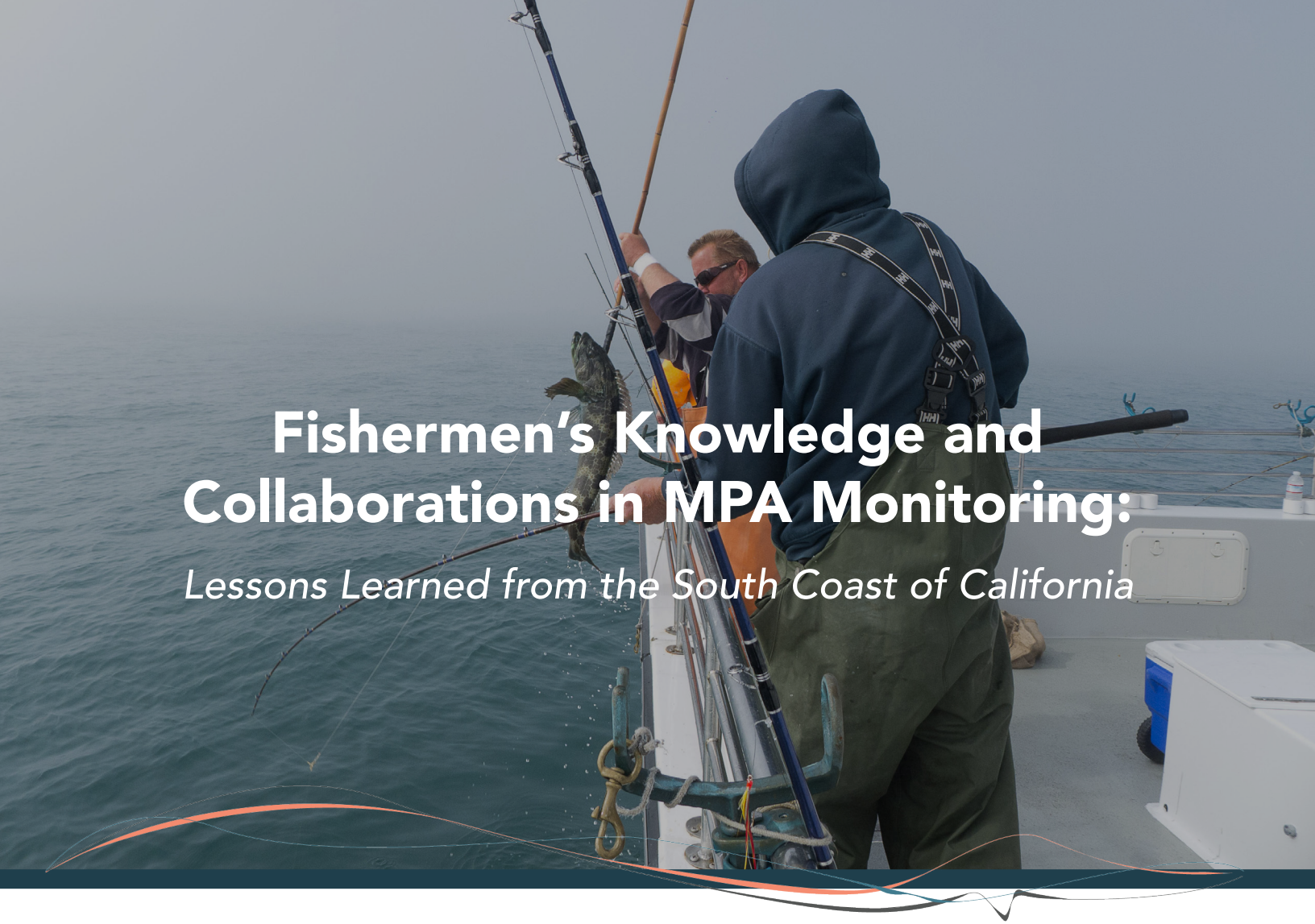

Fishermen's Knowledge and Collaborations in MPA Monitoring:

Lessons Learned from the South Coast of California

CALIFORNIA OCEAN SCIENCE TRUST

Authored by
California Ocean Science Trust

March 2017

Table of Contents

About this Document

This report provides lessons learned from three projects that utilized fishermen's knowledge in the South Coast region during the Marine Protected Area (MPA) baseline phase between 2011-2015. The report is written for anyone who works with or is intending to collaborate with fishermen, including academics, non-governmental organizations, consultants, and fisheries managers.

It was developed by Ocean Science Trust, with support from Strategic Earth Consulting, and informed by South Coast fisheries members, as well as a brief literature review. Ocean Science Trust also consulted with California Department of Fish and Wildlife staff in the development of this report.

California Ocean Science Trust is a non-profit organization based in Oakland, California. Ocean Science Trust works with scientists, citizens, managers and policy-makers to build shared understanding and trust in science for healthy, resilient, and productive coasts and oceans. More information is available at http://www.oceansciencetrust.org.

Contact

Leila Sievanen, Ph.D.
California Ocean Science Trust
leila.sievanen@oceansciencetrust.org

Suggested Citation

Fishermen's Knowledge and Collaborations in MPA Monitoring: Lessons Learned from the South Coast of California. California Ocean Science Trust, Oakland, CA USA. March, 2017.

1 Introduction

Before the 20th century, all California fished species were managed solely using local knowledge. Archaeologists have documented a 10,000-year fishing history on the Central Coast of California (Jones et al. 2016). By the 19th century, Europeans and Asians were also controlling various fisheries, many of which were species they fished for in their home countries (McEvoy 1986). For example, Portuguese whaled; Chinese fished for squid and abalone; and Italians targeted sardines and other coastal pelagic species. Each group carried on business in relative isolation from the others, with their own markets, fishing methods, and social organizations (McEvoy 1986).

Even though conventional science has become the primary source of knowledge for marine management in California, local knowledge still plays an important role. Fishermen's knowledge (FK) and skills are increasingly being incorporated into marine science and policy through collaborative research projects. Despite the growing popularity of using FK, there has been little analysis of the elements that lead to the success or failure of these efforts, or a suggested framework for how and when to include fishermen and their knowledge in research projects (see Yochum et al. 2011 for an exception). There has also been limited consideration of the role of FK in MPA monitoring. In response to this, California Ocean Science Trust, in coordination with the California Department of Fish and Wildlife (CDFW), fishermen, and other partners, has developed this product to reflect on lessons learned from collaborations undertaken during the South Coast MPA baseline phase. Baseline projects conducted within this period focused on ecological and socioeconomic monitoring inside and outside MPAs between Point Conception and the California-Mexico border from 2011 to 2015.

The South Coast MPA baseline phase provides an opportunity to reflect on three MPA monitoring projects that integrated FK at various stages of design and implementation. The projects (presented as case studies) are referred to as Interpreting Commercial Passenger Fishing Vessel (CPFV) Fleet Data with the Sportfishing Association of California, the Southern California Spiny Lobster Research Project, and Cooperative Bass Tagging off the Coast of San Diego[1]. Ocean Science Trust solicited insights and feedback from fishing leadership directly involved in these projects to discuss the role of FK in informing scientific research design, data collection and interpretation, and communicating research results. While these case studies do not represent the full extent of collaborative projects in California, they can act as a starting point to begin a conversation with state resource managers and others to discuss the benefits and challenges for integrating FK into future collaborations as part of long-term MPA monitoring, including adaptive management.

2 What is Fishermen's Knowledge?

It has been almost 40 years since Robert Johannes, a fisheries biologist, made the case for the importance of FK in informing marine management (Johannes 1981). This launched a movement for scholars to begin documenting fishermen's "traditional ecological knowledge" (e.g., Johannes 1989, Berkes 1999). This term was primarily applied to indigenous communities using place-based knowledge to sustainably manage ecosystems over long time periods.

[1] Not all of these projects were baseline-funded; however all three projects were conducted during the baseline phase.

Since this time, scholars have documented that fishermen in the United States and Canada also utilize local ecological knowledge to sustainably manage resources (McCay 1980, Acheson 1988, Neis 1992). The focus on ecological knowledge has been extended to include knowledge of social and economic dimensions of the fishery, and some have emphasized that knowledge is held by many members of the fishing community, not just fishermen (Neis and Felt 2000). In this product, the term FK is used to include both social and ecological dimensions. The term fishermen refers not only to those who fish but also those involved in the fishing industry more broadly, particularly processors. We use the term fishermen because it is how men and women catching or harvesting fish and invertebrates in California describe themselves.

FK is derived from fishing experiences and observations (Pálsson 1998, 2000), and is typically bound with skills. Often knowledge is stored in fishermen's memories and logbooks. Like fisheries science, FK is not held uniformly by all individuals and often there are multiple viewpoints. Also, FK is not static (Agrawal 1995) but is subject to change based on contrary evidence. Collaborative research is one of the avenues by which both FK and marine science can be mutually transformed.

Globally, interest in including FK in marine science and management through collaborative research has grown over the last three decades. Tag and recapture studies, whereby a marine organism is caught and marked to allow for their identification when they are caught again, may be one of the most common types of collaborative fisheries research (Wilson et al. 2003).

3 Potential Benefits of Fisheries Collaborations

Why would managers want to collaborate with fishermen?

The Marine Life Protection Act (MLPA), passed in 1999, directed California to reevaluate all existing MPAs and design new MPAs that together function as a statewide network to more coherently and effectively protect the state's marine life, habitat, and ecosystems. From 2004-2012, the state of California redesigned and implemented four MPA regions to comprise the redesigned Statewide network. This Statewide network of MPAs is intended to protect the diversity and abundance of marine life, conserve marine populations, and improve recreational, educational and study opportunities of marine communities with minimal human disturbance. The MLPA also mandates monitoring to measure MPA performance and inform adaptive management.

Securing funds and human capacity for data collection are common hurdles for monitoring. MPA managers have many science and data needs, some of which may be well-suited to include fishermen in data collection. Including FK could prove to be a cost-effective means to fill information gaps and generally improve the knowledge base used to inform decisions by allowing for data collection at larger spatial and temporal scales or at a finer resolution than would otherwise be possible. Collaborative research has the potential to inform both human and ecological dimensions of MPAs. Fishermen have knowledge not only about fish ecology, such as the locations of spawning aggregations, but also of social and economic aspects of their fishery.

Collaborative monitoring could not only be used to evaluate the effects of MPAs but could also provide information to support fisheries management needs. Both the Marine Life Management Act (MLMA) and MLPA require monitoring and adaptive management (FGC §2852, 2853, 7081, 7056 (g)). The MLMA requires the collection of "essential fisheries information" and

recommends the use of monitoring to provide this information. In some cases, FK can offer more local information, potentially allowing for an increase in the ability to detect changes in populations, or help extend the spatial and temporal scales of monitoring through recruiting fishermen already on the water.

In addition to improving the information that managers base decisions on, research collaborations can improve relationships between fishermen and managers (Wendt and Starr 2009). The MLPA Initiative process was frequently contentious (Weible and Sabatier 2005, Gleason et al. 2013), and not all fishermen support MPAs. Cultivating personal relationships through a process of mutual discovery could provide a way to strengthen relationships, as well as increase the perceived legitimacy of management decisions through increasing the trust in the knowledge on which decisions are based (McCay and Jentoft 1996).

Why would fishermen want to collaborate with scientists and managers?

Fishermen also stand to benefit from engaging in research collaborations with scientists and managers. MPAs have real effects on fishermen's livelihoods and communities, as well as on the species that they target. While the ecological impacts of MPAs are generally well-documented, effects on fishermen and their communities are poorly understood (Mascia et al. 2010). As MPAs limit or prohibit the take of fish and invertebrates from inside MPA boundaries, patterns of fishing or harvesting outside MPAs often change. For example, on the Central California coast, MPAs were shown to negatively affect the activities of nearshore finfish and Dungeness crab fishermen (Chen et al. 2013), but have positively affected the activities of CPFV captains engaging in government charters as well as diving activities (Chen et al. 2013).

Because of these effects, it is important that fishermen agree that rules and regulations are based on good information. In other words, fishermen are interested in management decisions that reflect what they are seeing on the water. If fishermen are engaged in building the knowledge base that informs decision making, there is a greater chance that management decisions will reflect a view of the fishery that conforms to their own experiences.

In addition to wanting to contribute to the knowledge base that informs management decisions, many fishermen want to know more about the species they target. They are interested in how MPAs affect fish and invertebrate stocks and ultimately the fisheries that support them. Collaborations with scientists and managers have the potential to answer questions developed through observations on the water.

4 Fishermen's Knowledge in MPA Management in California

While there has been a long history of collaborative research in fisheries management in California (McEvoy 1986, Wendt and Starr 2009), there has been less collaborative research on MPAs, with much of this collaboration occurring quite recently. For example, along California's Central Coast (which ranges from Pigeon Point in San Mateo County south to Point Conception in Santa Barbara County), collaborative fisheries research in MPAs has been taking place since 2006. The California Collaborative Fisheries Research Program (CCFRP) has integrated the knowledge, skills, and experiences of scientists and recreational fishermen to establish a baseline of conditions that can be used to assess changes in fish populations within MPAs (Wendt and Starr 2009, Yochum et al. 2011). This project contributed to informing the MPA baseline in the region in 2013, and resulted in one methodology for conducting collaborative

fisheries surveys applied across Central Coast MPAs (Yochum et al. 2011). Along California's North Coast (which ranges from the California-Oregon border south to Alder Creek near Point Arena in Mendocino County), there are a number of state-funded collaborative research projects underway to help establish a baseline in the region.

FK sits alongside other types of knowledge informing marine management in California, including conventional science, citizen science, and traditional knowledge[2]. Specifically, the MLPA Master Plan 2016 highlights traditional knowledge as highly relevant for MPA management. It may be of value to managers and others, then, to consider how these knowledge types can be brought together to diversify and strengthen the information on which management decisions are based.

5 Report Methodology

The majority of the research that informed this product was conducted in June and July 2016. Ocean Science Trust conducted a series of semi-structured interviews with eight fishing leaders in California, mainly from Santa Barbara through San Diego, as well as six scientists and managers. The majority of interviewees were involved in the three projects; two were fishing leaders with experience in other collaborative fishing efforts. Due to limited time, Ocean Science Trust was not able to interview everyone involved in each project; however interviews were conducted with the main project participants. Ocean Science Trust invited the interviewees to review the resulting case studies and draft product upon completion to ensure accuracy. Additionally, marine managers at CDFW were requested to provide guidance and feedback on the overall approach of this product to ensure that the information provided is useful for managers, researchers, and others when considering how best to integrate fishermen and their knowledge into MPA monitoring.

6 South Coast Case Studies

A brief overview of the integration of FK in the three case studies occurring in the South Coast during the MPA baseline phase is presented below, as well as in Table 1.

Two of the projects coordinated with recreational fishermen, while the spiny lobster project worked with commercial fishermen. The CPFV project focused on the review and interpretation of social and economic conditions and impacts following MPA implementation, while the spiny lobster project and the bass project were both tag and recapture efforts. Lessons learned from these cases inform Figure 1, which outlines roles that FK can play in MPA monitoring, trust-building practices, and potential challenges.

[2] In California, traditional knowledge is used to refer specifically to knowledge held by California Native Nations.

Table 1. Summary of fishermen's knowledge (FK) contributions by case study

Case Study	Collaboration Type	Fishermen Involved	Role of Fishermen	FK Contribution
Interpreting CPFV Fleet Data with the Sportfishing Association of California	Social and economic data interpretation	Sportfishing Association of California (SAC)	• Research design • Data interpretation	Knowledge of ecological, social, and economic conditions of the fishery
Southern California Spiny Lobster Research Project	Tag and recapture	Commercial lobster fishermen	• Planning/ logistics • Data collection • Use of vessels	Technical knowledge of gear and vessel operations Spatial/temporal distribution of species
Cooperative Bass Tagging off the Coast of San DIego	Tag and recapture	SAC; San Diego's recreational fishing community	• Research design • Planning/ logistics • Data collection • Use of vessels • Outreach	Technical knowledge of gear and vessel operations Spatial/temporal distribution of species

Interpreting CPFV Fleet Data with the Sportfishing Association of California

In the MLPA planning process in California, FK was collected in an effort to minimize social and economic impacts to fisheries. Fishermen were surveyed to identify important fishing grounds and engaged in dialogue as part of regional planning processes involving a broad range of stakeholders. At the end of this rather contentious policy process, many people were dissatisfied with the outcome, including fishermen who lost access to former fishing grounds that had been identified as economically important areas. It was in this context that the SAC and the CPFV fleet was asked to participate in an MPA-related project in Spring 2013. While SAC leadership and many members saw limited value in engaging in a conversation about MPAs, there was an expressed interest in working to rebuild relationships and 'turn the page' with members of the academic science community in the spirit of collaboration.

In January 2015, a group of senior CPFV owner/operators met with Ocean Science Trust to interpret South Coast CPFV fleet dynamics and socioeconomic and ecological trends. A draft outline for a one-day meeting was developed in partnership with SAC leadership, and approved by the SAC's board. Per the SAC's request, the proposed outline did not involve quantifying the economic impacts of MPAs on the CPFV fleet. Also, being mindful of the apprehension by the CPFV fleet to participate in an information exchange, a neutral facilitator with existing relationships with CPFV owner/operators and SAC leadership supported the meeting design and in-person discussions.

During the meeting, discussions ranged from fishermen interpreting changes in the fleet that took place between 2000-2012 (e.g., geospatial distribution, landings, etc), to the role of outside influences such as the cycles of 6-pack charters and coupon-based promotions (e.g., Groupon). While there was not a request for each CPFV owner/operator who participated to share personal economic information, the economic impacts as a result of MPAs, environmental shifts, and larger economic drivers at a national scale and how they are reflected in the logbook data were discussed in detail. Fishermen who participated in the meeting were not paid for their time, and attended primarily as a result of their relationship with SAC (all were SAC members).

Lessons learned from this project include:

1. **Understand the history of engagement.** MPA management is a political process. When fishermen provide their knowledge to inform management, their knowledge is combined with other information that influences the outcome. This outcome can influence fishermen's willingness to participate in future research projects. For example, if fishermen experience that their knowledge was used to restrict their ability to access an area, they may be less willing to share knowledge in future research projects. In this case, how FK was used in the MPA process influenced the South Coast CPFV fleet's willingness to participate in additional research that aimed to evaluate the impacts of MPAs on the fleet. However, SAC leadership saw value in investing limited time and energy to show goodwill and engage in a collaborative discussion about MPA monitoring. This effort has opened lines of communication and the potential for collaboration on species/areas of interest that are high priority for SAC members.
2. **Be clear about the need for fishermen's engagement.** When asking fishermen to participate in a project, it is important to be clear about why they are being asked to participate, what is needed from them, and how information will be used and by whom. Bringing resource managers into discussions is one way that FK and concerns can inform management decisions.
3. **Identify fishing leadership.** The willingness of SAC leadership to engage made this meeting possible. Identifying the appropriate entry point into a given fishery or fleet, including following the appropriate steps to solicit and gain board or organizational approval, is key.
4. **Bring in a neutral voice.** Including a neutral facilitator with existing relationships within the CPFV fleet helped to support a constructive dialogue and take steps towards building trust.

Southern California Spiny Lobster Research Project

The California spiny lobster (*Panulirus interruptus)* fishery is one of the most economically important in California, supporting both commercial and recreational fishermen (Miller 2014, CDFW 2016). There is a great deal of interest from fishermen, scientists, and managers in how MPAs affect these organisms. In 2011, scientists from San Diego State University, Scripps Institution of Oceanography, and CDFW responded to a request for proposals for the South Coast MPA baseline phase. The idea to team with fishermen emerged from discussions with a project collaborator who took part in the MPA planning process. The project was designed to provide baseline information on spiny lobster abundance, size distribution, growth, and behavior inside and outside MPAs in the South Coast MPA baseline phase (Hovel et al. 2015). The group chose five sites inside and outside of newly established MPAs, and the study was conducted outside of the spiny lobster fishing season.

During a three-year period, primarily in the spring and summer, scientists accompanied fishermen and volunteers on their boats to trap spiny lobsters. To recruit and train volunteers, project leaders partnered with the San Diego Oceans Foundation, a non-profit organization focusing on educating the public about ocean stewardship and implementing projects to improve ocean health. In planning the research, scientists worked with fishermen to learn about the locations of major spiny lobster habitats. In addition to site knowledge, the project relied on commercial fishermen's boats as well as their knowledge of bait and trap pulling techniques. The fishermen donated their time and boats, and were compensated for the cost of fuel, insurance, and wear-and-tear to their vessels (Meyer et al. in prep). One trapping trip took place every month per site and took three field days to complete. Over 19,000 spiny lobsters were trapped and tagged (Hovel et al. 2015). Findings included that spiny lobsters are more abundant but smaller in southern sites compared to northern sites, lobster growth rates were similar among the sites, and lobster catch-per-unit-effort (CPUE) was higher in the southern sites (Hovel et al. 2015).

The majority of people interviewed saw this as a successful collaboration that included fishermen's input and expertise. One individual expressed concern that the study was conducted outside of the spiny lobster fishing season, which limited fishermen's understanding of where lobster might be congregating. One challenge of the project was that fishermen were financially strained in waiting for compensation from the grant funding. Several scientists also brought up that random sampling techniques were counter-intuitive for many fishermen, which led to some confusion. As fishermen by nature are focused on catching spiny lobster, it was not clear at first why they should set traps in habitats that didn't contain lobsters. Scientists simply reiterated to fishermen throughout the duration of the project that random sampling technques are necessary to properly estimate abundance.

Lesson learned from this project include:

1. **Discuss research design early.** Early discussions about research design can help to clear up questions and prevent confusion between researchers, fishermen, and managers.
2. **Discuss timing of compensation.** Streamlining the payment process or simply clarifying at the beginning of the project how long participants should expect to wait for compensation may have eased fishermen's concerns.
3. **Consider the contextual nature of FK.** As the study took place outside of the lobster fishing season, fishermen could provide input on gear but did not know where lobsters congregate outside of the fishing season.

Cooperative Bass Tagging off the Coast of San Diego

In Southern California, basses of the genus *Paralabrax* represent highly important recreational fisheries, yet their populations have shown long-term declines. The bass populations are expected to benefit from MPAs, but more stringent bag and size limits were implemented as an additional tool for rebuilding stocks. Scientists at Scripps Institution of Oceanography formed the Coastal Angler Tagging Cooperative to measure population dynamics of the basses (both inside and outside local MPAs) in partnership with the recreational fishing community in Southern California (e.g., SAC), CDFW, and the San Diego Oceans Foundation. While the primary focus of the project was not MPAs, they did sample inside and outside of two MPAs in La Jolla.

Stakeholder partnerships began during the initial design phase of the project, which allowed

the scientists to gather input and support from both recreational anglers and fisheries managers. Initial contact between scientists and other stakeholders was facilitated by personal relationships built from past collaborations, although most of the angler participants were new volunteers. Scientists worked with the San Diego Oceans Foundation to charter CPFVs and invite volunteer anglers to participate in tag-and-release trips. They conducted 51 CPFV charters with 15 to 20 anglers on each trip. In addition to these charters, private boat owners volunteered to donate their boats and help with tagging on 151 additional trips. The direct participation from anglers, the transparent project design, and extensive outreach efforts (including TV and radio shows, club presentations, trade show booths, newspaper, and magazine articles) all helped to build trust and project awareness among stakeholder groups.

Over 16,000 basses were tagged from San Diego to Long Beach, California. Movement patterns, population abundance, mortality, and size structure were measured for the basses at multiple sites, both inside and outside local MPAs. Fish traveled up to 95 km from the site of tagging, but most were recaptured within 1 km of the initial tagging site. Times from tagging to recapture ranged from 1 minute to 733 days, with a 98.2% initial post-release survival rate. Size structure of some species was greater inside the La Jolla MPAs, but there were no differences in CPUE between areas inside and outside the MPAs.

All of the angling community members and scientists interviewed view this as a successful collaboration. Similar to the lobster project, the main challenge faced during the project was that fishermen were financially strained while waiting months for compensation from the grant funding[3].

Lessons learned from this project include:

1. **Discuss timing of compensation.** Similar to what was learned from the Southern California Spiny lobster Research Project, streamlining the payment process or simply clarifying at the beginning of the project how long participants should expect to wait for compensation may have eased fishermen's concerns.
2. **Identify fishing leadership.** The support of the SAC in this project helped with its promotion and success.
3. **Choose a fishery of high value/importance.** The motivation by the CPFV fleet to get involved was partly because a species was chosen that they fish and are concerned about.

[3] The Scripps researchers are now using a similar cooperative research model at the NOAA Southwest Fisheries Science Center to conduct a rockfish tag and recapture project off San Diego. Over 2,000 rockfish have been tagged and released to date. Researchers are working with the recreational angler community to measure the effectiveness of fish descending devices for maximizing post-release survival of rockfishes, especially for cowcod (*Sebastes levis)*, a protected species that is now showing signs of its population rebuilding.

7 Roles Fishermen's Knowledge Can Play in the Research Process

Lessons learned from the interviews and case studies have been synthesized to identify suggested best practices, including the roles that fishermen can play at key steps in the research process, and some potential challenges associated with each step (Figure 1). This roadmap is intended for managers and researchers to use when designing collaborative research projects. Four general steps have been identified for consideration when designing collaborative fisheries research as part of MPA monitoring. Fishermen have the potential to play a role at every stage of the research process; however, the extent and nature of involvement will depend on the project and the level of interest by the fisherman. In general, the more fishermen are invited to participate, the more confidence they are likely to have in the process, its results, and any potential management outcome.

Setting up the collaboration

Fishermen and scientists bring different, and often complementary, expertise and skillsets to the table. Scientists generally bring training in identifying research questions, sampling design, data analysis, and writing. Fishermen have deep knowledge of fishing techniques, locations, ecological connections, as well as the social and economic aspects of the fishery.

Figure 1 highlights a list of trust-building practices for managers and researchers to consider when designing any successful collaboration. These include face-to-face communication, agreement on clear goals, and meaningful engagement throughout the process to create a sense of investment and ownership. Particularly around the topic of MPAs, many fishermen are concerned about their fishing access becoming further limited. With this in mind, it is helpful to acknowledge up-front how information gathered will inform management decisions, including any potential changes to fishing access. It is also helpful to explicitly identify early on what skills particular individuals bring to the collaboration and define roles and responsibilities (Johnson and van Densen 2007). These include agreeing to time and financial obligations, determining financial compensation, assigning responsibility for data collection and analysis, and communicating results (Yochum et al. 2011). Additionally, cultivating a culture of mutual respect for the diverse knowledge being brought into a collaborative research project is key. All participants should feel that their skills and knowledge are valued. The success of any project relies on setting up a process that fosters a sense of ownership and trust.

The development of the research question is a key part of the process whereby FK can contribute to cooperative research. Research questions also often emerge from management

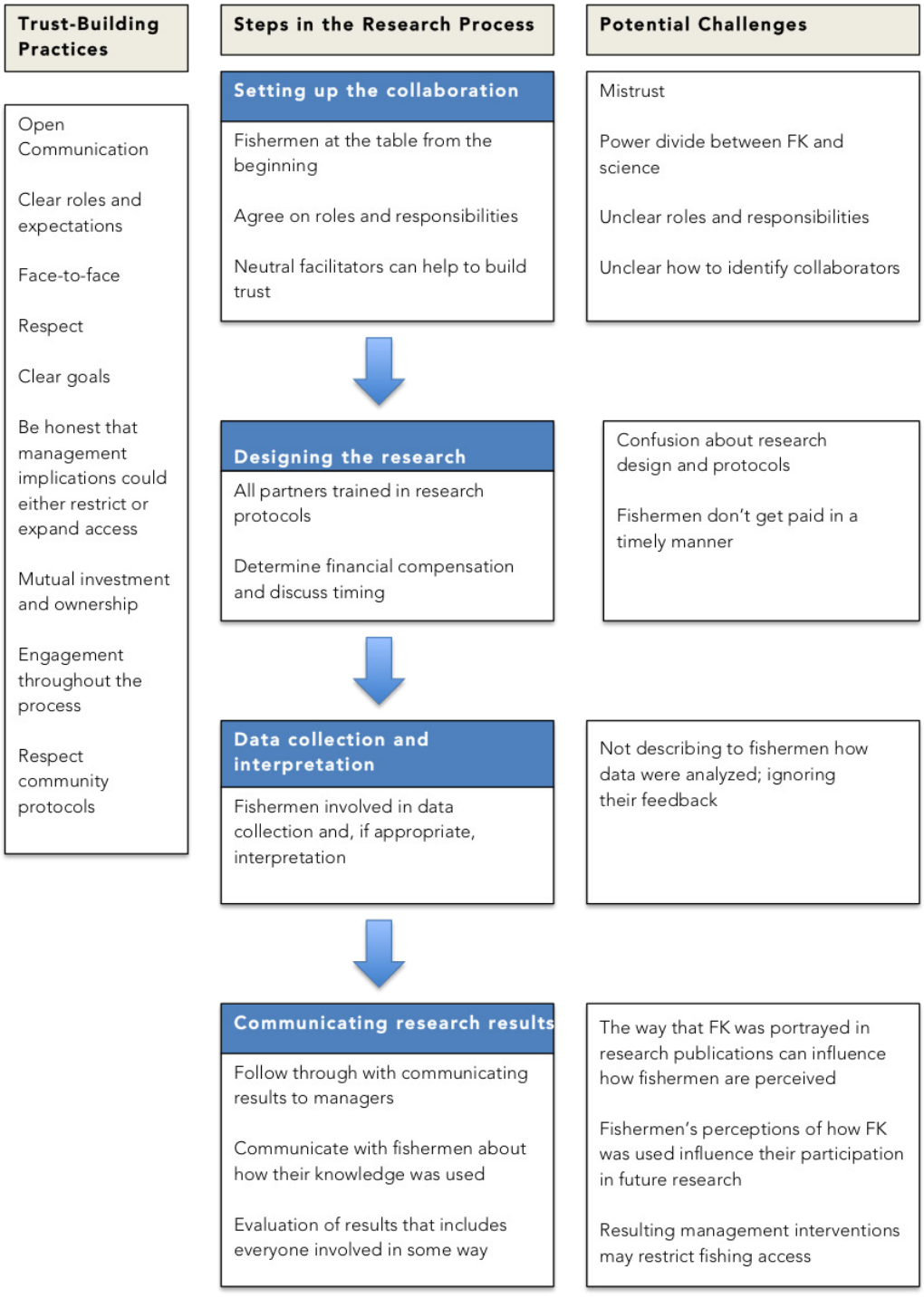

Figure 1. Four steps for planning and implementing collaborative fisheries research, including trust-building practices and potential challenges; intended for researchers, managers, and othersto use when designing collaborative research projects.

priorities. For example, the Southern California Spiny Lobster Research Project received state funds to conduct baseline monitoring on the abundance, size, and behavior of spiny lobsters in South Coast MPAs (Hovel et al. 2015). Many cooperative research projects are also based on hypotheses or questions identified by fishermen based on their experience and knowledge of marine ecosystems and institutional environments. Bringing together fishermen, scientists, and managers early in the research process to identify research questions can result in a stronger, more comprehensive project.

Designing the research

After the research questions have been defined, all collaborators need to determine how questions will be answered. Projects often benefit from all members of the team, including participating fishermen, contributing to and understanding the research protocols. Fishermen's participation in shaping the research can ensure that it is practical in terms of time, finances, and logistics (Yochum et al. 2011). Once defined and agreed upon, everyone involved in data collection should be trained on the research protocols prior to going into the field (Yochum et al. 2011). If this does not happen, there could be confusion on the water. For example, confusion over the concept of random sampling in the Southern California Spiny Lobster Research Project led to the need for explanation and discussion on the water. Early discussions about research design can lead to engagement and ownership.

Data collection and interpretation

It is common for fishermen to be involved in data collection but not as common for fishermen to be involved the interpretation of key findings and results. Fishermen played a dominant role in data interpretation in only one of the case studies described here. For some projects, it may not make sense for fishermen to actively analyze project data. However, in other cases, fishermen could help to explain why certain patterns are being seen. Regardless of whether or not fishermen are involved in data interpretation, the form in which data will be made available to fishermen and other partners, and how it will be shared outside the project team, should be discussed early in order to maintain transparency.

Communicating research results

Early discussions about the potential implications of research results with all partners, including managers, can ensure that no one is surprised with outcomes. Fishermen's perceptions of how their knowledge may be used can negatively impact their willingness to participate in future research projects, particularly if a resulting management intervention reduces fishing access (Shackeroff and Campbell 2007). The way that FK is portrayed in research publications or other project communication materials can also influence how fishermen are perceived by outsiders.

8 Conclusions

These lessons learned are meant to serve as a springboard for a larger conversation that involves scientists, managers, and fishermen to advance collaborative research projects in California. In addition to the examples described above, there are a number of other cases in California with additional lessons learned that could be important to learn from. Failed collaborations can make everyone apprehensive about future projects. However, when done well, collaborative fisheries projects have the potential to be a cost-effective approach to knowledge building and sharing that can enhance legitimacy and strengthen the knowledge base on which management decisions are made.

There is a lot of potential in California for managers, fishermen, and scientists to work together to produce a more comprehensive and shared understanding of the marine social-ecological system, including projects on social or biophysical trends. The knowledge and relationships that result could allow all partners to be more responsive to environmental change. A network of fishermen, managers, scientists, and other partners operating at multiple scales also has the potential to create more responsive and locally relevant decision-making (Wilson and Delaney 2005).

Even though the value and importance of including FK in MPA monitoring has been described in this product, it is equally important to acknowledge that not all fishermen may want to participate in collaborative research projects. There are, however, many fishermen excited and interested in advancing these types of collaborations.

Based on the information above, we have developed several recommendations for advancing collaborative research with fishermen:

- *Support bottom-up, management-driven collaborative research focused on MLMA-MLPA integration*
- *Launch a forum for fishermen to be able to share research ideas with scientists and vice versa*
- *Establish stronger connections among FK, management, and policy at multiple scales by bringing together CDFW, Ocean Protection Council, National Marine Fisheries Service, and collaborative research teams (e.g., CCFRP)*
- *Bring FK and other knowledge types (e.g., TK, academic science) together to inform management*
- *Develop scientific guidance on how to bring FK to bear in long-term MPA monitoring*

References

Acheson, J. M. 1988. The lobster gangs of Maine. Hanover, NH: University Press of New England.

Agrawal, A. 1995. Dismantling the divide between indigenous and scientific knowledge. Development and Change 26: 413-439.

Berkes, F. 1999. Sacred ecology, traditional ecological knowledge, and resource management. Philadelphia: Taylor and Francis.

California Department of Fish and Wildlife (CDFW) Marine Region. 2016. California spiny lobster fishery management plan. https://nrm.dfg.ca.gov/FileHandler.ashx?DocumentID=121938&inline

Chen, C, C. LaFranchi, K. Sheeran, and C. Steinback. 2013. Establishing a Spatial & Economic Baseline of Human Uses. Executive Summary Report for Baseline Monitoring of Ecosystem & Socioeconomic Indicators for MPAs along the North Central Coast of California. A report to California Sea Grant.

Gleason, M, E. Fox, S. Ashcraft, J. Vasques, E. Whiteman, P. Serpa, E. Saarman, M. Caldwell, A. Frimodig, M. Miller-Henson, J. Kirlin, B. Ota, E. Pope, M. Weber, and K. Wiseman. 2013. Designing a network of marine protected areas in California: Achievements, costs, lessons learned, and challenges ahead. Ocean and Coastal Management 74: 90-101.

Hovel, K. A., D. J. Neilson, and E. Parnell. 2015. Baseline Characterization of California Spiny Lobster (*Panulirus Interruptus*) in South Coast Marine Protected Areas. A report to California Sea Grant and the California Ocean Science Trust.

Johannes, R. E. 1981. Words of the Lagoon: fishing and marine lore in the Palau District of Micronesia. Berkeley: University of California Press.

Johannes, R. E. 1989. Fishing and traditional knowledge. In Traditional ecological knowledge: a collection of essays, pp. 39–42. R. E. Johannes (ed). IUCN, Gland, Cambridge, Switzerland, UK.

Johnson, T. R., and W. L. T. van Densen. 2007. Benefits and organi¬zation of cooperative research for fisheries management. ICES Journal of Marine Science 64: 834–840.

Jones, T. L., K. W. Gobalet, and B. F. Codding. 2016. The archaeology of fish and fishing on the Central Coast of California: The case for an under-exploited resource. Journal of Anthropological Archaeology 41: 88-108.

Mascia, M. B., C. A. Claus, R. Naidoo. 2010. Impacts of marine protected areas on fishing communities. Conservation Biology 24 (5): 1424-29.

McCay ,B. J. 1980. A Fishermen's Cooperative, Limited: Indigenous Resource Management in a Complex Society. Anthropological Quarterly 53: 29-38.

McCay, B. J., and S. Jentoft. 1996. From the bottom up: participatory issues in fisheries management. Society & Natural Resources 9(3): 237-250.

McEvoy, A. 1986. The Fisherman's Problem: Ecology and Law in the California Fisheries, 1850-1980. Cambridge: Cambridge University Press.

Miller, E. F. 2014. Status and Trends in the Southern California Spiny Lobster Fishery and Population: 1980-2011. Bulletin, Southern California Academy of Sciences 113 (1): 14–33.

Neis, B. 1992. Fishers' ecological knowledge and stock assessment in Newfoundland. Newfoundland and

Labrador Studies 8: 155–178.

Neis, B., and L. Felt, eds. 2000 . Finding our sea legs: linking fishery people and their knowledge with science and management. St. John's, Canada: ISER Books.

Pálsson, G. 1998. Learning by fishing: practical engagement and environmental concerns. In Linking social and ecological systems: Management practices and social mechanisms for building resilience. C. Folke and F. Berkes (eds). Cambridge: Cambridge University Press.

Pálsson, G. 2000. Finding One's Sea Legs. In Finding our sea legs: linking fishery people and their knowledge with science and management. B. Neis and L. Felt (eds). St John's, Newfoundland: ISER Books.

Shackeroff, J. M., and L. M. Campbell. 2007. Traditional ecological knowledge in conservation research: problems and prospects for their constructive engagement. Conservation and Society 5 (3): 343-360.

Weible, C. W., and P. A. Sabatier. 2005. Comparing policy networks: Marine Protected Areas in California. The Policy Studies Journal 2: 181-201.

Wendt, D. E., and R. Starr. 2009. Collaborative research: an effective way to collect data for stock assessments and evaluate marine protected areas in California. Marine and Coastal Fisheries: Dynamics, Management, and Ecosystem Science 1: 315–324.

Wilson, D. C., J. R. Nielsen, and P. Degnbol. 2003. The fisheries co-management experience: accomplishments, challenges, and prospects. MA: Kluwer Academic Publishers.

Wilson, D. C., and A. Delaney. 2005. Scientific knowledge and participation in the governance of fisheries in the North Sea. In Participation in fisheries governance. T. S. Gray (ed). Dordrecht, The Netherlands: Kluwer Academic Publishers.

Yochum, N., R. M. Starr, and D. E. Wendt. 2011. Utilizing fishermen knowledge and expertise: keys to success for collaborative fisheries research. Fisheries 36 (12): 593-605.

California Ocean Science Trust
2201 Broadway, Suite 101
Oakland, CA 94612