Perspectives of "People on the Water": A pilot study to connect ocean users with CalCOFI datasets

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Executive Summary:

The California Cooperative Oceanic Fisheries Investigations (CalCOFI) has been engaging in efforts to make long-term dataset more relevant to ocean users and learn from holders of local environmental knowledge to inform monitoring programs. In order to achieve this goal, it is critical to create spaces for reciprocal learning with ocean users. Here we describe a pilot study designed to explore the perspectives of ocean users to inform future efforts that center stakeholder consultation with the intent to curate CalCOFI datasets to better fit the needs of ocean users. We describe the motivation and importance of this work, the methods developed for the study, results, and key recommendations for future work.

This pilot study involved five semi-structured interviews with ocean users located in Northern and Southern California representing three sectors of ocean users: recreational users (surfers, divers, recreational fishers), commercial fishing, and aquaculture production. The aim of the interviews are to understand the types of decisions that ocean users face, the data requirements for decision making, management of risk and uncertainty, and values. The specific research questions addressed include the following: 1) what types of decisions are ocean users making in terms of time frame, urgency of decision, and perceived impact of decisions?; 2) what data and knowledge is required to make these decisions and where do ocean users source data?; 3) what uncertainties do ocean users face and how do they manage these risks?; and 4) what is important to ocean users and what are their hopes for the future?

Interview results indicated that most decisions are made on a timescale ranging from daily to seasonal and were low urgency unless relating to public health concerns. However, the perceived consequences of decisions ranged greatly from inconsequential to potentially detrimental. The results highlighted the wide variety of information and data sources used by ocean users across sectors, including personal experience and crowdsourced platforms, and some mentioned concern about the reliability of some long-term datasets. The incorporation of ocean users' local ecological knowledge could be used to complement datasets to increase credibility and trust among users. Interviewees mentioned kelp decline, rising sea temperatures, and coastal water contamination as major concerns for the future of the oceans. Participants also emphasized the importance of accounting for risk and uncertainty, shared visions for the future rooted in inclusion of Indigenous and local knowledge, expressed concerns about ecological decline, and highlighted a deep personal relationship with the ocean as both rewarding and uniquely powerful.

Introduction

The ocean is a constantly variable place, and ocean users are currently tasked with making decisions in the context of changing ocean conditions, shifts in species distribution, extreme weather events, and unpredictable climate phenomena. In order to make decisions in the face of this uncertainty, ocean users rely on experiential knowledge and monitoring datasets to inform choices on how to engage with marine environments.

Long-term environmental monitoring data plays a critical role in ecosystem management, helping managers and policy makers make decisions about the use of ocean resources (Wolfe et al., 1987). Under changing conditions and emerging environmental stressors, this data can help establish baselines, identify deviations from long-term trends, and deduce drivers of change and regime shifts. This information can then be used to adaptively manage natural resources, which involves an iterative approach of experimentation and adjustment aimed to reduce uncertainty in decision making (Williams, 2011). However, it has been reported that environmental monitoring datasets are sometimes insufficient to fully inform managers and decision-makers in order to implement adaptive management under new conditions and stressors (Stoffels et al., 2024; McCord & Pilliod, 2022; West et al., 2019).

In order to address the needs of managers to adapt to new conditions, there has been a recent push for the adoption of *adaptive monitoring* frameworks, which allows environmental monitoring programs to be adjusted to meet changing research priorities, account for shifts in environmental conditions, and incorporate emerging technologies (Lindenmayer & Liken, 2009). One key aspect of creating an environmental monitoring program that is adaptive is to incorporate stakeholders into the development of the program's objectives, design, implementation, and assessment (Zuniga-Teran et al., 2022). Stakeholders can provide alternative types of information, such as experiential observations, local or place based knowledge, and Traditional Ecological Knowledge (Danielsen et al., 2022), which can improve natural resource management and protect culturally important regions (Zedler & Stevens, 2018).

Community-led monitoring can help tailor programs to address environmental problems that are of concern to community members, increasing the accuracy and relevance of data by generating a more comprehensive set of inputs that can support the long-term success of monitoring programs (Danielsen et al., 2022). Involving local stakeholders into monitoring design can increase the transparency and credibility of a program and build public trust in the results (Reed, 2008). However, monitoring programs do not always align with stakeholder values or definitions of success (Turnhout et al. 2007; Waylen & Blackstock, 2017). This disconnect can create a barrier for data use and local community support. A more thorough involvement of stakeholders in the monitoring program design process not only improves the data being collected, but can increase the applicability and impact of data across sectors (Kaiser et al., 2019). Closing the gap between local communities, intended data users, and monitoring program managers can help maximize the impact and usability of these datasets.

Goals and Objectives

California Cooperative Oceanic Fisheries Investigations (CalCOFI) is interested in exploring how to make existing long-term datasets more relevant to ocean users and create opportunities for reciprocal learning to inform monitoring efforts. Long-term oceanic monitoring efforts, while incredibly valuable for scientific pursuits, require substantial investments of governmental and private resources. The involvement of stakeholder groups and people with ample experience interacting with the ocean, i.e. "people on the water", can help connect potential data users with available resources and tailor existing datasets for the collective benefit.

The overall goal of this work is to explore potential avenues to address the needs and concerns of diverse coastal ocean users to further the mission of CalCOFI of providing reliable and relevant ocean observations and promote conservation of California's ocean resource. In order to achieve this, our objectives were to better understand the types of decisions different coastal ocean users are making, how they incorporate various datasets into the decision making process, how they deal with uncertainty, and their concerns for the future of the oceans. Through this exploration, there is the possibility to better leverage existing information and inform long-term monitoring design to support the decision needs of users at many levels and sectors. This pilot study aims to serve as a preliminary exploration of coastal ocean users priorities in order to inform future studies that can identify how to increase the usability of long-term datasets by curating and presenting data in a way that aligns with users needs.

Background of the CalCOFI Program

CalCOFI is a long-term ecosystem research program located off the coast of central and southern California. Originally established in 1949 to monitor the decline of sardines, the CalCOFI program measures the physical, chemical, and biological processes of the ocean to inform sustainable management of California's marine ecosystems and resources. The program is supported by a partnership between federal, state, and academic partners to measure changes in the marine environment, trends in ecosystem structure and function, and identify indicators of climate oscillations (e.g. El Niño, La Niña), fishery health, and climate change. Data is collected in state, federal, and international waters up to 300 miles off the coast and to depths of about 500 meters (Figure 1). Datasets are collected during quarterly scientific cruises.

CalCOFI has already begun the process of soliciting feedback from stakeholders on the ways in which CalCOFI can improve its monitoring program, data products, and partnerships to meet fishery and ocean ecosystem monitoring needs. For example, CalCOFI has conducted stakeholder workshops (Engeman et al., 2020), surveys, and interviews to understand how CalCOFI data is currently used, what stakeholders identified as monitoring questions and needs, and emerging marine concerns that could be addressed. These efforts can help inform an adaptive approach to large scale monitoring. The CalCOFI program has already demonstrated an ability to dynamically adapt to emerging research questions, as the program was originally designed to monitor sardine declines and has since been modified to be capable of addressing management needs related to climate variability and ecosystem function.

Pilot project to explore perspectives of ocean users to potentially inform CalCOFI monitoring

In order to build upon past efforts to incorporate perspectives of current CalCOFI data users (e.g., Engeman et al. 2020), we designed a pilot project to understand how to connect with the needs of potential data users who directly engage with the ocean. We selected participants who interact with the ocean but do not currently directly use CalCOFI produced datasets in their decision making, but who may potentially be able to use CalCOFI data. We were interested in exploring data needs, decision making processes, and perspectives on significant knowledge gaps and uncertainties of those that spend time in the marine environment to incorporate their perspectives. We hope to understand how to best curate the existing long-term dataset to be reflective of the experiences of "people on the water".
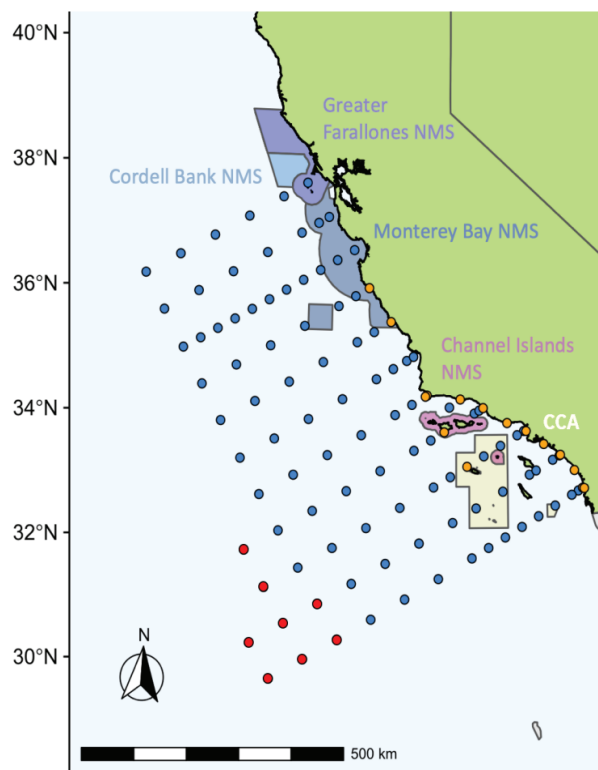

Figure 1. CalCOFI Long Term Monitoring Program Reach showing state (orange), federal (blue), and international waters (red) monitoring sites. Map from CalCOFI (https://calcofi.org/).

Research Questions

This pilot study aimed to document the experiences of "people on the water" to bridge the connection between long-term monitoring programs and the needs and values of ocean users. The specific research questions addressed are outlined below.

Specific Research Questions:

1. What types of decisions are ocean users making in terms of time frame, urgency of decisions, and perceived impact of decisions?
2. What data and knowledge is required to make these decisions and what data sources are consulted?
3. What uncertainties do ocean users face and how do they manage these risks?
4. What is important to ocean users and what are their hopes for the future?

Study Development

Project Design

The semi-structured interviews were designed to served two main purposes: first, to trial the interview guide to ensure the questions could evoke answers to meet the project goals and to identify any inadequate questions; and secondly, to take advantage of the semi-structured interview format to speak with key informant individuals to gain an increased understanding of the context and problems of concern in order to inform future interview efforts.

This study was designed through an iterative process of discussions between the CA Sea Grant Fellow and CalCOFI personnel to identify research objectives and refine interview questions. We also received feedback from outside collaborators with experiences in using qualitative and participatory methods for social-environmental investigations. The study design involved individual, semi-structured interviews with relevant participants. Semi-structured interviews are based on an interview guide of open ended questions to keep the interview focused (Jamshed, 2014). This method allowed us to have comparability between participant responses but freedom to discuss additional topics as they arose. The interview guide for this study begins with an introductory question about the participants and continues with eleven open-ended questions (Appendix A).

Participant Criteria

When trying to identify what groups could be potential users of the CalCOFI data, it is important to understand what types of decisions oceans users are making and what time scale they are considering in their decisions. CalCOFI samples quarterly, and therefore is best suited to support decisions made on a quarterly, annual, or interannual scale. Therefore, we aimed to understand the types of decisions that ocean users are making at these timescales in order to leverage the longer term CalCOFI datasets available.

Participants were selected based on meeting relevant criteria, which included: 1) location: individuals that are making decisions about California coasts and oceans; 2) interaction: interact frequently with the ocean or ocean data/information; 3) potential users: individuals who don't currently use, but could use, CalCOFI data products. As this was a preliminary study, we invited participants from our professional circles that met the criteria and selected participants that covered different regions across California's coast and different ocean sectors. Participants

were located in both northern and southern California and represented private commercial anglers, commercial seaweed aquaculture, and recreational ocean users that participated in activities of fishing, harvesting, free diving, and surfing (Figure 2). The exact location is not listed to maintain participant anonymity. Participants engaged with the ocean, either through direct contact or thought about ocean topics, between five to six times per week. These users provided direct insight and perspectives of how coastal environments have shifted overtime and how these changes affect the way in which they engage with the ocean.

Methods

All interviews were conducted virtually using the Zoom platform. In order to capture the interview data effectively, the interviews were recorded and transcribed with the consent of the participants. Recorded interviews are considered more reliable than hand written notes and allows for the verbatim transcripts of the interview (Jamshed, 2014). Interviewees were notified before beginning the interview that they have the ability to stop the interview or the recording of the interview at any time, and that the recording can be erased at their request. The recording and transcripts were only viewed by members of the research team, and both the recordings and transcripts were deleted after the completion of the research project. Transcripts were reviewed for accuracy by the research team and coded inductively according to emerging themes.

Figure 2. Study participants location along the California coast and associated sector. Base map from California Department of Fish and Wildlife.

Results and Discussion

A summary of the main emergent themes and key comments that came out of the five interviews with ocean users are described in Table 1. We also present quotes to highlight the key findings associated with each key comment in Table 1 and as italicized quotes in the results and discussion below.

Table 1. Key findings from the pilot project looking at perspectives of "people on the water".

Theme	Key Comment	Exemplary Quote
Decision making and uncertainty	Perceived consequences of decisions vary greatly among users from inconsequential to potentially detrimental	*"It's just kind of like whether I have a good time or a great time."* *"As a public entity, you're always under scrutiny about making the right choice."*
	Scenario development and "preparing for the worst" are used to deal with uncertainty	*"I think it's also just thinking ahead, right?...It's kind of anticipating the worst sometimes so when it hits you're kind of prepared."*
Data needs and uses	Data needs are often met by cross-referencing several datasets	*"I will look at a lot of different datasets before I go out."*
	Crowdsourced platforms are perceived as reputable for anglers, harvesters, and recreational ocean users	*"[local anglers] have been doing this for 40 years 50 years. They were, you know, the pioneers of these industries.They know where these fish are."*
	Skepticisms exists towards large-scale species range monitoring efforts	*"The fishermen that I work with feel like that dataset is skewed. It's not right, it's something that if you went with a fisherman that knows these species they could get a better count for it."*
Visions for the future	Incorporation of local, Traditional, and Indigenous knowledge into the ocean science paradigm and ecosystem conservation	*"…we need to look at bringing the native community into these conversations…not kind of approach in the aftermath of when something drastic has already happened, [but] bringing [them] more in the actual conversation of finding what the solutions look like."*
	Concerns and pessimistic outlooks	*"It seems like everything is crumbling and falling apart, and all the species are dying and all this stuff."*
Relationship with the ocean	Unique experiences that are unattainable on land.	*"Something that I think is really cool about the ocean is that it's so remote and it happens so immediately. You can get 500 yards into the ocean and you are out there on your own. It's hard to experience that somewhere else on land…You go a mile into the woods you feel relatively safe, when you go a mile out into the ocean you are very vulnerable."*
	Personally rewarding	*"I'm the best version of myself when I am spending a lot of time in the ocean."*

Decision making and uncertainty

Decisions made by participants ranged from daily to seasonal. All ocean users reported daily consultation of datasets in order to plan activities. Data was used to inform decisions on whether or not to partake in a particular activity (such as fishing, harvesting, diving, or surfing) and if so, where to do so. However, the temporal scale of data used to inform decisions did not always align with decision frequency. For example, interviewees in the aquaculture sector reported how the decision to harvest seaweed, a seasonal decision, is informed by daily water quality nutrient concentration data in order to maximize harvest yield. Insufficient data can negatively impact these seasonal decision-making abilities.

Respondents noted that most decisions have low urgency, except those that could impact public health in the cases of commercial fisheries and aquaculture. While recreational divers noted that the consequences of making a wrong decision are relatively low, aquaculture practitioners stated that the decisions they make can have *"detrimental consequences"* in terms of public health and public trust in aquaculture producers and entities. Public opinions can be very hard to change once established and public trust can be hard to regain if a wrong choice is made, highlighting the importance of high quality and reliable data to inform decision making. Aquaculture requires high spatial and temporal resolution data of nutrients, heavy metals, and chemical contaminants. The ability to incorporate more data sharing and comparison between real-time monitoring of coastal waters and oceanic data was noted as a potential way to increase the relevance of ocean monitoring data for coastal applications.

For fishers and harvesters interviewed, one of the biggest uncertainties they face, beside the presence of desirable species, is changes to harvesting regulations and catch limits. Recreational fishers noted that the expansion of Marine Protected Areas (MPAs) in their region was reducing their access to fishing grounds and recreational diving spots. They recommended the placement of higher restrictions on catch, opposed to the closure of these spaces for fishing through the designation of MPAs, in order to promote the sustainable management of fish populations.

There was reported uncertainty about how changes in climate and ecosystem structure will affect ocean users. One user reported using a scenario approach to help prepare for potential changes, noting their strategy as *"I think it's also just thinking ahead, right?...It's kind of anticipating the worst sometimes so when it hits you're kind of prepared."* Long term data sets and annual data are being used to prepare for occurrences of phenomena like La Niña or El Niño years, along with dinoflagellate blooms that could affect fishing conditions or aquaculture production. However, as conditions change, participants reported that previous prediction methods might be less useful in the future. As historical trends become less indicative of future conditions and events, the exploration of additional tools to assist in decision making under uncertainty could become increasingly useful.

<u>Data needs and uses</u>

Water quality data was of particular interest to participants, likely because all participated in either commercial or recreational fishing and commercial aquaculture. All participants cross-reference various datasets in order to make decisions, indicating that no one data platform was sufficient to meet all data needs. The datasets referenced included local ocean condition hotlines, subscription surf condition camera services, government operated coastal water reports, social media (ex. Facebook groups), among other websites. The need to cross reference was due to highly variable conditions and perceived unreliability of individual datasets, specifically for information on water clarity.

Both commercial and recreational fishers and harvesters reported the value of using crowd-sourced datasets that report fish abundance and sightings. The participant from the commercial fishering section reported paying for access to data, such as annual high resolution aerial imagery, in order to inform decisions on where to fish and harvest during the season.

An interviewee from the commercial fisheries and harvesters sector noted that while species abundance data is critical to inform their decisions for where to fish and what species to target, that there is the perception that the sampling methods and data produced by large scale monitoring efforts are *"skewed"* and not representative of fish abundance and locations according to local anglers. There is a perceived exclusion of this local knowledge and an encouragement for more reciprocal learning between local ocean users and large-scale monitoring programs. In order to address this disconnect and lack of confidence by local anglers in monitoring data, it could be beneficial to create comparable or merged datasets that can incorporate both crowdsourced information and monitoring program data. This can help increase the reputability of these datasets among ocean users and increase the frequency of monitoring observations.

<u>Visions for the future: concerns and hope</u>

Participants had mixed feelings about the future of the ocean, some expressed the perspective that conditions will continue to get worse while others were hopeful in the ability of restoration and new technologies, such as aquaculture and bioprospection, to overcome current challenges. Participants expressed excitement for the *"undiscovered medicines in the ocean with algaes or even fish or venom"* that could be used to create new treatments to diseases.

Two of the participants had belief in the ability of target restoration efforts to reestablish giant kelp communities, but noted that there needs to be more involvement of local knowledge, specifically Traditional and Indigenous Knowledge, in the creation of restoration projects and marine stewardship. One interviewee stated that *"it's not just scientists that are doing the work, it's a lot of the community as well. In terms of what else makes me excited [about the future] is more people getting the training and access to do that."* Increasing the capacity of local communities to participate in data collection, research objective and goal formation, and analysis can help generate sustainable conservation models.

All five interviewees noted kelp declines as a major concern for California marine ecosystems and their work personally. One interviewee stated that *"everything really depends on it [kelp], and it's scary to think that it's not naturally rebounding"*. This concern for kelp establishment was noted by both participants in Southern and Northern California, and the kelp declines of 2014 were referred to as "*the great disaster*" by one interviewee. Additional trends noted by participants include increasing sea surface temperature over the past years, which was noted as a major concern for three participants, especially as it has direct implications for aquaculture and commercial fishing. Lastly, coastal water contamination, and specifically land-based pollution and plastic waste, was another concern for participants in Southern California near international borders.

Relationship with the ocean

The open ocean is a place where many people do not venture, and it can be challenging to design long-term monitoring programs that involve stakeholder input for an area that has relatively low levels of interaction compared to other terrestrial ecosystems. However, participants described a unique relationship with the open ocean, describing a level of awe, appreciation, and excitement regarding the unknown. Being able to further understand the cultural and personal connection that ocean users and the general public have to these spaces can help ensure that science communication efforts align with personal and community values.

Reflections and Future Directions

This pilot study looked at several different components of the lived experiences of ocean users to understand what decisions they are making, how they utilize existing datasets, how they manage uncertainty in decision making, and how they conceptualize the future of the oceans. Our goal was to explore ways that the perspectives of "people on the water" can be used to inform long-term monitoring and how to increase the usability of existing dataset for potential users. We found that data needs and use are met through a range of sources, including personal experience and crowdsourced platforms, though some users are uncertain about the quality of some long-term monitoring data. Participants also emphasized the importance of accounting for risk and uncertainty, expressed concerns about ecological decline, shared visions for the future that include Indigenous and local knowledge, and highlighted a deep personal relationship with the ocean.

Upon reflection, we concluded that this range of discussion topics was too broad for a semi-structured interview format to be able to create concise and comparable answers across participants, thus future efforts could hone in on a few key areas to allow for more in-depth exploration of key topics. It could also be beneficial to frame the first conversations as scoping discussions to identify what themes were relevant to ocean users across the varying sectors or to identify a unique sector of interest. The scoping discussions could then be used to inform the creation of an interview guide with a more precise focus. Additionally, shorter questions, opposed to long complex questions, tended to provide answers that more directly respond to the question and were comparable between participants. Several participants noted that it was

difficult to talk generally about the types of decisions or choices that they face regarding the ocean since decisions can be so broad. One participant suggested using one specific decision that they face as an example based on which they can answer the rest of the questions. Finally, this pilot study had a small sample size and narrow range of ocean users that were selected as participants. Generating more specific selection criteria and increasing the sample size will aid future studies.

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Appendix A: Interview guide used for discussions in pilot study

Interview Guide:

Perspectives of "People on the Water": Leveraging the CalCOFI long-term monitoring program for marine resource decision making

Hi, my name is [name] and I am a Sea Grant Fellow working in partnership with the California Cooperative Oceanic Fisheries Investigation (CalCOFI) program.

We are interested in hearing from people who spend a lot of time on the water or working with ocean data. We would like to ask you a few questions about what kinds of decisions you make in your work, how you get the information you need to make these decisions, any changes you have noticed over time, and what is important for you in your line of work.

This interview should take around one hour to complete, however you are welcome to end the interview at any time. With your consent, we would like to record the interview on Zoom. The recording can be stopped or deleted at your request. The recordings will only be viewed by the project team and your name will not be associated with any perspectives you share. The recordings will be erased when the research is completed.

Questions:

Introduction question:

0. Could you introduce yourself and share your connection to the ocean? You can feel free to share a little about your background, your experience working with the ocean or marine resources.

How much time per month do you spend on the water?
How much time per month do you spend thinking about ocean-related topics?

Decision Making:

1. What kinds of decisions do you make in your work regarding the ocean?
    a. How often are you making these decisions? What is the **time frame** that you are thinking about (ie. seasonal, annual, multi-year?).
    b. **Uncertainty:** what unknowns exist while you are making these decisions? What are you uncertain about?
    c. **Impact:** What is the impact of these decisions? Are they reversible or adjustable if the wrong choice is made?
    d. **Urgency:** What is the urgency of the decision? How much time do you have to make it?

        e. **Complexity:** What is the complexity of the decision? How many different things do you have to consider to make this choice?
2. What kind of experiential knowledge or expertise do you use to make these decisions?
3. What kind of information or data do you consult/reference to make this decision?

Observed Changes:

4. What kinds of changes/trends have you observed during your time spent "on the water"? What stands out most to you?
5. How have these changes impacted your work and how have you adapted?

Futures Thinking:

6. What concerns you most about the future of the ocean?
7. What promises or prospects does the ocean hold? What information is needed to realize this vision?
8. What kind of additional information would be most valuable to you?

Wrap Up:

9. Is there anything else you think we should know or that you would like to share?
10. Who else would you recommend we talk to?

Name and contact information.