (Golden Marine Consulting)
- Zeke Grader (Pacific Coast Federation of Fishermen's Association)
- Joanna Grebel (California Department of Fish & Game)
- Madeleine Hall-Arber (MIT Sea Grant College Program)
- Xi He (NOAA National Marine Fisheries Service)
- Kenyon Hensel (Fisherman)
- Marc Heisdorf (California Department of Fish & Game)
- Meisha Key (California Department of Fish & Game)
- Patrick Kilduff (University of California, Davis)
- Gordon Gislason (GSGislason & Associates Ltd)
- Nicolas Gutierrez (University of Washington)
- Peter Halmay (California Sea Urchin Association)
- Michael Harte (Oregon Sea Grant Extension)
- Sherman Hoyt (University of Maine, Cooperative Extension Sea Grant Program)
- Bob Ingles (Fisherman)
- Peter Kalvass (California Department of Fish & Game)
- Tim Klassen (Fisherman)
- Traci Larinto (California Department of Fish & Game)
- Leeanne Laughlin (California Department of Fish & Game)
- Chris Legault (NOAA National Marine Fisheries Service)
- Jim Martin (Recreational Fishing Alliance)
- Jan Mason (NOAA National Marine Fisheries Service)
- Don Maruska (San Luis Obispo Science & Ecosystem Alliance)
- Mark Maunder (Inter-American Tropical Tuna Commission)
- Howard McElderry (Archipelago Marine Research)
- Carey McGilliard (University of Washington)

– Karma Norman (NOAA National Marine Fisheries Service)
– Ken Oda (California Department of Fish & Game)
– Bob Osborn (Fisherman)
– Wayne Palsson (Washington Department of Fish & Wildlife)
– John Petterson (Impact Assessment Inc.)
– Kristina Phipps (Oceans Program Environmental Defense Fund)
– Paul Pierce (Coastside Fishing Club)
– Jeremy Prince (Biospherics P/L)
– Paul Reilly (California Department of Fish & Game)
– Laura Rogers-Bennett (California Department of Fish & Game)
– Will Satterthwaite (UC Santa Cruz)
– Steve Schroeter (UC Santa Barbara)
– David Smith (CSIRO)
– Rick Stanley (Fisheries and Oceans Canada)
– Paul Starr (New Zealand Seafood Industry Council)
– Jon Sutinen (University of Rhode Island)
– Ian Taniguchi (California Department of Fish & Game)
– Cindy Thomson (NOAA National Marine Fisheries Service)
– Roger Thomas (Golden Gate Fishermen's Association)
– Chris Voss (California Abalone Association)
– Shizen Wang (California Department of Fish & Game)
– Ryan Watanabe (California Department of Fish & Game)
– Kate Wing (Ocean Policy and Communications)
– Dean Wendt (Cal Poly San Luis Obispo)
– Deb Wilson–Vandenberg (California Department of Fish & Game)
– Jono Wilson (UC Santa Barbara)
– Lynne Yamanaka (Fisheries and Oceans Canada)

Appendix 3: List Of Submitted Papers

Authors and titles of manuscripts that were submitted for the "Managing Data-Poor Fisheries: Case Studies, Models, and Solutions" workshop. Workshop papers are located on Supplementary Data CD and are in draft format. Do not cite or distribute without the authors' express permission. (* indicates authors that attended the workshop)

*Ames, Ted. Managing fisheries without adequate data: the multispecies coastal shelf recovery plan (a collaborative, ecosystem-based approach).

*Bentley, Nokome and Kevin Stokes. Engineering management procedures to achieve multiple objectives in data-poor fisheries.

*Bentley, Nokome and Kevin Stokes. Moving fisheries from data poor to data sufficient: evaluating the costs of management versus the benefits of management.

Bloeser, Jennifer, *Leesa Cobb and *Jim Golden. A workshop on alternative tools for nearshore fisheries management and a case study of the Port Orford Stewardship Area and plan to implement community based fisheries management.

*Botsford, Loo and *D. Patrick Kilduff. The data-richness spectrum and sustainability in California fisheries.

*Brooks, Elizabeth, Todd Gedamke, and Katherine A. Sosebee. Deriving management reference points without fisheries data.

*Butterworth, Doug S., Susan J. Johnston and Anabela Brandão. On pre-testing the likely efficacy of suggested management approaches for data-poor fisheries.

*Conway, Flaxen, *Caroline Pomeroy, and *Madeleine Hall-Arber. Managing data-poor fisheries by paying attention to managing relationships.

*Cope, Jason and André Punt. Length-based reference points for data-limited situations: applications and restrictions.

*Culver, Carolynn S., *Stephen C. Schroeter, Henry M. Page and Jenifer E. Dugan. Essential fishery information for trap-based fisheries: development of a framework for collaborative data collection.

*Dewees, Christopher M. More than one way to skin a fish: identifying approaches to managing California's data-poor marine fisheries.

*Dichmont, Cathy and I.W. Brown. A case study in successful management of a data-poor fishery using simple decision rules: the Queensland spanner crab fishery.

Field, John, *Jason Cope, and *Meisha Key. A descriptive example of applying vulnerability evaluation criteria to California nearshore species.

*Hall-Arber, Madeleine, *Caroline Pomeroy, and *Flaxen Conway. Figuring out the human dimensions of fisheries: illuminating models.

*Harte, Michael, Brycen Swart, Gil Sylvia and David Ullman. Integrating social, economic and biological information in the management of data-poor fisheries.

*Honey, K.T., *J.H. Moxley, and *R. M. Fujita. From Rags to Fishes: Data-Poor Methods for Fishery Managers.

*Mason, Jan. What can we learn from historic fisheries data?

*Maunder, Mark. A depletion estimator for within-season management of yellowfin tuna.

*McElderry, Howard and Gordan Gislason. Video-based electronic monitoring of fishing operations.

Moore, Slade and John Sowles. Local-scale ecosystem-based fisheries in a Gulf of Maine estuary: managing for complexity, adapting to uncertainty.

Norman, *Karma, Jennifer Sepez, and Kim Engie. Socioeconomic profiling of marine dependent communities on the northwest coast of the U.S.

*Petterson, John and *Edward Glazier. Fishery management, monitoring systems, and data layering in data-poor environments.

*Phipps, Kristina, Rod Fujita, and *Tom Barnes. From paper to practice: incorporating new data and stock assessment methods into California fishery management.

*Prince, Jeremy. Managing data poor fisheries: solutions from around the world.

Rago, Paul and *Chris Legault. Application of an index method (AIM) to data rich situations: can simple methods capture major features of complex assessments?

*Schroeter, Steve, *Nicolás Gutiérrez, *Peter Halmay, Michael Robinson, and Ray Hilborn. Moving from data poor to data rich: a case study of community-based data collection for the San Diego red sea urchin (*Strongylocentrotus franciscanus)* fishery.

*Smith, David C., A.D.M. Smith, A.E. Punt, N.A. Dowling, and G.N. Tuck. Reconciling approaches to the assessment and management of data-poor species and fisheries with Australia's Harvest Strategy Policy.

*Stanley, Rick, and Norm Olsen. The accuracy of catch estimates from the British Columbia Groundfish Integration Project.

*Starr, Paul. Fisher-collected sampling data: lessons from the New Zealand experience.

*Starr, Richard M., Mark Carr, Dan Malone, Ashley Greenley, and *Selena McMillan. Complementary sampling methods to inform ecosystem-based management of nearshore fisheries.

*Sutinen, Jon. Improving compliance and enforcement in data-poor fisheries.

*Thomson, Cynthia J. Data requirements for integrating socioeconomic considerations into regulatory analysis: examples from California commercial fisheries.

*Wendt, Dean and *Richard M. Starr. Collaborative research: an effective way to collect data for stock assessments and evaluate marine protected areas in California.

*Wilson, Jono R., *Jeremy D. Prince and Hunter Lenihan. Setting harvest guidelines for sedentary nearshore species using marine protected areas as a reference.

*Yamanaka, K. Lynne and Gary Logan. Developing British Columbia's inshore rockfish conservation strategy.

Appendix 4: List of Papers by Workshop Topic

Papers submitted for this workshop were categorized by either general information or by the three workshop topics. Although many of the papers pertain to more than one topic, we have listed them here by only one for reference purposes. **Bold** names indicate presenter/participant. Asterisks indicate papers presented in plenary sessions.

General Papers

Bentley, Nokome and Kevin Stokes
*Engineering Management Procedures to achieve multiple objectives in data-poor fisheries

Botsford, Loo and Patrick Kilduff†
*The data-richness gradient in California fisheries

Butterworth, Doug, Susan Johnston and Anabela Brandão
*On pre-testing the likely efficacy of suggested management approaches for data-poor fisheries

Dewees, Christopher
*More than one way to skin a fish: Identifying approaches to managing California's data-poor marine fisheries

Honey, Kristen T., Jerry H. **Moxley**, and Rod M. **Fujita**.
From Rags to Fishes: Data-Poor Methods for Fishery Managers.

Phipps, Kristine, Rod **Fujita** and Tom **Barnes**
*From paper to practice: Incorporating new data and stock assessment methods into California fishery management

Prince, Jeremy
*Managing data poor fisheries: Solutions from around the world

Smith, David, André Punt, Natalie Dowling, Anthony D.M. Smith, Geoff Tuck, and Ian Knuckey
*Reconciling approaches to the assessment and management of data-poor species and fisheries with Australia's Harvest Strategy Policy

TOPIC 1: New Management Approaches

Ames, Ted
The multispecies coastal shelf recovery plan (A collaborative, ecosystem-based approach)

Bentley, Nokome and Kevin **Stokes**
Moving fisheries from data poor to data sufficient: Evaluating the costs of management versus the benefits of management

Bloeser, Jennifer, Leesa **Cobb** and Jim **Golden**
A workshop on alternative tools for nearshore fisheries management and a case study of the Port Orford stewardship area and plan to implement community based fisheries management

Dichmont, Cathy and Ian Brown
*Successful management of a data-poor fishery using simple decision rules

Harte, Michael, Brycen Swart, Gil Sylvia and David Ullman
Integrating social, economic and biological Information in the management of data- poor fisheries

Sutinen, Jon
Improving compliance and enforcement in data-poor fisheries

Yamanaka, K. Lynne and Gary Logan
Developing British Columbia's inshore rockfish conservation strategy

*TOPIC 2***:** *New Analytical Techniques*

Brooks, Elizabeth, Todd Gedamke and Katherine Sosebee
Deriving management reference points without fisheries data

Cope, Jason and André Punt
Length-based reference points for data-limited situations: Applications and restrictions

Field, John, Jason **Cope** and Meisha **Key**
A descriptive example of applying vulnerability evaluation criteria to California nearshore species

Rago, Paul J. and Christopher M. **Legault**
Application of an index method (AIM) to data rich situations: Can simple methods capture major features of complex assessments?

Mason, Janet
What can we learn from historic California fisheries data?

Maunder, Mark
A depletion estimator for within-season management of yellowfin tuna

McElderry, Howard and Gordon Gislason
Video-based electronic monitoring of fishing operations

Carey **McGilliard**
Approaches for using MPAs in stock assessments and management of data-poor fisheries

Petterson, John and Edward Glazier
Fishery Management, Monitoring Systems, and Data Layering in Data-Poor Environments

Stanley, Richard and Norm Olsen
The accuracy of yelloweye rockfish catch estimates from the British Columbia groundfish integration project

Starr, Richard, Mark Carr, Dan Malone, Ashley Greenley, Selena McMillan
Complementary sampling methods to inform ecosystem-based management of nearshore fisheries

Thomson, Cynthia
Data requirements for integrating socioeconomic considerations into regulatory analysis: Examples from California commercial fisheries

Wilson, Jono, Jeremy **Prince** and Hunter Lenihan
Setting harvest guidelines for sedentary nearshore species using marine protected areas as a reference

TOPIC 3: New Ways to Collect and Integrate Data

Conway, Flaxen, Carrie. **Pomeroy** and Madeleine **Hall-Arber**
Managing data poor fisheries by paying attention to managing relationships

Culver, Carolynn, Stephen **Schroeter**, Henry Page, and Jenifer Dugan
Essential fishery information for trap-based fisheries: Development of a framework for collaborative data collection

Hall-Arber, Madeleine, Carrie **Pomeroy** and Flaxen **Conway**
Figuring out the Human Dimensions of Fisheries: Illuminating Models

Moore, Slade, and John Sowles (Presented by Sherman **Hoyt**)
Local-scale ecosystem-based fisheries in the Gulf of Maine estuary: Managing for complexity, adapting to uncertainty

Norman, Karma†
Trapped between the details and the deep blue sea: Socioeconomic profiling of marine dependent communities on the U.S. northwest coast

Starr, Paul
*Fisher-collected sampling data: Lessons from the New Zealand experience

Schroeter, Stephen, Nicolas **Gutierrez**, Michael Robinson, Ray Hilborn and Peter **Halmay**
Moving from data poor to data rich: A case study of community based data collection for the San Diego red sea urchin (*Strongylocentrotus franciscanus*) fishery

Wendt, Dean and Richard **Starr**
Collaborative Research: An effective way to collect data for stock assessments and evaluate marine protected areas in California

Appendix 5: Abstracts from Submitted Papers

Managing Fisheries without Adequate Data: The Multispecies Coastal Shelf Recovery Plan (A Collaborative, Ecosystem Based Approach)

Ted Ames
Penobscot East Resource Center

An ecosystem-based collaborative management plan for restoring New England's depleted Multispecies Groundfish fishery is under development. The plan would create areas where fine-scale events directly affecting the biological productivity of a stock can be managed more effectively. Inner areas would provide small scale, habitat-friendly, selective inshore fisheries with controlled landings that allow stock recovery and provide substantial numbers for recruitment offshore. Improvements in local productivity under such a plan will help ensure that both inshore and offshore fisheries become sustainable. The plan addresses the inability of traditional system-wide assessments to detect local changes by creating a series of smaller contiguous management areas on the coastal shelf that nest within existing federal and State management systems. Boundaries for each area would be designed to bracket spawning components of key species such as Atlantic cod and would include their spawning grounds, nursery habitats and migration routes to the outer edge of the coastal shelf. Access would be limited to those who agree to restricted landings in the outer area using habitat-friendly, selective fishing gear that minimizes bycatch inshore. Collaborative management would include area advisory councils of fishermen under State administration with regional council oversight in federal waters. Area participants would be enlisted in collaborative efforts to identify additional critical habitats and enhance stock recoveries. The approach is compatible with total allowable catch (TAC) management, but does not rely on a TAC as the primary management tool.

Engineering Management Procedures to Achieve Multiple Objectives in Datapoor Fisheries

Nokome Bentley[1] & Kevin Stokes[2]
[1]Trophia Ltd.
[2] SeaFIC

We contrast two paradigms for fisheries management decision making: the 'assessment' paradigm, based around stock assessments, and the 'procedural' paradigm, based around management procedures. The assessment paradigm has difficulty in providing management for data-poor stocks and we illustrate this in the New Zealand context. In contrast, the procedural paradigm has the potential to be useful for the data-poor stocks, but to date, most of the work on developing management procedures has focused on high value, data-rich stocks. This may be because several aspects of the procedural paradigm seem to be misunderstood or neglected. Giving appropriate attention to these aspects will improve the application of fisheries management procedures, particularly for data-poor stocks. Specifically, we argue that the design, evaluation and selection of management procedures should be treated as an exercise in engineering by applying generic solutions in cases where specific solutions are not currently available, and giving appropriate attention to how trade offs are made amongst multiple management objectives.

Moving Fisheries from Data Poor to Data Sufficient: Evaluating the Costs of Management versus the Benefits of Management

Nokome Bentley[1] & Kevin Stokes[2]
[1] Trophia Ltd.
[2] SeaFIC

Fisheries are data-poor usually because they are low in value and as such are the lowest priority for funding. But there is often no formal evaluation of the cost of data collection versus the benefits it brings. In this paper, we describe how the costs and benefits of data collection can be evaluated within the context of fisheries management procedures. We provide an illustration, based on a data-poor fishery in New Zealand, of how to evaluate the utility associated with simple management procedures that incorporate no monitoring, fixed monitoring or adaptive monitoring. We demonstrate that it is feasible to do formal

evaluations of alternative data collection regimes by including their costs in a utility function that incorporates other performance measures. Our particular example demonstrates the potential benefits of monitoring even in low value fisheries and, in principle, the gains that can be made through the use of management procedures that include adaptive monitoring.

A Workshop on Alternative Tools for Nearshore Fisheries Management and a Case Study of the Port Orford Stewardship Area and Plan to Implement Community Based Fisheries Management

Jennifer Bloeser[1], Leesa Cobb[2] & Jim Golden[3]
[1]Pacific Marine Conservation Council
[2]Port Orford Ocean Resource Team
[3]Golden Marine Consulting

Current fisheries management is characterized by stock assessments and regulatory action that are applied on a large spatial scale. In the West Coast groundfish fishery, overfished species have required plan amendments to minimize harvest and allow rebuilding of stocks. Rockfish Conservation Areas (RCAs) have forced fleet effort both inshore and offshore. Growing markets for nearshore live and fresh market continue to put pressure on nearshore fisheries but the stock status remains unknown for many of them as insufficient data exist to carry out assessments. Small coastal communities and agencies are beginning to see the need to acquire more data and manage on a smaller spatial scale to address local concerns about resource sustainability and economic viability of smaller nearshore fisheries. In this paper we report on the results of a workshop on alternative tools for determining stock status and management of nearshore resources and a case study of a small fishing community's efforts to implement a Community Based Fisheries Management (CBFM) model in Port Orford, Oregon.

The Data-Richness Spectrum and Sustainability of California Fisheries

Louis W. Botsford & Patrick Kilduff
Department of Wildlife, Fish and Conservation Biology, University of California Davis

One approach to representing the current state of an ecosystem would be to describe the data available for each of its fisheries in terms of their usefulness in assessing sustainability and managing for optimum yield. The "data richness spectrum" for California's 149 marine fisheries indicates that 92 percent have landings data, but many of those have landings data only, hence would have no ability to track depletion in abundance, a minimal requirement for assessing risk. Sixty percent have catch and effort data, hence could possibly track depletion, depending on the quality of the effort data. Half of these (30 percent of California fisheries) also have sufficient age or size structure data to have had a stock assessment. A slightly greater number have not had stock assessments but have either size or age data, hence some potential for development of data poor methods for some level of assessment. The data richness spectra vary among the different specific fishery types, with nearshore invertebrates having no age distribution data, nearshore fish having a higher fraction of size structured data, and groundfish having a greater fraction of age structure data. We recommend development of data gathering and analytical methods that provide some means of improving the ability to at least track sustainability, possibly through collaborative efforts with the fishing industry.

Deriving Management Reference Points without Fisheries Data

Elizabeth N. Brooks[1], Todd Gedamke[2] & Katherine A. Sosebee[1]
[1]Northeast Fisheries Science Center
[2]Southeast Fisheries Science Center

Assessment of skate species in the Northwest Atlantic Ocean has proven to be difficult due to the aggregated nature of commercial landings and the paucity of information on discards. We illustrate a method to derive biological reference points using only data from the research surveys conducted by the Northeast Fisheries Science Center, thereby avoiding the potential problems associated with disaggregating the commercial catches or attempting to estimate or hindcast discards. Time series of spawners and recruits were derived from the research surveys based on length of full vulnerability to the gear ("recruits") and length at maturity ("spawners"). Beverton-Holt curves were fit to pairs of spawner-recruit observations, after appropriate lagging to account for the age of recruits. SPR-based reference points were then derived from life-history parameters and the fitted Beverton-Holt stock recruit relationships. Overfishing reference points are given as $F_{\%SPR}$ and overfished reference points are expressed in terms of spawning stock depletion from unexploited conditions (i.e., $S_{F\%SPR}/S_{F=0}$). The ability to express the reference

points explicitly in terms of survival, maturity, and fecundity allows the proxy SPR level to be tailored to the species of interest rather than applying a generic, 'one-size-fits-all' value. The appropriateness of the SPR level can be evaluated by inspection of the individual components to determine whether they are biologically realistic. The sensitivity of the method to the assumed age-constant natural mortality (M) was explored for a reasonable alternative range. The errors in variables problem was ignored in fitting the stock recruit relationship (*status quo*).

On Pre-Testing the Likely Efficacy of Suggested Management Approaches for Data-Poor Fisheries
Doug S Butterworth[1], Susan J Johnston[2] and Anabela Brandão[3]
[1]MARAM (Marine Resource Assessment and Management Group)
[2]Department of Mathematics and Applied Mathematics
[3]University of Cape Town

The thrust of this paper is that decision rules for the management of data-poor fisheries cannot be based on expert judgment alone. Such rules need to quantify the extent of a management response to the values of the indicators available for the fishery and their trends. Prior simulation testing is needed to confirm that the application of any rules suggested is likely to achieve the objectives sought for the fishery. The management procedure (MP) approach (alternative termed management strategy evaluation, or MSE), which provides a framework for such testing, is summarized briefly. An example is presented of how this approach could be used to develop a decision rule (empirical MP) for a data-poor fishery for which the only indicator available is the mean length of the catch. The extent to which performance in meeting objectives could be improved if an unbiased index of relative abundance was available, and an MP based on a fitted population model applied, is illustrated. An MP developed for the fishery for Patagonian toothfish off the sub-Antarctic Prince Edward Islands is summarized. This illustrates how the MP testing framework can be used in circumstances where available indicators conflict, leading to considerable uncertainty about the present resource status. The information content of indicators is closely related to the extent to which they vary about trends in related underlying resource attributes (e.g. CPUE about underlying abundance). The compilation of lists of the statistical properties, such as CVs and autocorrelations, of residuals about detrended time series of indicators for fisheries worldwide is suggested. This would provide a sound basis to specify error structure in the simulation tests advocated for both generic and case-specific decision rules for data-poor fisheries.

Managing-Data Poor Fisheries by Paying Attention to Managing Relationships
Flaxen Conway[1], Caroline Pomeroy[2], and Madeleine Hall-Arber[3]
[1]Oregon State University/Oregon Sea Grant Extension Program
[2] California Sea Grant Extension Program
[3] Center for Marine Social Sciences, MIT Sea Grant College Program

Long before multi-million dollar NOAA Fisheries vessels were built, fisheries scientists relied on traditional or local ecological knowledge and valued the information that fishermen gathered during their daily life on the water. The information was eclectic, and included observations about a wide range of conditions and interactions of various species. Reflecting back upon these times, both fishermen and scientists have commented that the relationships between them were also very important. Later a "great gulf" between scientists and fishermen developed, as scientists focused more on hiring fishing vessels to use as research platforms and less on engaging and learning from fishermen to develop research ideas or test hypotheses. Over the last decade, the tide has turned again, and there is growing interest and activity in cooperative fisheries research (CFR). Some fishermen are growing increasingly comfortable with science, and more scientists have realized that there is untapped potential for mutual learning. Others have addressed the procedural considerations for effective CFR. This paper expands that work by highlighting the importance of the relationships among partners, the costs and benefits to everyone involved in CFR, and how these are actually critical factors for the establishment and achievement of sound scientific goals. Managing these relationships could be an important key to understanding how to manage data-poor fisheries.

Length-based reference points for data-limited situations: applications and restrictions.
Jason M. Cope[1,2] and André E. Punt[2]
[1]Fishery Resource Analysis and Monitoring Division Northwest Fisheries Science Center NOAA Fisheries
[2]School of Aquatic and Fishery Sciences University of Washington

Current fisheries management policies often require assessing stock status, a difficult task when population and fisheries data are limited. Froese (2004) offered three simple metrics (P_{mat}, P_{opt}, P_{mega}) based on catch length

compositions by which to monitor population status relative to exploitation that avoids growth and recruitment overfishing. However, it is unknown how these measures relate to stock status and thus, how to apply them to inform future catches. We attempt to make this connection by exploring the relationship of these measures (collectively referred to as P_x) to fishing mortality and spawning biomass. The relationships are compared specifically to current target (0.4 SB_0) and limit (0.25 SB_0) reference points used for the U.S. west coast groundfish fishery using simulations based on a deterministic age-structured population dynamics model. Sensitivity is explored to fishery selectivity, life history traits and recruitment compensation (steepness). Each P_x measure showed a wide range of possible values depending on fishery selectivity, steepness, and the ratio of the length at maturity (L_{mat}) to the optimal fishing length (L_{opt}). The values of P_x suggested by Froese (2004) as being compatible with sustainable fishing are not always sufficient to insure stock protection from overfishing. Moreover, values for P_x cannot be interpreted adequately without knowledge of the selectivity pattern. A new measure, P_{obj} (the sum of P_{mat}, P_{opt}, and P_{mega}) is introduced to distinguish selectivity patterns and construct a decision tree to develop indicators of stock status. Heuristic indicator values are presented to demonstrate the utility of this approach. Although several caveats remain, this approach builds on the recommendations of Froese (2004) by giving further guidance related to interpreting catch length composition data under variable fishery conditions without collecting additional information. It also provides a link to developing harvest control rules to inform proactive fisheries management under data-limited conditions.

Essential Fishery Information For Trap-Based Fisheries: Development Of A Framework For Collaborative Data Collection

Carolynn S. Culver[1,2], Stephen C. Schroeter[2], Henry M. Page[2] and Jenifer E. Dugan[2]
[1]University of California Cooperative Extension Sea Grant Program
[2]Marine Science Institute, University of California, Santa Barbara

The availability of detailed up-to-date information needed for managing marine resources, including those that support fisheries, is limited throughout the world. In California, this lack of data is hindering the implementation and evaluation of two recent State laws, the Marine Life Management Act and the Marine Life Protection Act. The inability to meet the objectives of these laws is particularly acute for large cryptic benthic species (e.g., crabs, lobster, spot prawns) that play important roles in nearshore ecosystems and support valuable trap fisheries. These species are not readily quantified using conventional methods and thus are not usually included in existing monitoring efforts. Data collection programs, where fishery participants, managers and scientists collaboratively design, collect and analyze data, have the potential to provide essential fishery information needed to manage marine resources in a cost-effective way. However, broad application of this type of program requires development of a framework that facilitates the use of effective and efficient sampling methods and protocols, as well as the management of collected data. Using the rock crab trap fishery as a model system, we conducted field sampling and held discussions with fishing partners and others involved in data collection efforts to investigate the feasibility of using a collaborative data collection approach to collect essential fishery information for trap fisheries in California. We explored methods and protocols that could be integrated into fishing practices to efficiently collect accurate data for the rock crab fishery, and potentially other trap fisheries. Our findings suggest that collaborative data collection programs are well suited for trap fisheries, particularly those that include multiple species or practice high rates of selectivity (i.e., sorting of the at-sea catch). Resulting recommendations for ensuring the process is transparent and the data are accurate and integrated into the management process, include the development and use of 1) scientifically sound data collection methods and protocols that are accepted by fishery managers, 2) hands-on training and re-certification programs for participants, 3) validation of the collected data, 4) well defined procedures for handling confidential data, 5) sufficient compensation and an adequate funding source, and 6) timely and consistent reviews of the data with subsequent actions as needed. While additional administrative, infrastructure and regulatory procedures are needed to successfully integrate this method into the management process in California, our results support the use and development of collaborative data collection programs, particularly for cryptic benthic species targeted in trap fisheries, for providing scientifically robust data for managing marine resources.

More Than One Way to Skin a Fish: Identifying Approaches to Managing California's Data-Poor Marine Fisheries.

C.M. Dewees
University of California, Sea Grant Extension Program and Wildlife, Fish & Conservation Department, University of California, Davis

This paper introduces workshop participants to California fisheries and challenges them to identify applicable, feasible management approaches for fisheries in data-poor situations. Biological and human dimension approaches to fisheries management are listed along with key variables for both. I define seven key elements needed for improved management in data-poor situations.

A case study in successful management of a data-poor fishery using simple decision rules: the Queensland spanner crab fishery.

Cathy M. Dichmont[1] and I.W.Brown[2]
[1]CSIRO Marine and Atmospheric Research
[2]Queensland Department of Primary Industries and Fisheries

The Queensland spanner crab (*Ranina ranina*) is the target of a relatively data-poor, low value fishery that has been managed for the last decade using Total Allowable Catches in an Individual Transferable Quota system. Despite the fact that this management system is usually applied to data-rich fisheries, it has been successfully used on a data-poor fishery. The key ingredient has been the use of harvest strategies that consisted of only simple decision rules that were appropriate given the size of the fishery and knowledge of the resource. These strategies were tested in a Management Strategy Evaluation (MSE) framework. The MSE was not traditional in that a) the operating model (or "true" resource to be managed) was not conditioned to data but set to parameter ranges seen as appropriate for the resource and b) the TAC was not set using a stock assessment model so the magnitude of the stock biomass was unknown. The important test was whether one could develop harvest strategies that were robust to this large uncertainty in knowledge using only commercial catch rates. The management system had to be adaptive over time as more was learnt about the biology of the species and how the harvest strategies affected the management of the fishery. This meant that the TAC was almost always set using the harvest strategies, but that modifications to the decision rules were able to be made on several occasions as more was learned about the fishery. The transparency and simplicity of the rules mean that the industry is empowered to make significant contributions to fine-tuning the harvest strategies. As a result, the process does not rely only on scientific advances, but also on the pooled knowledge of scientists, industry and managers in a cooperative environment.

A Descriptive Example of Applying Vulnerability Evaluation Criteria to California Nearshore Species

John Field[1], Jason Cope[2] and Meisha Key[3]
[1]Southwest Fisheries Science Center, National Marine Fisheries Service
[2]Northwest Fisheries Science Center, National Marine Fisheries Service
[3]Marine Region, California Department of Fish and Game

In light of ongoing crises in fisheries and marine ecosystem management, a growing body of literature has highlighted the need for biologists and resource managers to develop and apply methodologies that are capable of identifying species or populations at greater risk of overexploitation and extirpation. One increasingly popular approach is a productivity and susceptibility analysis (PSA), originally developed for Australian prawn fisheries, in which the vulnerability of a given stock is based on a combination of the estimated or perceived productivity of the stock plotted against the susceptibility to overfishing. This manuscript provides an example of this type of analysis developed for the 19 species included in the California Nearshore Fishery Management Plan (NFMP). The methodology is based on a version of the PSA approach being developed by the NOAA Fisheries Vulnerability Evaluation Working Group (VEWG), which is currently in the process of preparing draft technical guidance for conducting vulnerability assessments for species managed under Fishery Management Plans implemented by the regional Fishery Management Councils. Results of this case study in particular indicate that the more vulnerable species in the NFMP include China, copper, quillback and blue rockfishes, of which only the latter has been evaluated in a formal stock assessment. More importantly, we suggest that additional and more rigorous analysis of these or of other species managed by either (or both) the State of California and the Pacific Fishery Management Council, may aid managers and stakeholders in setting research and assessment priorities, considering management

alternatives and strategies, developing or revising species assemblages for multi-species management systems, and evaluating how precautionary catch limits should be based.

Figuring out the Human Dimensions of Fisheries: Illuminating Models

Madeleine Hall-Arber[1], Caroline Pomeroy[2], and Flaxen Conway[3]
[1]Center for Marine Social Sciences, MIT Sea Grant College Program
[2]California Sea Grant Extension Program
[3] Oregon State University/Oregon Sea Grant Extension Program

Both natural scientists and economists commonly use quantitative data to create models of the systems that interest them, and then use these models to inform fisheries management. Other social scientists rely on lengthier, descriptive texts based primarily on qualitative data to assess the human dimensions. To their dismay, fisheries social scientists find that much of their rich narrative with keen insights ends up filling pages that are neither read nor meaningfully integrated into decision-making in fisheries management. Yet what all scientists, practitioners, and managers want and need is information that will lead to a better understanding of the ecosystem (comprised of interdependent ecological and human systems) and therefore, to fisheries management that benefits the whole system. Believing that only a combination of high quality quantitative and qualitative data will provide both the numbers and the context needed for success in ecosystem-based management, in this paper we discuss efforts to present social and cultural information in forms more familiar to those who rely on models for a representation of reality in the fisheries context. We point out how the designers of these models (or how we) think the models might be applied to fisheries management, noting how each model attempts to incorporate qualitative data to depict context essential for grounding the more commonly used biological and economic models. We also assess the benefits and limitations of these models including the constraints on both their development and use.

Integrating Social, Economic and Biological Information in the Management of Data-poor Fisheries

Michael Harte[1], Brycen Swart[1], Gil Sylvia[2], David Ullman[3]
[1]Marine Resource Management Program & Oregon Sea Grant, College of Oceanic and Atmospheric Sciences Oregon State University
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Fisheries management is a complex undertaking and the management of fisheries that are information limited is doubly so. Using two fisheries case studies from the west coast of the United States, the application of a structured Bayesian-based multi-criteria assessment (MCA) to data-deficient fisheries management issues is demonstrated. Managing the bycatch of yelloweye rockfish and minimizing the impact of commercial fishing on essential fish habitat requires fishery managers and stakeholders to evaluate and choose between management strategies that have different biological, social and environmental outcomes. A deficiency of biological, social and economic information to support such evaluations means the role of uncertainty must also be addressed in the decision-making process. The case studies show the major benefits of the Bayesian-based MCA to be the ability to: 1) Integrate biological, social and economic information measured in incommensurate units; 2) engage managers and stakeholders in the decision process increasing the probability of stakeholder buy-in for the decisions made; and 3) explicitly take into account uncertainty when evaluating alternative management strategies. Adoption of a structured MCA by fisheries managers improves decision-making in data-poor fisheries by making the selection of management strategies analytically robust, inclusive and transparent.

From Rags to Fishes: Data-Poor Methods for Fishery Managers

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Fishery managers often must make decisions regardless of data availability or completeness of scientific understanding. Existing and new legal mandates, such as the requirement to establish Annual Catch Limits for each United States fishery by 2011, as well as the ongoing need to improve understanding of fish stock dynamics, are driving efforts to develop new, more efficient ways to assess fish stocks when data are insufficient for full stock

assessments. Moreover, there is an increasing recognition of the need to assess stocks at smaller spatial scales. In December 2008, fishery scientists, fishermen, and managers convened at a workshop in Berkeley, California (USA), to discuss such methods. One goal of the workshop was to identify methods for estimating potential reference points for managing data-poor fisheries, such as science-based overfishing thresholds, allowable biological catch levels, and vulnerability indices. Here we review methods presented at the workshop, as well as some promising methods gleaned from the literature, for establishing reference points for data-poor situations. We present a new framework to help managers and stakeholders consider and choose appropriate analytical methods and alternative management approaches, based on available data (type, quantity, and quality) and feasibility constraints (scale, value, and implementation costs). We highlight limitations and considerations for each method and illustrate the use of our framework by presenting case-study examples. Too often, lack of data and/or proper data analysis results in lack of management. This status quo, however, poses risks to the economic and biological sustainability of fisheries. Application of data-poor methods, while subject to many caveats, can reduce these risks by providing scientific guidance for management.

What can we learn from historic California fisheries data?
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Current stock assessment models require extensive sets of data. In addition to many life history parameters, they rely on time series of catch from fisheries to calculate total removals and to estimate historic biomass levels. Recent assessments have constructed catch series for various recreational, and commercial fisheries. California commercial landings are stored in several databases, which differ in time period, spatial coverage and spatial resolution. Information on type of fishing and an estimation of species composition from port sampling programs are available in more recent data. The longest series of California marine recreational data is the Commercial Passenger Fishing Vessel (CPFV) logbook series, but it groups all rockfish together. The Marine Recreational Fisheries Statistical Survey, which began in 1980, surveys all types of marine recreational fisheries in northern and southern California for catch disposition, effort, species size and weight. To create estimates for CPFV rockfish species catch before 1980, several sources of data must be integrated and assumptions made about similarity of species composition from different eras. Several recent assessments have used catch per unit effort from the recreational fisheries as an indicator of abundance. As catch of some species is restricted, other indices of recruitment are being explored including larval and juvenile abundance in trawl surveys, power plant impingement time series and observations from scuba and manned submersibles.

A depletion estimator for within-season management of yellowfin tuna
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A depletion estimator is developed to estimate annual abundance from annual time series of catch data and an index of abundance. The method is applied to weekly data for yellowfin tuna in the eastern Pacific Ocean. The estimates of abundance from the depletion estimator are similar to estimates derived from a full stock assessment. The method can be applied to estimate abundance when only partial data are available for a given year, and the estimates of abundance can be used for within-season management. Cross-validation tests show that the method performs well (less than about 15% error) even in a situation when only a quarter of a year's data are available. Information from the stock assessment about the fishing mortality levels corresponding to maximum sustainable yield suggest that the catch quota should be set at about 60% of the abundance estimate at the begging of the year.

Video-Based Electronic Monitoring of Fishing Operations.
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Credible catch monitoring of landings plus discards is becoming a necessary condition for demonstrating that a commercial fishery is environmentally sustainable. Monitoring of at-sea discards and at-sea interactions with sensitive animals and habitats requires that on-vessel monitoring systems be employed. These monitoring systems must be independent third party systems, as apposed to self-reporting systems, in order to provide reliable and credible data. Over the past decade, video-based electronic monitoring (EM) technology has been developed,

piloted and implemented to provide third party at-sea oversight of fishing operations. EM systems, consisting of up to four closed circuit television cameras, a GPS receiver, a hydraulic pressure sensor, a winch sensor, and a system control box, can be deployed on fishing vessels to monitor a range of fisheries issues including fishing location, catch, catch handling, fishing methods, protected species interactions, and mitigation measures. This paper first provides a general description of the EM technology and then presents the EM case study application to the groundfish hook & line fishery of Pacific Canada. In comparison with observer programs, EM has a number of advantages including suitability across a broad range of vessel sizes and operations, creation of a permanent data record, lower cost, higher scalability, and the ability to audit self-reported information from industry. In particular, EM has a compelling cost advantage - EM costs can be less than one third of a 100% observer program. Third party monitoring of total catch provides needed transparency in fishing practices and this in turn instills public confidence and trust in the commercial fishery. And 100% monitoring is the gatekeeper to economic sustainability through greater fishing opportunities, access to markets and needed industry rationalization.

Local-scale ecosystem-based fisheries in a Gulf of Maine estuary: managing for complexity, adapting to uncertainty

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Ongoing development of a Comprehensive Resource Management Plan for the Taunton Bay Estuary, Maine is intended to put resource-uses in the larger context of supporting the estuary's capacity to accommodate those uses without degrading ecosystem integrity or resilience. The initial phase of this plan targets issues of immediate concern regarding environmental alteration and stock depletion associated with fisheries for four benthic species. Having no dedicated funding, our overall approach for developing ecosystem-based fisheries for this estuary relies heavily on thrift and efficiency, two attributes not intuitively associated with managing for ecosystem complexity. Specific elements of the approach include integrating the participation and guidance of local resource-users, prioritizing key information needs, conducting local research and monitoring to identify objectives and track progress and creating mechanisms for adaptive management. Despite making inroads towards better understanding specific ecological attributes, processes and vulnerabilities of this estuary, the complexity of ecosystem components and unpredictability of responses to management actions nevertheless leaves much uncertainty. Advancing a nascent, ecosystem-based management effort under such uncertainty requires adoption of coping strategies, or project-crippling inertia is risked. Depending on the circumstances, we approach uncertainty by using alternative knowledge systems to their best advantage, affording ourselves with opportunities for making prompt management shifts, encouraging a long-term process of positive, incremental change in management and erring on the side of equability and precaution where sensitive species, ecologically influential community types, and the livelihoods of resource-users are at risk.

Socioeconomic Profiling of Marine Dependent Communities On the Northwest Coast of the U.S.

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This article summarizes two different research elements of a fishing community profiling effort for the U.S West Coast. The first such element involves a quantitative model, Data Envelopment Analysis (DEA), for ranking commercial fisheries involvement by communities and describes the experiences of the joint Northwest Fisheries Science Center (NWFSC) and Alaska Fisheries Science Center (AFSC) social science teams in applying this model to West Coast and North Pacific fisheries. The breadth and robustness of the data available for this model allowed for a novel approach to characterizing communities according to their involvement in fishing. A list of communities most involved in fishing, according to the model employed, then allowed for 125 brief community profiles to be produced and distributed to fisheries managers. The strengths and weaknesses of the Data Envelopment Analysis (DEA) modeling approach are discussed. In describing the second element of our research, the article summarizes the effort to work in detail with some of the communities from the initial analysis. In order to ameliorate the lack of depth in the profiles, a subset of the communities selected by the DEA model were identified for further, more detailed profiling. Although this second element subsequently limited the geographic scope, the detailed profiles were designed to provide additional community information in a data-poor environment. A much different selection

approach was employed in determining which communities to profile in-depth, and was generated both by the goal of providing community examples, and the desire to respond to short and long term policy needs.

Fishery Management, Monitoring Systems, and Data Layering in Data-Poor Environments
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Using the example of California's MPA monitoring program, we demonstrate how multiple, independently-derived, data sets can be assembled and analyzed, within low-information environments, to identify use areas, gear, seasonal, and social conflicts, and re-concentration of effort, resulting from past and present regulatory and fishery management actions. The paper examines, in particular, two methodological approaches intended to resolving both the issue of data inadequacies and data abundance (in the form of GIS data layering and analysis), and the issue of informant selection and reliability (through careful, replicable, informant network analysis). The results represent the basic requirements of a robust system for tracking changes over time in response to MPA constraints, and for "adaptive management" to a multitude of complex and overlapping regulatory controls on fisherman behavior.

From Paper to Practice: Incorporating New Data and Stock Assessment Methods into California Fishery Management
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Conventional data collection and stock assessment methods, which require large amounts of time and resources, have become a bottleneck in California Fishery Management Plan (FMP) implementation, and in the transition of fisheries to science-based management. New, alternative methods that are less time and resource intensive could address this problem. However, clarity regarding how the California Department of Fish and Game ("the Department") will vet and accept new data collection and stock assessment methods is needed in order to spur the development and use of new methods and ensure that the results can be applied to fisheries management. This paper elucidates the Department's expected approach regarding the use of new stock assessment methods under existing FMPs and in the development of future FMPs, and sets forth a vetting process for stock assessment development and potential incorporation into management. The Department is open to considering – on a case-by-case basis – new, peer-reviewed approaches to estimating stock status and sustainable yield that produce quantitative results. The Department likely will review alternative stock assessment proposals in light of a set of established output criteria, including, for example, whether the assessment produces a quantitative estimate of vulnerability to fishing and quantitative sustainable harvest reference points. Once incorporated into FMPs or otherwise used for management decisions, peer-reviewed alternative analyses likely will allow fisheries to transition to science-based management from unmanaged states, or from precautionary management that is not based on quantified uncertainty.

Managing Data Poor Fisheries: Solutions from Around the World.
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Most of the world's fisheries are data-poor fisheries and this and across Latin America, Oceania, Asia and Africa and over the last 2-3 decades there has been considerable investment and success with their management. This paper provides a synthesis of this body of experience which arrives out a general consensus about the factors needed to manage data-poor and spatially complex fisheries. At its core the formula is: property rights, local fisher involvement, local communities managing for conservative levels of spawning per recruit, simple Transparent assessment structures using basic data provided by fishers. Two case studies are presented illustrating how transparent assessment structures based around the managing local SPR are being used in Australia to foster fine scale management and data-collection. In the case of Australian abalone fishery divers are being taught to visually assess abalone reefs using shell morphology to distinguish newly emerged sub-adult abalone from fully fecund adult abalone. A decision tree codifies these qualitative assessments and is used by the diver's association to broker agreement on voluntary reef-scale catch caps and size limits. In the second case a quantitative decision tree is presented which uses size-based catch rates to incrementally determine the catch level that stabilizes a population around any target level of SPR. Developed for use with local stocks of finfish with uncertain levels of linkages to larger meta-populations I believe it has great application to rockfish assessment and management in California.

Application of An Index Method (AIM) to Data Rich Situations: Can Simple Methods Capture Major Features of Complex Assessments?

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One of the core problems in fisheries science is the estimation of the scaling factor between estimates of relative abundance and true population size, called the catchability coefficient. Traditional stock assessment approaches to estimate these scaling factors rely on the ability to track cohorts using age data or on knowledge of fish biology and fishery characteristics. Fish stocks without age data and severely limited biological and fishery information are encountered all too frequently due to limited resources to collect data. In this paper we explore the general trends in abundance and fishing mortality deducible from only a time series of catch and a survey index. The model is named AIM (An Index Method) and is readily available on the NOAA Fisheries Toolbox website (http://nft.nefsc.noaa.gov). We define the relative fishing mortality rate as the ratio of catch to survey index and relate it to what we call the replacement ratio. The replacement ratio is an analytic, although heuristic, tool for examining the historical behavior of a population and any potential influences of removals due to fishing activities. We compare this simple method to results from more complex assessments of the same stock to examine whether AIM can capture major features of complex assessments in a data rich environment. In general, AIM correctly tracked the population trend and identified the relative impacts due to fishing, which supports the inference that AIM can be used in many data poor situations. However, manifestations of problems in complex assessments can sometimes be seen in the AIM results, which suggest that simple models are not immune to the pathology of misspecification.

Moving from Data Poor to Data Rich; A Case Study of Community-Based Data Collection for the San Diego Red Sea Urchin (*Strongylocentrotus Franciscanus*) Fishery

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The San Diego Watermen's Association has developed a community based sampling program in cooperation with University scientists and the California Department of Fish and Game. The primary elements of the program include: (i) design of scientifically valid sampling protocols; (ii) implementation of these sampling protocols by working sea urchin divers; (iii) data quality assurance and control by scientists in cooperation with fishing partners; (iv) calibration studies to determine accuracy and precision; and (v) visualization and dissemination of data and results. Divers have collected data, both during normal fishery activities and in ancillary surveys using these protocols since 2003. We compare data quality and quantity to current state agency protocols and demonstrate some uses for stock assessment. In addition we discuss incremental changes in protocols that would facilitate monitoring of associated biological communities. Some results of the 6-year ongoing program for fishery dependent and independent data are briefly summarized.

Reconciling Approaches to the Assessment and Management of Data-Poor Species and Fisheries with Australia's Harvest Strategy Policy

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There is an increasing expectation for decision makers to use robust scientific advice on the status of exploited fish stocks. As such, Australia has recently implemented a Harvest Strategy Policy for federally managed fisheries that sets limit and target biomass reference points. In common with most fisheries jurisdictions, however, Australia has many data-poor species and fisheries. Consequently, the challenge for those tasked with providing management advice for Australian fisheries has been reconciling the need to achieve specific risk-related sustainability objectives, given the reality of the available data/assessments for data-poor species and fisheries. Using case studies from two multi-species trawl fisheries, some general recommendations are drawn. Control rules for data-poor species should recognize that sufficient data may never be available for some species to enable quantitative assessments to be

conducted. The lack of data on which to base quantitative stock assessments using population dynamics models, however, does not preclude the development of objective harvest control rules. Evaluation of harvest control rules using, for example, the Management Strategy Evaluation (MSE) approach is ideal, but implementation before rigorous testing is sometimes a necessary reality. Information from data-rich species and fisheries can be used to inform 'assessments' for data-poor species and thereby develop appropriate control rules. This can be done through formal methods such as the 'Robin Hood' approach or less formally by grouping species into "baskets" and basing management decisions on one appropriate member of the group. Stakeholder knowledge and buy-in to the process is essential when species or fisheries are data-poor. Use of this information, however, needs to be constrained by policy decisions such as pre-specified performance standards. There will always be a trade-off between the cost of data collection and the value of a fishery; in this paper we highlight that this does not have to be a major impediment to the development of realistic and sufficiently precautionary controls rules for the management of data-poor species and fisheries.

The Accuracy of Catch Estimates from the British Columbia Groundfish Integration Project
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The British Columbia fishing industry and the Department of Fisheries and Oceans Canada introduced 100% monitoring of the commercial groundfish hook-and line fisheries in April 2006. The monitoring system was introduced as part of a three-year pilot integration project. Among other elements, the system includes cameras and GPS-linked winch sensors mounted on all boats, 100% dockside monitoring of piece counts and weights, and 100% retention of all rockfish. Using catches of yelloweye rockfish as an example, this study examines the accuracy of the catch estimates produced by the monitoring program from April 2007-March 2008. The monitoring provides two separate official estimates of total catch in pieces (retained and discarded) by adding the catches for all trips as recorded in either the fisher logs or validated during dockside monitoring. We derived a third and independent catch estimate from the data output of the random review of the video footage. This review process randomly selects 10% of the events from each trip and enumerates the catch of each species from these events. Originally intended as an audit check on the veracity of the fisher logs, the review data can be used to provide an unbiased estimate of the mean and the variance of catch per event which can then be expanded to total catch. Since the data are collected at the moment of capture, unlike the official estimates from fisher logs or dockside monitoring, the video-based estimate is unaffected by misreporting of discards or dumping. Fortunately, the analysis indicated close agreement among the three estimates. This allows managers and industry to assume that the official estimates, which are essential for the day-to-day accounting in the fishery, provide reasonable estimates of catch and that there is negligible unreported discarding and dumping overall. The video-based estimate provides an unbiased catch estimate, rare in fisheries monitoring, which can capture the extent to which official catch accounting system is biased.

Fisher-Collected Sampling Data: Lessons From the New Zealand Experience
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The New Zealand fishing industry has adopted a strategy of using fishers to collect biological sampling data from their fisheries, usually on a voluntary basis. This is an approach that can be adopted by data-poor fisheries to obtain data that would otherwise be not available. This paper describes the history of this approach over the 15 years that it has been used, including the types of fisheries where this approach has been applied. It also describes the designs employed, how these data have been used in stock assessment and fisheries management situations, and some of the problems encountered in administering these programs. The paper concludes that, while these programs need supervision and support in order to succeed, the benefits that can accrue are considerable. These include an inherent dynamic design that should ensure good representation of the fishery and the involvement of the fishers in collecting the data that are used to manage their fishery.

Complementary Sampling Methods to Inform Ecosystem-Based Management of Nearshore Fisheries

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Area-based fishery management and ecosystem-based management strategies are presented as beneficial marine resource management tools, but require finite information about the structure and function of ecosystems to evaluate populations and describe ecosystem effects of fishing. The required information is not likely to be obtained from sporadic, fishery-dependent data collected from data-poor fisheries, and it is unlikely that there will be funds in the near future to conduct extensive fishery-independent surveys. This situation has led to an interest in relating or combining information from a variety of disparate sampling methods. From 2003–2006, we investigated relationships between estimates of catch-per-unit-effort (CPUE) and abundance generated from typical nearshore commercial fishing operations and estimates of density and abundance derived from SCUBA surveys in the same locations. Relationships among CPUE estimates from different sampling methods were found to be statistically significant in the case of many of the common species sampled across sites in Carmel Bay, CA. The compounding effects of within-sample variance and the error associated with regression equations, however, would result in poor confidence in values translated from one sampling method to another. Our results indicate that different sampling methods may each provide reasonable estimates of population trends, but are sufficiently different and variable so as to preclude the use of a scaling factor to standardize population estimates among sampling methods. A sampling program that benefits from the complementary strengths of both fishing gear and SCUBA sampling will likely result in the most comprehensive description of nearshore fish assemblages.

Improving Compliance and Enforcement in Data-Poor Fisheries

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One of the principal challenges of fishery management is securing acceptable levels of compliance with the regulations and management measures implemented in a fishery. A major part of the challenge is that fishery enforcement is expensive, accounting for a quarter to over a half of all public expenditures on fisheries management. This raises two key questions: Are there are ways to improve the cost-effectiveness of traditional enforcement in data-poor fisheries? Are there ways to secure compliance without heavy reliance on costly enforcement? To address these issues, this paper explains the framework for assessing the performance of fisheries compliance and enforcement programs, and for identifying ways to improve compliance and to strengthen enforcement. Based on this framework and supporting evidence, we derive a set of general policy prescriptions for smart compliance policy. Smart compliance policy involves promoting voluntary compliance, targeting frequent violators, maximizing the deterrent of sanctions, accounting for non-compliance in setting regulations, and implementing of enforceable regulations.

Data Requirements for Integrating Socioeconomic Considerations into Regulatory Analysis: Examples from California Commercial Fisheries

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An important role of fishery regulatory analysis is to provide managers with information regarding potential implications of their decisions before those decisions are made. The ability to diagnose management problems, devise customized solutions to these problems and anticipate the implications of alternative solutions is highly contingent on the types of data available. This paper describes various commercial fishery data sources – landings receipts, observer and logbook programs, port sampling programs, vessel registration files, State and Federal permit files, and socioeconomic data collections – and potential enhancements to these sources that may be beneficial for evaluating socioeconomic effects in the context of regulatory analysis. For illustrative purposes, California fishery data sources are used as a framework for considering uses of available data and contemplating future data possibilities. Various types of vessel and dealer behavior that may be relevant to regulatory analysis are depicted using landings receipt data. Recommendations are made regarding the need for additional data elements that could expand the scope and depth of current regulatory analysis and suitable venues for their collection.

Collaborative Research: An Effective Way to Collect Data for Stock Assessments and Evaluate Marine Protected Areas in California

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Collaborative fisheries research (in contrast to cooperative research) is based on the intellectual partnership between scientists and fishermen, and is an effective way to collect data for stock assessments and evaluate marine protected areas. Collaborative fisheries research is discussed in the context of co-management of marine resources and how it contributes to a more democratic form of fisheries management. Many benefits result from working together including 1) the incorporation of fishermen knowledge and expertise into the management process, and 2) the development of shared perspectives on the status of marine resources. The California Collaborative Fisheries Research Program was formed in 2006 to participate in the monitoring of marine reserves established through California's Marine Life Protection Act. This program can serve as a model for other areas on how to implement collaborative research, and that doing so will contribute significantly to the realization of community-based, co-management of marine resources.

Setting Harvest Guidelines for Sedentary Nearshore Species Using Marine Protected Areas as a Reference

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Classical approaches to fisheries management rely on methods that are not conducive to assessing stocks for which little historical data on catch and effort exist. Moreover, most nearshore rocky reef species exhibit spatial variation in harvest pressure and demographic rates, further limiting traditional stock assessment approaches. With the ever-increasing implementation of Marine Protected Areas (MPAs), there is great potential for improving decision-making in management through comparisons of fished populations with those in MPAs. Here we conduct a management strategy evaluation (MSE) of a novel approach using MPAs as a reference area to set sustainable harvest levels in a decision tree framework. We examine this model for a hypothetical population of grass rockfish (*Sebastes rastrelliger*) in California by introducing process, observation and model uncertainty for a variety of possible scenarios, and compare these scenarios with the current precautionary approach now used to manage this species. Our model consistently improves total catch while maintaining total biomass and potential egg production at levels well within acceptable thresholds of management. We suggest further exploration of this MPA-based management approach and outline a collaborative research program in the California Channel Islands that may well be suited for testing an experimental management procedure.

Developing British Columbia's Inshore Rockfish Conservation Strategy.

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The inshore rockfish hook and line fishery in British Columbia is diverse with participants in directed commercial, recreational and Aboriginal fisheries, as well as other incidental fisheries coastwide. Expansion of the fishery outpaced management's effort controls and catch quotas were implemented in the early 1990's. Conservations concerns largely based on life history traits, resulted in restrictions to the directed fishery but other fisheries remained unmanaged. A growing mismatch between the demands of fishery management and the difficulties of inshore rockfish stock assessment led to the development of a conservation strategy in 2001. The strategy included four components: comprehensive catch monitoring, dramatically reduced fishing mortality, extensive fishery closed areas and improved stock assessment and monitoring. Targets were met by reducing fishing mortality by 50% and 75% by 2002 and 2003 for the harvesting sectors. Research survey programs were reinstated by the provision of funds in 2003. An intricate catch accounting and monitoring proposal from industry set the rules in a pilot groundfish licensing integration program launched in 2006. Progress continues to be made on this difficult task. Closed areas were implemented in 20% and 30% of rockfish habitats coastwide in 2007. Key to the development of the strategy was the consultation process. Consensus-based decision making within DFO and the organization and commitment of industry participants contributed to this success. Open communication and respectful conduct brought participants to the table and kept them engaged. Without the consultation process and the benefits from this exchange, the conservation strategy would not have been possible.

Appendix 6: Suggestions For Managing Data-Poor Fisheries Summaries From All Workshop Sessions

Group 1: Nearshore Invertebrates (Trap Fisheries)
Suggestions For Managing Data-Poor Fisheries

Management Suggestions for the Spiny Lobster Fishery

- Need to look at current data to see what is going on with the lobster fishery before deciding on management actions.
- Bring all stakeholders together to discuss management options.
- Improve recreational catch data (report cards will help).
- Implement restrictions on hoop nets: ban their use at night or all together.
- Develop franchises permitting a certain number of traps in certain areas in exchange for collaborative data.
- Use technological approaches to capture data (e.g., video monitoring).
- Collect size frequency data.
- Rather than using transferable permits, establish an apprenticeship program.
- Use data from commercial fishermen logbooks.
- Help recreational fishermen become "research fishermen" (e.g., measuring lobster).
- Look at catch rate by area; evaluate the spatial content of the current data.
- Have escapement vents on traps. Let lobsters out before they are brought on board so that there is less handling of lobsters.
- Get size at maturity information.
- Need to limit the number of recreational (hoop net) fishermen or just let them use one trap.
- Gain a better understanding of the fishery:
    - How much of the fishery belongs to commercial fishermen?
    - To recreational fishermen?
    - To the US? To Mexico?
- Use control measures such as: trap and hoop net limits, slot limits, adjust escape rings, shorter season.
- Improve data by conducting collaborative research.
- Create "research fishermen" by encouraging fishermen to be a part of the solution.
- Manage with all stakeholders as part of the process
- Improve logbooks
- Create a recreational fishing database

Management Suggestions for the Spot Prawn Fishery

- DFG should not do anything unless the CPUE declines (compare past CPUE with now).
- Need to collect basic information to check up on the state of the fishery.
- Need to maintain a feedback loop with fishermen and use the data that they are providing.
- Gather spatial data to use in the discussions of establishment of MPA.
- Need additional biological data on spot prawns, and need to inform fishermen of the results.

Management Suggestions for Managing Any Data-Poor Fishery

- Need to standardize logbook forms among fisheries, preferably electronic.
- Need to look for cross cutting/rapid assessment techniques such as analyzing data from multiple fisheries in a standard way.
- Starting at the statewide level, only analyze a resource discretely if that fishery stands out.
- Determine if there is enough current data to assess the susceptibility of the data-poor fisheries.
- If data are lacking, perhaps use data from other areas for the same species.
- Once CPUE data are calculated, look at other approaches.
- Need to refrain from catching fish before they reach maturity.
- Need a "low-down dirty estimate," all monitoring strategies have a down side, but they may be the best information available.
- Need to make sure that reference areas share similar habitat with MPAs for monitoring and assessment.
- Need to develop multiple types of methods for estimating abundance trends
- Need to compare two independent methods to see if the data make sense (e.g., independent and dependent methods).
- Create an MPA to protect nursery or spawning grounds where appropriate.
- Put together a decision tree to establish a hierarchy of different techniques.
- Develop clear, over-arching, measurable management objectives for each fishery.
- Complete standard analyses using existing data to better understand the status of the fisheries and develop cost effective means for doing it (e.g., data analysis group).
    - Collect data where needed to conduct these analyses for each fishery.
- Explore collaborative management programs, using collaborative research and monitoring.
- Develop simple indicators (biophysical, economic, and social) of stock status.
- Seek improvement of reporting of landings data (need more detail).
- Create a standardized approach to characterizing different fisheries.

Group 2: Nearshore Invertebrates (Dive Fisheries)
Suggestions For Managing Data-Poor Fisheries

Management Suggestions Related to All Nearshore Invertebrate Fisheries

All Nearshore Invertebrate Fisheries:

- Develop a way to give communities sense of ownership and engagement in resource.
    - Local community should have rights and privileges to manage fishery.
        - Develop a way the community can benefit from visitors access.
        - One example is the Trout management in some areas. Community set up trout lodges. Locals don't eat them; harvest is just for tourists.
- Take zonal approach to alleviate compaction on the resource.
- Have advisory committees help with data collection.
- Need to develop incentive for recreationalists to be good stewards of resource.
- Tag every animal caught.
    - Use different color tags to specify region.
    - Tags will give a quick visual way of improving enforcement and data flow.
- Main charge is to provide recommendation on how Total Allowable Catch (TAC) would work.
    - There are different catch/risk scenarios for Management approaches.
- Collect data before abalone fishery is re-opened in Southern California.

Multiple Species Fisheries

- Develop relationships among fishing groups
    - Will bring to the table if given the chance
    - Must begin with trust
- Focus on starting point
    - Tiered planning to develop complexity over time
    - People can come in at entry level tier, and develop over time
    - Critical to provide data back to them, or will not last
- Feedback, they can see their stuff, what they collected
    - All issues about not wanting other guy to see data
        - This is almost like a confessional
        - If you pay the price and collect your data, participation just shot up
- Would let them place any condition they place on the relationship, and let it grow

Small-Scale Invertebrates Fisheries

- Incorporate Public involvement in counts, collection, reporting of data
    - Like "Adopt-A-Clam-Bed"
- Transform local harvesters into stewards
- Caleta Plan (in Chile) was about giving exclusive access rights in return for developing the collection methods and data reporting
    - Every species ended up getting included

Management Suggestions for Recreational Invertebrate Fishery

Northern Recreational Fishery:

- Develop zonal approach.
    - Current tagging program could be adapted to support this approach.
- Enact short recreational seasons to reduce poaching and bolster enforcement.
- Identify people who have local interest to assist in monitoring, enforcement (honorary wardens, stewardship, etc.).
- Provide more posted notices regarding CalTIP at site "Hotspots".

Southern Recreational Fishery:

- Initiate multi-species (e.g., abalone, sea urchins, etc.) commercial diver surveys (easy to incorporate new benthic species into commercial surveys).
    - Surveys could collect information on small-scale fisheries such as snails.
- Continue collaboration between fishers and managers to explore fishery options.

Small-Scale Invertebrate Fisheries (snails, clams, limpets):

- Consider blanket closures for species that are highly vulnerable, or link to people in existing fishing sector/community who has responsibility for multi-species surveys.
- Manage fisheries cooperatively and multi-specifically at local scale.
    - Link to people in existing fishing sector/community who has responsibility to develop the resource.
- Design management strategies in a way to transform local cooperative harvesters into local stewards.
- Consider Chilean Caleta Model:
    - Employs local fishing groups with responsibilities for data collection and management (i.e., co-management, collaborative management). This may work well for recreational fisheries.
- Consider Reef Check Model:
    - This is an example of group that has been able to empower interested parties to collect data and preserve resource.

Management Suggestions for Sea Urchin Fishery

- Use Chilean fishery as an example
- Build on and expand existing efforts to develop local capacity and partnerships.
- Explore local community strategies:
    - Develop collaboration between California DFG and local fishing community.
        - Use collaboration to develop management and data collection (low cost, low maintenance).
    - Encourage grass roots efforts (empowering community) to minimize need for further government regulations.
    - Encourage fishermen's cooperative groups to work together on harvesting and marketing.
- Stimulate or support local fishermen's organizational efforts.
- Develop apprenticeship program (building future of fishing community).
- Foster cohesive industry groups within local (port) areas.
- Do capacity goal analysis.

    - Explore whether or not there is a need to reduce capacity.
- Explore pathways for sharing management authority over specific resource with local communities.
- Explore legal sanctions for area-based management.
- Explore Dedicated Access Privilege Program (DAPP)/Quota Fisheries for social (not biological) reasons
- Dedicated access privilege (quota fishery) provides incentives for building commitment to long-term data collections and proactive management.
    - Tradable days should be considered as a starting place to allocate days to consider overall impact
- Encourage formation of groups of divers to work collaboratively under some form of collective Dedicated Access Privilege Process (DAPP) in certain areas could achieve the same objective (TURF/zonal management).
- Develop case studies with TURF or zonal management along coast .
- Increase data collection in Santa Barbara where fishery is focused (about 80% of fishery).

Management Suggestions for the Cucumber Fishery

- Conduct and evaluate Reef Check type surveys and compare with a few scientific surveys (e.g., Laura Roger-Bennet's program).
- Use recruitment collectors.
- Consider zonal management as an index of populations; works with long term time data collections.
- Use collectors to determine when recruitment occurs in each region.
- Explore dedicated access rights, privileges, and links to community responsibility, for collection of abundance data.

Management Suggestions for the Clam Fishery

- Initiate local involvement in data collection by encouraging fishermen to put down a grid, dig up some clams, and capture the data (e.g., Elkhorn Slough groups, "adopt-a-clam bed", the Great American Fish Count).

Management Suggestions for Managing Any Data-Poor Fishery

- "Rome wasn't built in a day" We need to evolve with bottom-up engagement.
- Develop relationships with trust. "It's all about trust."
- Processes – consultative, data collection, assessment, management
- Communication – "Needs to be two-way"
- Need to develop for incentives fishermen to get involved.
- Make sure management is reality-based.
- Be flexible and foster innovation.
- Do not front load, start simple.
- Provide ongoing opportunities for feedback and input.
- Data rich scenarios can be used to provide information about what data/indicators help inform and which data should be collected for other areas/fisheries.
- Determine what dedicated access privileges works best with state and community goals to align individual economic incentives with collective conservation goals.

Group 3: Nearshore Invertebrates (Seine, Trap, Trawl)
Suggestions For Managing Data-Poor Fisheries

Management Suggestions for Dungeness Crab Fishery

- Determine if majority of fishermen want trap limits. If so, reduce amount of gear used per vessel.
- Start south and north season at same time.
- Enact trap limits.
- Utilize size, sex, and season for management of recreational fishery.
- Integrate/institutionalize recreational fishery management with commercial management.
- Whatever is going on for commercial should be the same for recreational
- Do not assume that fishing is doing all the damage.
- Identify: what other factors are affecting mortality, sources of decline.
- Recognize that Dungeness crab populations are difficult to predict (rather than "impossible to assess").
- Investigate Individual Transferable Quota (ITQ) system. Need to acquire information on pounds/pot/season.
- A mixture of management systems may be more success rather than one specific option
- Review management strategies.
- Consider trap limits.

Management Suggestions for the Market Squid Fishery

- Set daily trip limits.
- Refine escapement protocol.
- Find a way to meet FMP capacity goals (e.g., ITQ or catch limits).
- Consider eliminating light boats.
- Track 2-ton live bait fishery.
- Need light boat enforcement of weekend lighting.

Management Suggestions for Prawn, Pink Shrimp, Sea Cucumbers Fisheries

- Pacific States should set up data sharing.
- Develop central data repository and analysis system.
- Acquire log information and CPUE data.
- Develop trust based, informal permit transfer.
- Develop permit bank to attach conditions to transfer permits to guarantee good conditions of fishery.
- Accommodate understanding of existing fishing techniques and social structure as management strategy for protecting fisher
    - Develop ways that fishermen (boats and divers) can work together to address over-fishing through cooperative efforts to protect resource. This should be a discussion among fishermen with no formal regulations.

General Suggestions for Managing Any Data-Poor Fishery

- Use available data to refine management rules; target research to improve harvest control rules.
- Develop programs designed to increase collaboration and cooperation of fishermen.
- Establish fishery resource information system database of existing data archival information and insure that future data are protected.
- Increase funding for research.
- Acquire a collection of socioeconomic data for background information to affect community sustainability.
- Use catch data to give insight into socioeconomic characteristics of fishery.

Group 4: Nearshore Finfish (Commercial Fisheries)
Suggestions For Managing Data-Poor Fisheries

Management Suggestions for the Hook and Line, Longline-Fillet Fishery

- Don't be constrained by Maximum Sustainable Yield (MSY). Index of replacement or abundance is appropriate. (11)
- Use MPA baseline monitoring to collect data; use MPA on experimental basis. (12)
- Explore criteria to go to data-sufficient (vs. data-rich); need to do economic analysis. (5)
- Identify index sites and use inexpensive surveys to expand for regional management. (8)
- Close or severely restrict small lower-value fisheries. (0)
- Monitor mean length (10) and use MPAs in experimental basis.
- Explore alternative dedicated access privileges (CDFG with stakeholders explore this) (4)
- Explore co-management (i.e., Ted Ames example).
- Improve quality of CPUE data (logbooks).
- Look into mobile-phone data collection (more timely data-reporting).

*Numbers in parenthesis (#) indicate amount people out of seventeen participants in the group who voted for the suggestion.

Management Suggestions for the Live-Fish Fishery (Specifically)

- Improve quality of CPUE data (i.e., logbook program). (7)
- Don't be constrained by MSY. Index of replacement or abundance is appropriate. (12)
- Use MPA baseline monitoring to collect data. (9)
- Explore criteria to go to data-sufficient (vs. data-rich); do economic analyses. (3)
- Identify index sites and use inexpensive surveys to expand for regional management. (8)
- Close or restrict small lower value fisheries. (0)
- Monitor mean length of catch (may be very difficult). (4)
- Explore alternative dedicated access privileges. (5)
- Find more creative means to collect biological data. (8)
- Look into mobile-phone data collection (more timely data reporting). (0)
- Explore co-management. (8)
- Find ways to collect biological data (issue with live fish marketability) (2)

*Numbers in parenthesis (#) indicate amount people out of seventeen participants in the group who voted for the suggestion.

General Suggestions for Managing Any Data-Poor Fishery

- Clearly articulate goals and objectives for specific fisheries.
- Goals/ objectives need to be realistic; need to match the available data.
- Articulate and diagram fisheries management process for lay audience.
- Diagram process of recommendations path to implementation.

- Explore providing incentives to fishermen for gathering data while they are fishing (identify some things important to fishermen). Attend meetings and participate in management/ regulation setting process.
- Utilize triage technique: identify most vulnerable species. They should receive most detailed assessment, others less.
- Consider using AIM process. (Chris Legault)
- Use sonar to evaluate fish populations.
- Implement tools using Marine Protected Areas (MPAs); pay attention to MPA work.
- Surveys are important.
- Avoid regulations that lead to race for fish.
- Rank data importance, devise mechanism to integrate.
- Purchase product from fishermen to gather data.
- Systematically and hierarchically for each fish in the assemblage, evaluate harvest/catch data. (Does it provide adequate info?)
    - Look at whether effort data are adequate. If data are not adequate, how can we improve it?
    - Consider whether catch at length/catch at age data is sufficient.
- Improve port sampling data collection.
- Implement Paul Starr's approach; fishermen collect data.
- Improve access to federal observer data for managers and devise way to preserve confidentiality.
- Improve nearshore bycatch data availability.
- Partial observer data will be biased, if there is an incentive to bias it.
- Compare use of minimal data sets with new methods (Prince). Evaluate what works best.
- Evaluate minimum data assessment vs. robust assessment as a possible tool for the future.
- Maximize number of fisheries covered in surveys.
- Tailor surveys to geography and habitat.
- Revise logbooks to include crew information and economic data; link to landing receipts.
- Full economic valuation of recreational and commercial sectors at port level.
- Give consideration to sustainable fishing communities including all components (fishermen, infrastructure, etc).
- Integrate port meetings in developing/changing management regulations.
- Consult with fishermen on design of socioeconomic data surveys.
- Economic data provided can be biased if unclear how can benefit fishermen, will try to influence management regulations.
- Commercial fishermen may have incentive to participate in regional data collection if told may benefit them (their region), if California goes to regional management.

Refinement of management strategies

- Use MPA baseline monitoring to collect data/conduct experiments (4)
- Even if Maximum Sustainable Yield (MSY) can't be estimated, there is some value in estimating index of abundance and index of replacement for indicators of sustainability (e.g. FLEP, SPR) (7)

- MSY is not appropriate as a management target for some data-poor fisheries for which MSY or its proxies cannot be obtained In such cases adequate management approach is to aim to maintain current abundance or increase this at a rate which does not require substantial reduction of the fishery (5)
- Monitor catch at length (8)
- Identify index sites and use inexpensive surveys to expand for regional management (6)
- Explore trade-offs of going from data poor to data-sufficient vs. to data rich, including biological vulnerability, management costs, and fisheries opportunity (2)
- Explore alternative dedicated access systems with stakeholders (5)
- Close or restrict some small, low value fisheries (0)
- Improve quality of CPUE data- logbooks (6)
- Explore co-management (3)
- Look into mobile phone data collection/ more likely data reporting (1)

*Numbers in parenthesis (#) indicate amount people out of twelve participants in the group who voted for the suggestion.

Group 5: Nearshore Finfish (Recreational Fisheries)
Suggestions For Managing Data-Poor Fisheries

Management Suggestions for Spear Fishery

- DFG should consider spending less time and effort on managing these fisheries. There is no evidence of a problem.
    - DFG should learn more about the nature and extent of spear fisheries such as fishing effort (by species and areas), spatial distribution of fishing effort and mortality, size and sex composition of the catch and then take appropriate action.
- DFG should consider development of specific angler organizations to put spear fishermen into the arena of allocation and dedicated access issues.
- Use a vulnerability index on a regional basis to evaluate adequacy of existing data sets.
- Incorporate use of cell phone technology (voluntary system) to gather information about catches.

Management Suggestions for the Net Fishery

- Do nothing (status quo) to the net fishery.
- Investigate (inventory) habitat availability, quality, and threats, and then consider management based on the evaluation.
- Investigate role of fish in ecosystem and build a model.
- Increase educational efforts in lieu of additional regulations.
- Increase public education to encourage voluntary reduction in catch (i.e., catch & release).
- Investigate models (with environmental variables) to develop a proxy for abundance

Management Suggestions for Hook & Line Fishery

- DFG should develop a process to clearly define management goals and strategies, including:
    - Determine management approach – single species, complexes, and/or Ecosystem-Based Management (EBM).
    - Improve education of need and rationale for management.
    - Improve method, transparency, and rationale for management goals.
- DFG should create a system of co–management that includes all stakeholders, including:
    - How to develop incentives for stakeholders to work together as associations
    - How to integrate user groups into all aspects of the data, management, and enforcement process
    - How to build capacity (e.g., leadership) for co–management in the fisheries
- Involve groups in dedicated access privileges
- DFG should work to increase the understanding of recreational fisheries:
    - Social and economic (e.g., who, what, where, when, how often, how much, costs, etc.)
    - Biological (catch, effort, mortality, age, sex composition, etc)
- DFG should consider increasing the explicit area–based management approaches.

- DFG should pursue ways to integrate state management approaches with federal fishery management regulations and MPAs and other spatial management tools.
- DFG should investigate fishing gear interactions/modifications/development to spread fleet out and reduce impacts on specific species.
- Using collaborative research approaches when appropriate.
- Account for MPAs in resource management and regulations.
- Encourage/promote catch and release as a conservation measure.
- Get better estimates of catch and effort (consider using overflights for effort).
- Get better information from private boat fleet (effort, catch, bycatch).
- Revise logbooks to better capture actual fishing locations and times (DFG blocks are too large).
- Evaluate trade-offs between catch rates, quotas, and economic benefits of a longer season.
- Inventory existing data sets (e.g., state, federal, university, private) to evaluate amount, quality, and usefulness of data for management.
- Create and use data sets from MPAs to evaluate stock status.
- Use Chris LeGault's Index method to evaluate stocks.
- Use Vulnerability Index to set priorities for analyses of species.
- Collect more information about habitat-related catch and effort data.
- Use standard CPUE and length-frequency analyses to evaluate population trends.
- Work to develop an advisory process for obtaining meaningful advice from all interested groups (different fishing sectors, NGOs, public, landowners, etc). This will provide an important communication link between DFG and client groups, and build capacity for leadership in the industry
- Develop management objectives for the recreational fishery and vet through the advisory process.
- Collect data using video at boat ramps.
- Conduct over-flight for boat information and effort.
- Use aerial drones.
- Put GPS/VMS systems on boats.
- Use portable electronic tablets for samplers to use, more efficient, and use electronic logbooks.
- Develop requirements for anglers to understand more about species (e.g., differences between species).
- Create and implement an on-line test for license.
- Develop collaborative fisheries research programs across the state.
- Standardize protocols.

General Suggestions for Managing Any Data-Poor Fishery

- Increase catch and effort data collection.
- Develop means and commitment of integrating collaborative research data into resource assessment and management (memorandum of understanding?).
- Vulnerability index may be helpful in managing data-poor fisheries.
- Need to evaluate how MPAs affect fisheries management.
- Need to clearly define management goals and objectives.
- Need to create a system of co-management.

- Need to evaluate cost/benefit of sampling fisheries (e.g., is it necessary to sample grunion fisheries?).
- Evaluate sources of mortality to evaluate difference between natural, fishing, human-induced environmental (e.g., pollution).
- Use Management Strategy Evaluation approach to evaluate management actions.
- Keep collaborative studies going.
- Management Strategy Evaluation (MSE) can be used to push data through evaluation process can be good (used in real estate/development industry) approach.
- Revise logbooks to better capture actual fishing location and time, block size is too large.
- Evaluate trade offs between catch rates and season.
- Inventory existing datasets (within agencies and universities).
- Apply standard CPUE and length frequency to evaluate trends.
- Identify new techniques
- Determine what DFG wants to do: keep charter boats in business or out of business or use Individual Quota System in charter boat fishery?

Appendix 7: Specific Techniques Suggested at the Managing Data-Poor Fisheries Workshop

This list was compiled from papers submitted as well as presentations and discussions that occurred at the Managing Data Poor Fisheries Workshop, December 2008. Abstracts are provided in alphabetical order by author in Appendix 5 of this document. The referenced draft manuscripts and PowerPoint presentations are available in Appendix 9 (Supplementary Data CD).

Data Collection Techniques

- Cost-benefit analyses of management costs versus value of fishery
  - Bentley and Stokes, presentation and abstract/paper

- Value/Assessments of data collected by fishermen during fishing operations
  - P. Starr, presentation and abstract/paper
  - Culver et al., abstract/paper
  - Schroeter et al., abstract/paper
  - Wendt and R. Starr, abstract/paper

- Standardized collaborative fisheries research
  - P. Starr, presentation and abstract/paper
  - Conway et al., abstract/paper
  - Culver et al., abstract/paper
  - Schroeter et al., abstract/paper
  - R. Starr et al., abstract/paper
  - Wendt and R. Starr, abstract/paper

- Review of various data collection methods
  - Mason, abstract/paper

- Post hoc analyses of catch data based on oral histories of fishermen
  - Yamanaka and Logan, abstract

- Data collection utilizing electronic technology
  - On board video systems (electronic vessel monitoring systems) to record catch
    - McElderry and Gislason, abstract/paper
    - Stanley and Olsen, abstract/paper
  - Electronic logbooks for location information, lat/long, effort, socioeconomic data
  - Assessment of fishing effort by counts of active fishing vessels through use of video cameras on landing docks

Alternative Stock Assessment Techniques

- Length-based assessment techniques (e.g., fraction of lifetime egg production (FLEP))
    - Botsford, presentation
    - O'Farrel and Botsford 2006, *Ecological Applications*

- Application of an index method (AIM)
    - Legault, presentation
    - Rago and Legault, abstract/paper

- Density Ratio Method
    - McGilliard, presentation

- Reference Points
    - Management reference points
        - Brooks et al., abstract/paper
        - Honey et al., abstract/paper
    - Length-based reference points
        - Cope and Punt, abstract/paper
    - Depletion abundance estimator
        - Maunder, abstract/paper

Socioeconomic Techniques

- Socioeconomic analyses of existing data
    - Thomson, presentation and abstract/paper

- Data Envelopment Analysis (DEA) or other quantitative model to rank commercial fisheries involvement by communities (socioeconomic profiling)
    - Norman et al., abstract/paper

Statistical Techniques & Models

- Bayesian-based multi-criteria assessment (MCA) to integrate biological, social and economic information to inform management decisions
    - Harte, presentation
    - Harte et al., abstract/paper

- Flexible software for the Bayesian analysis of complex statistical models using Markov Chain Monte Carlo (MCMC) methods
    - WinBUGS (Bayesian inference Using Gibbs Sampling) by David Dietz

- Management Strategy Evaluation (MSE)
    - Butterworth, presentation
    - Butterworth et al., abstract/paper;
    - Dichmont, presentation
    - Dichmont and Brown, abstract/paper
    - Smith, presentation
    - Smith et al., abstract/paper
  - Decision Tree Model
    - Prince presentation and abstract/paper
    - Wilson et al. abstract/paper

- Vulnerability index to evaluate different catch per species and per regions of the state to look at ways to examine variance in other datasets, inform baseline marine protected areas (MPA)
    - Cope, presentation
    - Field et al., abstract/paper

- Models for integrating social science into fisheries management
    - Hall-Arber presentation
    - Hall-Arber et al., abstract/paper

- GIS layering and analysis (use patterns of marine areas)
    - Petterson and Glazier, paper/abstract

- Ecosim/Ecopath models (http://www.ecopath.org/)

Alternative Management Strategies

- Zonal Management
    - Ames, presentation and abstract/paper

- Procedural Management
    - Bentley & Stokes, abstract/paper

- Community-based Management (small-scale management)
    - Hoyt, presentation
    - Moore & Sowles, abstract/paper
    - Bloeser et al., abstract/paper

Appendix 8: List Of Acronyms

Acronym	Meaning
AIM	Application of an Index Method
ARMP	Abalone Recovery and Management Plan
CalCOFI	California Cooperative Fisheries Investigations
CCFRP	California Collaborative Fisheries Research Program
CDFG (or DFG)	California Department of Fish & Game
CFGC (or FGC)	California Fish & Game Commission
CPFV	Commercial Passenger Fishing Vessel (Recreational Charter Boats)
CPUE	Catch per unit effort
CRFS	California Recreational Fisheries Survey
CSIRO	Commonwealth Scientific and Industrial Research Organization
DAPP	Dedicated Access Privilege Program
EBM	Ecosystem-Based Management
EDF	Environmental Defense Fund
EIA	Economic impact assessment
FCMA (or MSA)	Fishery Conservation and Management Act (or Magnuson-Stevens Fishery Conservation and Management Act)
FLEP	Fraction of lifetime egg production
FMP	Fishery Management Plan
GPS	Global positioning system
HMS	Highly Migratory Species
IQ	Individual Quota
ITQ (or IQ)	Individual Transferable Quota (or Individual Quota)
MCMC	Markov Chain Monte Carlo methods
MLMA	Marine Life Management Act

Acronym	Meaning
MLPA	Marine Life Protection Act
MPA	Marine protected area
MRFSS	Marine Recreational Fisheries Statistical Survey
MSE	Management Strategy Evaluation
MSY	Maximum sustainable yield
NAFTA	North American Free Trade Agreement
NGO	Non-governmental organization
NMFS	National Marine Fisheries Service
NOAA	National Oceanic and Atmospheric Administration
OMB	Office of Management and Budget
OPC	Ocean Protection Council
PDA	Personal digital assistant
PDO	Pacific Decadal Oscillation
PFMC	Pacific Fisheries Management Council
PISCO	Partnership for Interdisciplinary Studies on Coastal Oceans
PSMFC	Pacific States Marine Fisheries Commission
RCA	Rockfish Conservation Area
ROV	Remotely operated vehicle
SPR	Spawner per recruit
TAC	Total Allowable Catch
TURF	Territorial use right in fisheries
UC	University of California
UCSB	University of California, Santa Barbara
VMS	Vessel monitoring system

Appendix 8: List Of Acronyms