Identifying Pathways to Distributive Equity in Ocean Access and Area-Based Marine Management in Central California

ACCESO AL OCÉANO EN CALIFORNIA: BENEFICIOS Y BARRERAS

CALIFORNIA OCEAN ACCESS: BENEFITS & BARRIERS

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California Marine Sanctuary Foundation

Identifying Pathways to Distributive Equity in Ocean Access and Area-Based Marine Management in Central California

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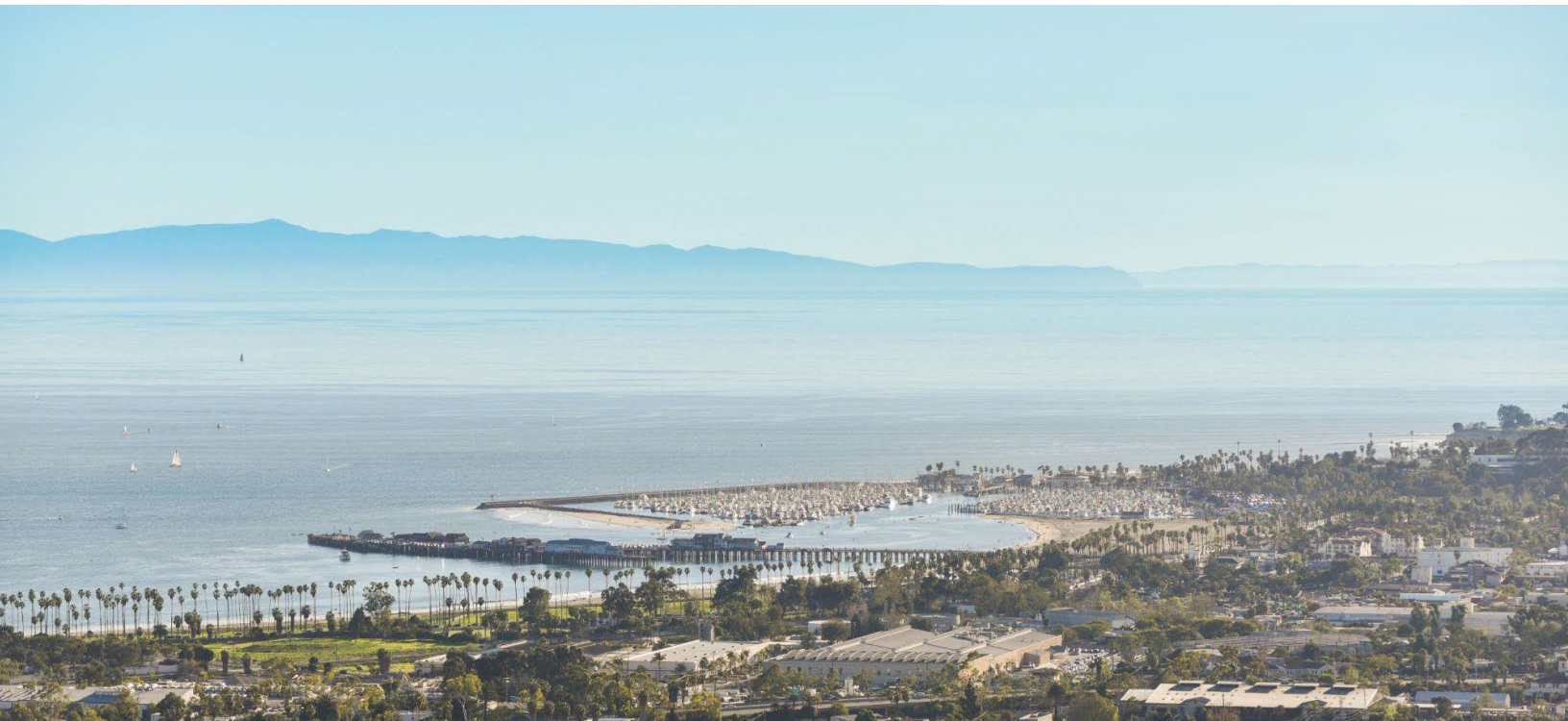
Project Website: https://www.californiaoceanaccessandmpas.com/

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EXECUTIVE SUMMARY

California's ocean and coasts are central to the state's identity, economy, and the everyday wellbeing of its residents. Yet access to and benefits from these areas and ecosystems remain deeply unequal. Despite mandates to ensure public access and enhance opportunities for livelihoods, recreation, and education, the regional mosaic of ocean health, amenities, and engagement continues to be influenced by historical policies of exclusion, uneven investment and regulatory enforcement, and ongoing coastal gentrification. In this report, we examine how marine governance approaches (including the state's Marine Protected Area (MPA) network) can better align ecological objectives with distributive, procedural, and recognitional equity. As part of a participatory and community-engaged research approach, we partnered with local organizations dedicated to advancing environmental justice and promoting ocean literacy to investigate a) how access, activities, values, and benefits from the ocean vary across diverse communities in Central California; and b) how benefits are influenced by management and social and environmental change.

Using a combination of semi-structured interviews, a large-scale survey instrument (n = 2,191 responses), targeted case studies, and focus group discussions, we worked to engage demographics underrepresented in collaborative coastal management processes to date (i.e., urban fishers, Tribal members, environmentally disadvantaged communities, etc.) in providing data, interpreting research results, and co-developing management recommendations. Our findings indicate that, despite existing legal frameworks, ocean access and benefits continue to accrue disproportionately to affluent, White communities living in close proximity to the coast, while underserved communities (including Black and Asian Americans, Tribal members, and/or low-income households) face compounding barriers (i.e., costs, information, social gatekeeping, etc.). In addition, we demonstrate that the loudest and most prominent voices in ocean and coastal management may not represent the needs and priorities of underserved communities, or Californians at large. Though much of modern policy discourse surrounds the provision and sustainability of material attributes (income, livelihoods, food, etc.), relational and subjective values associated with connection, healing, identity, and cultural expression were of primary importance for much of our study population. Rather than a strict focus on objective, ecological, and/or economic metrics, we suggest that MPAs and other conservation interventions would benefit from increased consideration of the diverse connections people have with marine environments (and the multitude of activities that support them) while pursuing strategies that simultaneously advance environmental health and human wellbeing. Indeed, increased attention to the lived experience of different populations across the Central Coast (as rooted in diverse uses, values, cultures, and traditions) is required to better understand how California residents are impacted by and respond to social and environmental change and management interventions.

As currently designed and managed, MPAs alone are unlikely to deliver a full suite of benefits to underserved communities at scale. Yet embedding equity in all stages of the adaptive management cycle and pairing ecological goals with tangible investments in *access infrastructure* (affordable transit/parking, accessible facilities), *information and safety* (multilingual signage, clear and transparent rules, targeted community programming), and pathways to *local workforce development* and *Tribal co-stewardship* could measurably increase engagement, trust, and support. When pursued collectively, we suggest such strategies may help cultivate a new generation of ocean advocates and stewards, aligning biodiversity gains with equitable ocean outcomes for underserved communities, while promoting durable and shared wellbeing across the coast.

Introduction

Ensuring that the benefits derived from healthy and sustainable ocean ecosystems are equitably distributed throughout society is an enduring management challenge (Hicks et al., 2016; Bennett et al. 2020). Across California, ocean and coastal spaces and marine ecosystems are important sources of economic activity and social meaning. They are indelibly linked to the cultural identity of what it means to be a California resident for recent immigrants, multigenerational legacies, and inhabitants since time immemorial. Yet access to oceans and coasts remain deeply unequal (Christensen and King, 2017). Despite resource managers' best intentions, coastal policy and established management and governance structures have often functioned to enhance ocean access and benefits for certain locations, demographics, and user groups at the expense of others (Friend & Moench, 2015; Reinman et al., 2016; Patsch & Reineman, 2024).

To-date, research on understanding human dimensions of marine social-ecological systems (SES) across the region has focused primarily on outcomes for fisheries and other economic sectors with comparatively little attention to other (broader) indicators of social resilience and wellbeing. Though significant effort has been made to engage commercial and sport fishers and tourism operators in the Marine Life Protection Act (MLPA) and other collaborative coastal management processes (Klein et al. 2008), the social values and priorities of stakeholders from minority and low-income populations and Tribal communities have received substantially less attention (Sayce et al., 2013; Hoffman et al., 2018, Stevenson et al. 2012, Quimby et al. 2020). As the pace of global environmental change accelerates, resource managers face an urgent need to better engage the diverse demographics and populations that make up California's coastal communities and better understand their varied relationships with ocean and coastal spaces. Indeed, without explicit attention to equity in marine SES research, interventions may serve only to reinforce systemic inequalities associated with uneven climate vulnerability and adaptive capacity.

Among the tools available to state marine resource managers, Marine Protected Areas (MPAs) are increasingly recognized for their capacity to support climate adaptation and ecosystem resilience (White et al., 2025). Previous research has shown that MPAs help reduce pressure on important fisheries resources (Micheli et al., 2012), while maintaining populations of larger individual organisms that may provide socioeconomic and ecological benefits (Lenihan et al., 2021). In the face of extreme environmental events and/or market and supply chain disruptions, MPAs may also support food security by ensuring that local seafood is available and sustainable (Mascia et al., 2011; Cabral et al. 2019). Yet MPA managers must confront governance and equity challenges when considering how the future will be shaped, for whose benefit, and by whom. While there is mounting evidence concerning the observed and prospective benefits of MPAs to marine ecosystems and resource dependent livelihoods, substantially less research effort has gone into understanding their intersection with social resilience and equity (Halpern et al., 2013; Hill et al., 2016; Richmond and Kotowicz, 2015).

Conservation and management actions that fail to consider such human dimensions and manage for the diverse connections that people have with the marine environment may pose a threat to long-term prosperity and community wellbeing (Bennett et al., 2020). Such conditions can contribute to a negative feedback loop in which perceptions of unfairness and illegitimacy drive unsustainable behaviors (Leach et al., 2018) and undermine social cohesion (Frawley et al., 2019). While several decades ago the establishment of many MPAs was motivated by the belief that separating humans from nature was necessary for achieving environmental protection and biodiversity conservation, recent scholarship has demonstrated the benefits to humans and nature of pursuing strategies that simultaneously advance environmental health and human wellbeing (Halpern et al., 2013; Gill et al., 2019; Nowakowski et al., 2023). Mounting evidence suggests MPAs and other sustainability interventions are most effective in achieving diverse objectives when they explicitly incorporate stakeholder rights and knowledge systems, enable broad participation in decision-making, management, and enforcement activities; and prioritize local benefits (Dalton 2005, Giakoumi et al., 2018, Bennett et al., 2021; Di Cintio et al., 2023). Importantly, equity considerations should extend beyond initial design and implementation and be embedded in ongoing, cyclical processes of monitoring, evaluation, and adaptive management (Kaplan-Hallam, 2017). Though scientific consensus increasingly supports equity centered approaches to MPAs and other conservation interventions, there is no one-size fits all approach. Maximizing benefits and minimizing tradeoffs requires processes and procedures appropriately tailored to local context and governance capacity.

For marine resources managers across the state the central problem is no longer simply how to optimize ecological performance but how to align conservation and climate goals with distributive, procedural, and recognitional equity (Martin 2017). In a recent report authored by the California Ocean Protection Council's (OPC) Science Advisory Team and Ocean Science Trust (Hoffman et al., 2018), expanded capacity to assess and address social science and climate resilience research was identified as a critical research need. The report highlighted the need for human dimensions investigations to address MPA knowledge gaps surrounding a) cultural and spiritual values, benefits, and outcomes; b) social priorities and needs under a changing climate; c) baseline studies and on social and economic service provision; and d) the existence of and interactions between social equity, adaptive capacity, and climate resilience.

The research documented in this report, as funded by California Proposition #68 (i.e., the California Drought, Water, Parks, Climate, Coastal Protection, and Outdoor Access for All Act of 2018), was developed to help address these knowledge gaps in a manner consistent with specific Goals and Objectives outlined in the OPC Strategic Plan (OPC 2020) including:

Goal 1: Safeguard Coastal and Marine Ecosystems and Communities in the Face of Climate Change; Objective 1.3: Improve Understanding of Climate Impacts on California's Coast and Ocean; Objective 1.4: Understand the Role of California's Marine Protected Areas in Conferring Climate Resilience.

<u>Goal 2</u>: Advance Equity Across Ocean and Coastal Policies and Actions; Objective 2.1: Enhance Engagement with Tribes; Objective 2.2: Enhance Engagement with Underserved Communities; Objective 2.3: Improve Coastal Access.

More specifically, the investigations undertaken by the research team (composed of researchers affiliated with the University of California Santa Cruz, California Marine Sanctuary Foundation, University of Washington, Stanford University, University of California Santa Barbara, and the Native Coast Action Network) were guided by the six research aims described in **Figure 1**. While the initial, motivating research questions concerned how MPAs might function to enhance (or diminish) the climate resilience of disadvantaged populations (as defined by the California Environmental Protection Agency (CalEPA); see *Section 3.0*) and Tribal communities, many of these Research Aims reflect a broader focus designed to assess more fundamental, prerequisite knowledge gaps. Indeed, a primary conclusion of the research is that prior to assessing the roles of MPAs in the adaptation and/or resilience of underserved communities one must first consider how different populations value and interact with ocean and coastal spaces and engage with associated management processes (or don't), and why.
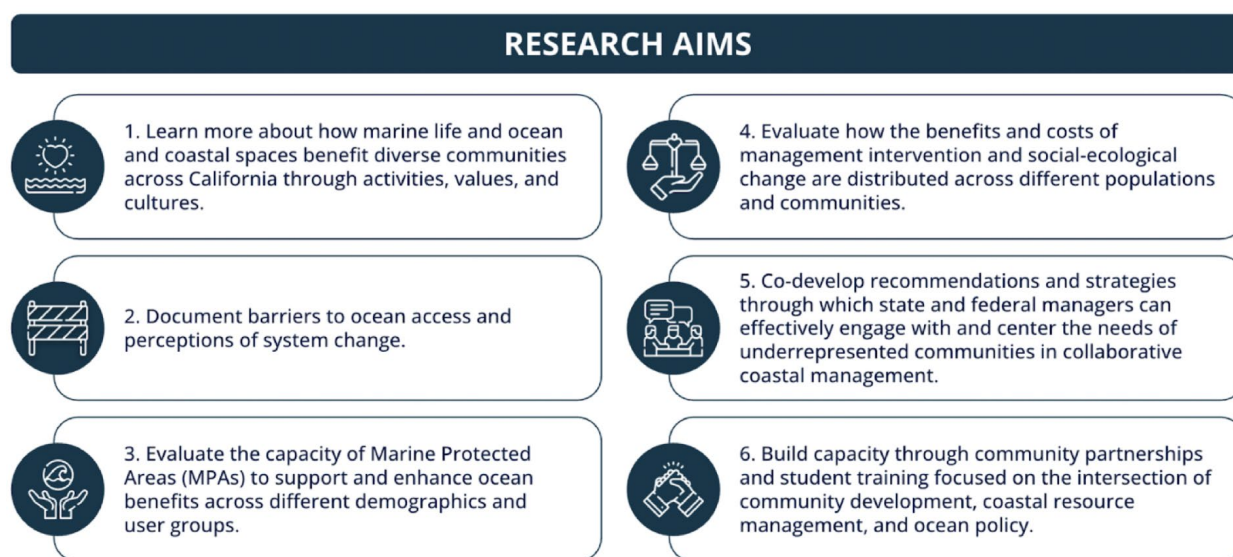

RESEARCH AIMS

1. Learn more about how marine life and ocean and coastal spaces benefit diverse communities across California through activities, values, and cultures.

2. Document barriers to ocean access and perceptions of system change.

3. Evaluate the capacity of Marine Protected Areas (MPAs) to support and enhance ocean benefits across different demographics and user groups.

4. Evaluate how the benefits and costs of management intervention and social-ecological change are distributed across different populations and communities.

5. Co-develop recommendations and strategies through which state and federal managers can effectively engage with and center the needs of underrepresented communities in collaborative coastal management.

6. Build capacity through community partnerships and student training focused on the intersection of community development, coastal resource management, and ocean policy.

Figure 1. *Focal research aims of the investigations described in this report.*

Our research aims were developed and pursued as part of a participatory and community-engaged research process in which the research team partnered with local non-profit organizations (n = 5) that were based in one or more of our focal study areas (i.e. Southeast San Francisco, Monterey Bay, Ventura/Oxnard, and Santa Barbara). The motivation for this approach is derived from an expanding body of scientific literature which suggests that collaboration with place-based organizations can build capacity for community-centered conservation governance (Armitage et al., 2020). More specifically, there is widespread evidence that engagement with local communities contributes to the social success of MPAs, including trust in management and perceived positive ecological benefits (Christie and White, 2007; McClanahan et al., 2005; Pajaro et al., 2010). Our partner organizations are

well-established in the communities in which they are based, and have missions dedicated to advancing coastal access and engagement and/or environmental justice. Community partnerships were leveraged to obtain feedback on experimental content and design, engage community-members in providing data, contextualize and interpret research results, and co-develop management recommendations. Though more specific detail is contained in each of the sub-sections below, a general overview of the research process is illustrated in **Figure 2.**
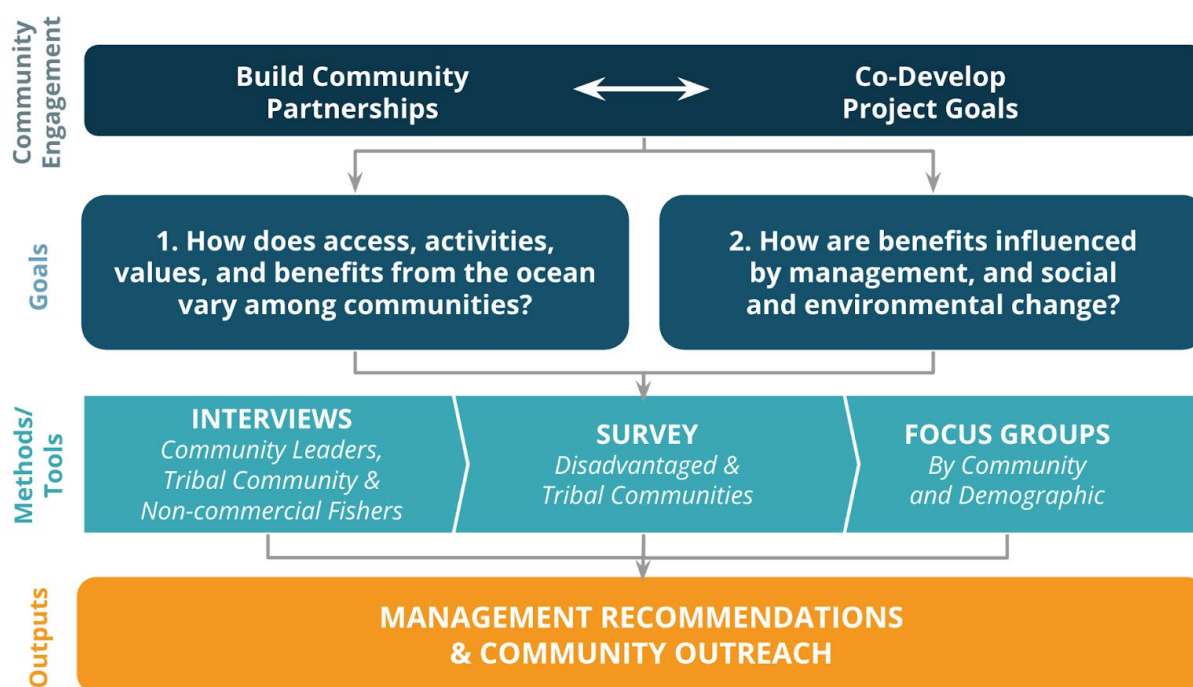

Figure 2. *Research process overview. In summary, community-partnerships w/ organizations based in Southeast San Francisco (Literacy for Environmental Justice), Watsonville (Regeneración), Santa Barbara (Sea League), Oxnard (Reel Guppy Outdoors), and Ventura (MERITO Foundation) were used to co-develop project goals and articulate specific research aims. Semi-structured interviews with non-commercial fishers (n = 12), community leaders (n = 10) and members of Tribal communities were used to identify and explore issues of local importance for different regions and demographics and inform the design of a structured survey instrument that was administered to 2,191 individuals across the state. Focus group discussions targeting different geographic communities (n=7) and demographics (n=3) of interest were subsequently used to validate, contextualize, and interpret survey results and facilitate the co-development of management recommendations.*

In the pages that follow we present the results of targeted investigations, beginning with holistic scoping projects which centered mixed methods and qualitative insight obtained from semi-structured interviews (*Section 2*), before moving into research that parses and analyzes data streams associated with the structured survey and focus groups instruments (*Section 3*), and ending with a short, summary conclusion (*Section 4*) intended to serve as a high-level policy brief featuring co-developed recommendations (**Research Aim 6**). More specifically, *Sections 2 & 3* contain:

Section 2.1 ("Mixed Methods Insights into Urban Fishing Practices, Culture, and Policy Gaps") employs and validates a novel method for extracting insight from social media data to explore variation in fishing strategies and motivating values across distinct non-commercial fishing subcultures and analyze how these groups experience and respond to ecological shifts and regulatory change. **Research Aims 1, 2, & 4**.

Section 2.2 ("Understanding and Restoring Access for Tribal Communities") integrates Western and Indigenous knowledge systems, and leverages semi-structured interviews to explore Tribal relationships with the coast, barriers that disrupt the continuity of coastal Tribal culture, and solutions to overcoming these barriers. **Research Aims 1-5**.

Section 3 ("Survey & Focus Groups Methods and Sample") briefly outlines the methods through which survey and focus group data was obtained and processed and the scope of the resulting samples. **Research Aims 1-4**.

Section 3.1 ("Integrated Assessment of Barriers to Ocean Access and Human Wellbeing") reports on the analysis of survey data used to a) evaluate how socioeconomic, demographic, and geographic factors interact to determine access of and engagement with ocean and coastal spaces; b) identify the most significant barriers to access for different groups; and c) assesses how these barriers function to mediate ocean's contributions to human wellbeing. **Research Aims 1 & 2**.

Section 3.2 ("Asian-American experiences of the central California coast") synthesizes survey and focus group results to a) understand the cultural significance of coastal use to Asian Americans; b) clarify social barriers and their intersectional dimensions faced by Asian Americans in accessing the coast; and c) summarize solutions to ocean access barriers. **Research Aims 1, 2, & 5**.

Section 3.3 ("Perceptions and Priorities Surrounding Area-based Marine Management across the Central California Coast") concerns data from a priority-ranking exercise to a) assess and compare priorities for area-based management across the diverse demographics that comprise our sample of survey respondents; and b) identify the demographic and behavioral basis of emergent stakeholder groups with shared opinions and beliefs. **Research Aims 3 & 5**.

Section 3.4 ("Climate Impacts on Regional Marine Environments and Coastal Spaces: Observations & Concerns") presents and compares information concerning survey respondents' a) general climate beliefs; and b) perceptions of and concerns surrounding environmental and socioeconomic drivers of change with the capacity to impact regional ocean use and benefits. **Research Aims 2 & 4**.

It is worth noting (as described in the *Authorship Information & Research Next Step*s subheading of each section) that the information presented in this report is often an excerpt of more exhaustive and detailed scientific manuscripts (in preparation or already submitted and undergoing peer-review with scientific journals). In such instances we have provided links to

preprints and/or the contact information of lead authors. Likewise, though a complete description of student training and community partnerships (**Research Aim 6**) is beyond the scope of this report, we would direct readers looking for additional information to the project website: https://www.californiaoceanaccessandmpas.com/

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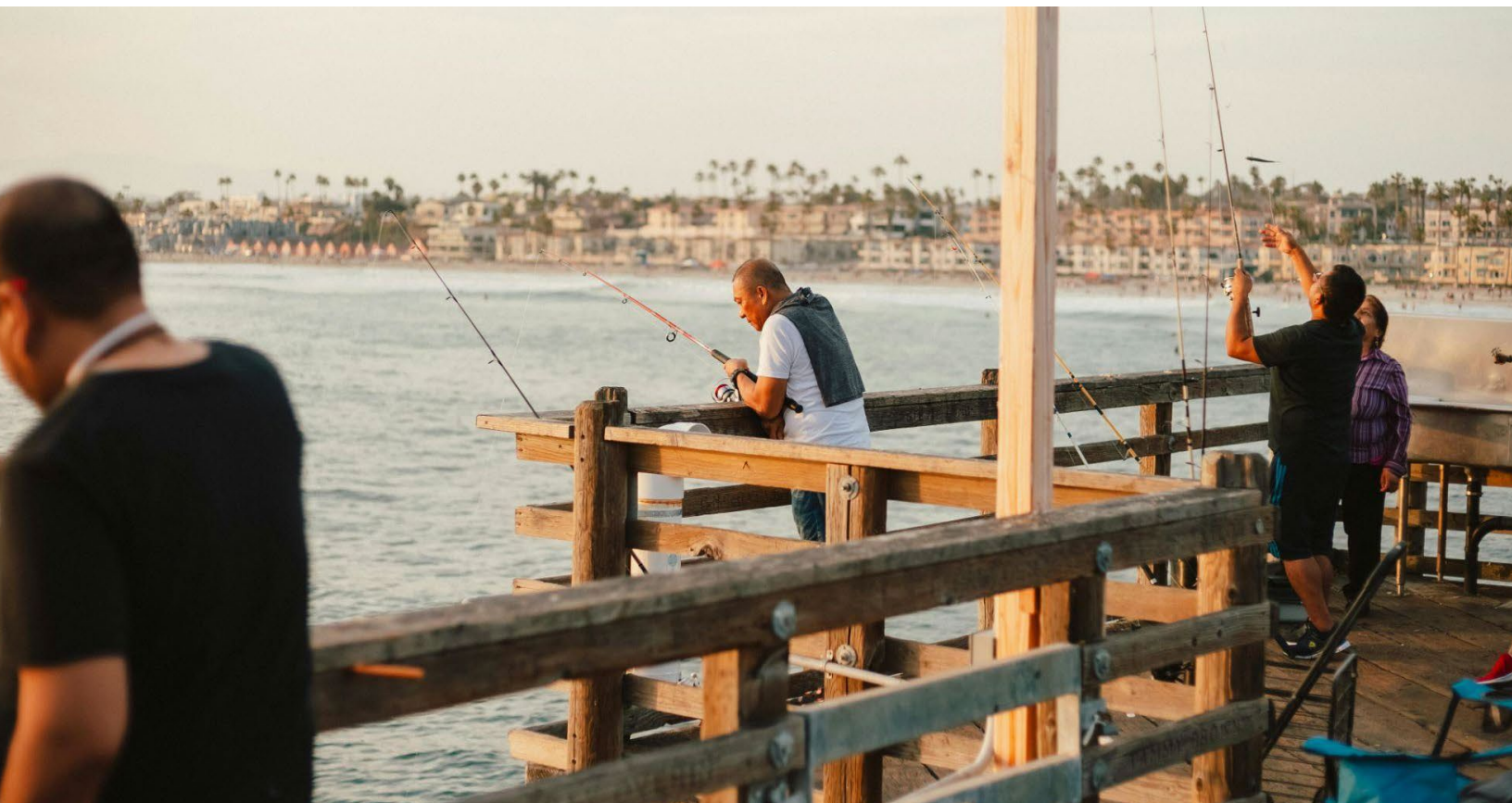
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PART 1
EXTERNAL ANALYSES

1.1. Mixed Methods Insights into Urban Fishing Practices, Culture, and Policy Gaps

Introduction

A comprehensive understanding of how different types of resource users interact with the marine environment is critical for effective and equitable marine monitoring and governance (Potts et. al., 2020; Furman et al., 2023). In California, significant effort has been made to engage coastal stakeholders in the Marine Life Protection Act (MLPA) and other collaborative coastal management processes. Yet, the participation of certain commercial and recreational fishing lobbies has often been prioritized over that of other more informal and underrepresented groups (Stevenson et al., 2012; Sayce et al., 2013). With the long-term success of Marine Protected Areas and other conservation strategies dependent upon public perceptions of legitimacy (Voyer et al., 2015) and equity (Hampton-Smith et al., 2024), there is an urgent need across the State to pursue more inclusive approaches in marine resource monitoring and management.

Below we adopt a mixed-methods research approach to highlight the activities and amplify the voices of non-commercial fishers (i.e., individuals who fish for personal use, recreation, or cultural purposes rather than for profit) in the San Francisco Bay Area. Previous studies focused on California recreational fisheries have frequently failed to differentiate recreational fishers motivated by sport and pleasure from those motivated by food security and/or other more complex relational and subjective values. Those studies that have made an explicit effort to move beyond licensed and vessel-based recreational fishing activity -in considering California pier and shore fishers- suggest that such groups are more likely to include immigrants, ethnic minorities, and non-English speakers (Pitchon & Norman, 2012; Quimby et al., 2020). Despite possessing deep, place-based knowledge of local species and ecosystems and exhibiting a high degree of dependence on marine resources for nutrition and wellbeing, to-date these user groups have been largely overlooked in formal assessments of fisheries effort, impact and access (Stevenson et al., 2012).

Combining qualitative insight obtained from semi-structured interviews (n=12) with a quantitative analysis of social media databases encompassing 41,464 Instagram posts documenting regional fishing activity (2014-2023) we: a) describe variation in fishing strategies and activities across regional, non-commercial fishers, leveraging a new and replicable method for extracting quantifiable data from large volumes of social media activity; b) use content analysis to identify and compare motivating values across different recreational fishing cultures and subgroups; and c) characterize how these groups are experiencing and responding to emergent ecological and regulatory changes impacting the fisheries system.

Methods and Analytical Approaches

Recognizing the imperative to better address the activities, needs, and vulnerabilities of user groups underrepresented in coastal management processes to-date, there is growing interest in incorporating insight from novel and/or alternative data sources. Among these, social media is increasingly recognized as a valuable, low-cost tool for real-time monitoring of coastal resource use and for detecting behavioral response to ecological and regulatory change. To obtain social media data relevant to non-commercial fishing activity in the San Francisco Bay Area, we developed an iterative, sequential approach reliant on a custom web scraper produced and maintained by Apify (i.e., apify/instagram-hashtag-scraper). This procedure obtained relevant photos, captions, and metadata from Instagram posts which included hashtags relevant to regional Fishing Areas (i.e., #bayareafishing, #831fishing, etc.; n = 27193 posts), pier and/or shore-based Fishing Groups (i.e., #southbayanglers, #westcoastcrabbers, etc.; n = 8507 posts), and Fishing Charters (#gatecrasherfishing, #happyhookersportfishing, etc.; n = 5818 posts). We then developed a series of data processing procedures through which the information contained within post captions could be used to a) quantify and compare fisher behavior, motivations, and species targeting; and b) explore how such factors may have changed over time. All procedures and analyses were informed by and ground-truthed using semi-structured interviews designed to qualitatively explore how regional non-commercial fishers interact with the ocean, their reasons for doing so, and how those activities had been impacted by recent regulatory and/or environmental changes.

Selected Data Summaries, Analyses, Figures, and Interpretation

Species targeting of Bay Area non-commercial fishers inferred by social media posts broadly corresponded with those articulated in semi-structured interviews. The taxonomic groups most frequently mentioned (i.e., referenced in the text captions and/or hashtags which accompany photos within social media posts) within our Fishing Areas data set were Striped Bass (24.9 %), California Halibut (19.9 %), Salmon (11.4%), and Rockfish (10.4 %) (**Figure 3A**). Overall, 15,783 of the 27,193 of the posts (58.3%) in this dataset mentioned one or more of our focal species. A comparison of species observed (via manual photographic review and species identification) with species mentioned in a random subset of 1,400 posts (**Figure 3B**) confirmed that species mentions can be used as an accurate proxy for photographically documented catch (R^2 = 0.894, $p < 0.0001$). Seasonal distribution of records across the most commonly mentioned and targeted species and taxonomic groups revealed temporal patterns driven by individual prioritization, species biology and life history, and local fishing regulations and restrictions. As one interview respondent reported, "*In the summers, I hit the bay. So we're looking at the halibut, striper, and salmon... Now if you're asking what's my favorite, it's salmon number one*," (Pier and Shore Fisher, Interview #8).

Semi-structured interviews reflected non-commercial fishing as an activity deeply rooted in the social and cultural fabric of the regional, coastal social-ecological system. Individuals reported diverse and interconnected reasons for fishing, ranging from practical needs to personal and subjective motivations. Beyond valuing fresh, self-caught seafood as a healthier (and more affordable) alternative to store-bought fish, fishing was often described as an activity that
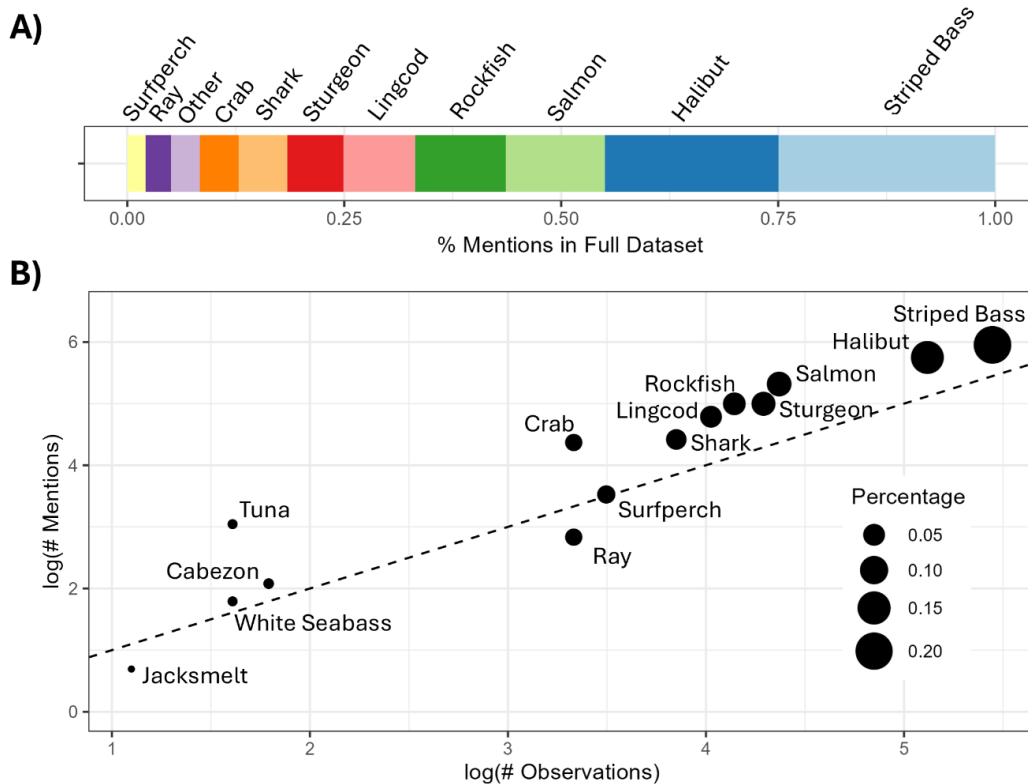
Figure 3. *Comparison of species that were observed (i.e., manually identified from photos) and species that were mentioned (in post captions) in the Fishing Areas dataset.* **A)** *Shows the relative frequency at which marine organisms embedded in different species categories were mentioned across the complete data set (n=27,887 total mentions, with posts frequently mentioning more than one species), while* **B)** *shows the broad and significant ($R^2 = 0.894$, $p < 0.0001$) correspondence between the log-transformed number of times different species were observed and the log-transformed number of times they were mentioned in post captions and/or hashtags in a 1,400 row random subset (~5% of each component hashtag). In* **A)** *tuna, cabezon, white seabass, and jacksmelt are lumped together in the "Other" category while in* **B)** *these species are displayed individually.*

helped strengthen social bonds. Fishing provided an opportunity to spend meaningful time with friends and family, passing down knowledge concerning specific practices from one generation to the next, and was frequently associated with a sense of belonging. Indeed, important aspects of regional, cultural identity were sustained by the rituals and traditions through which specific species are caught, shared, and/or consumed communally (i.e., serving fresh Dungeness crab for Thanksgiving). Beyond that, fishing was described as a source of peace and tranquility while offering a unique opportunity to disconnect from the modern, technology-focused world and practice self-reliance. As one respondent described, "*I wish I could explain it…it's just kind of like your happy place. You get out there, you're away from everything. Just kind of like a peaceful thing...*" (Boat Fisher, Interview #6).

Wordclouds used to parse the captions associated with posts within and across Fishing Groups and Fishing Charters social media datasets helped characterize nuances in the sub-cultures associated with different types of non-commercial fishing activity (**Figure 4**). As compared to
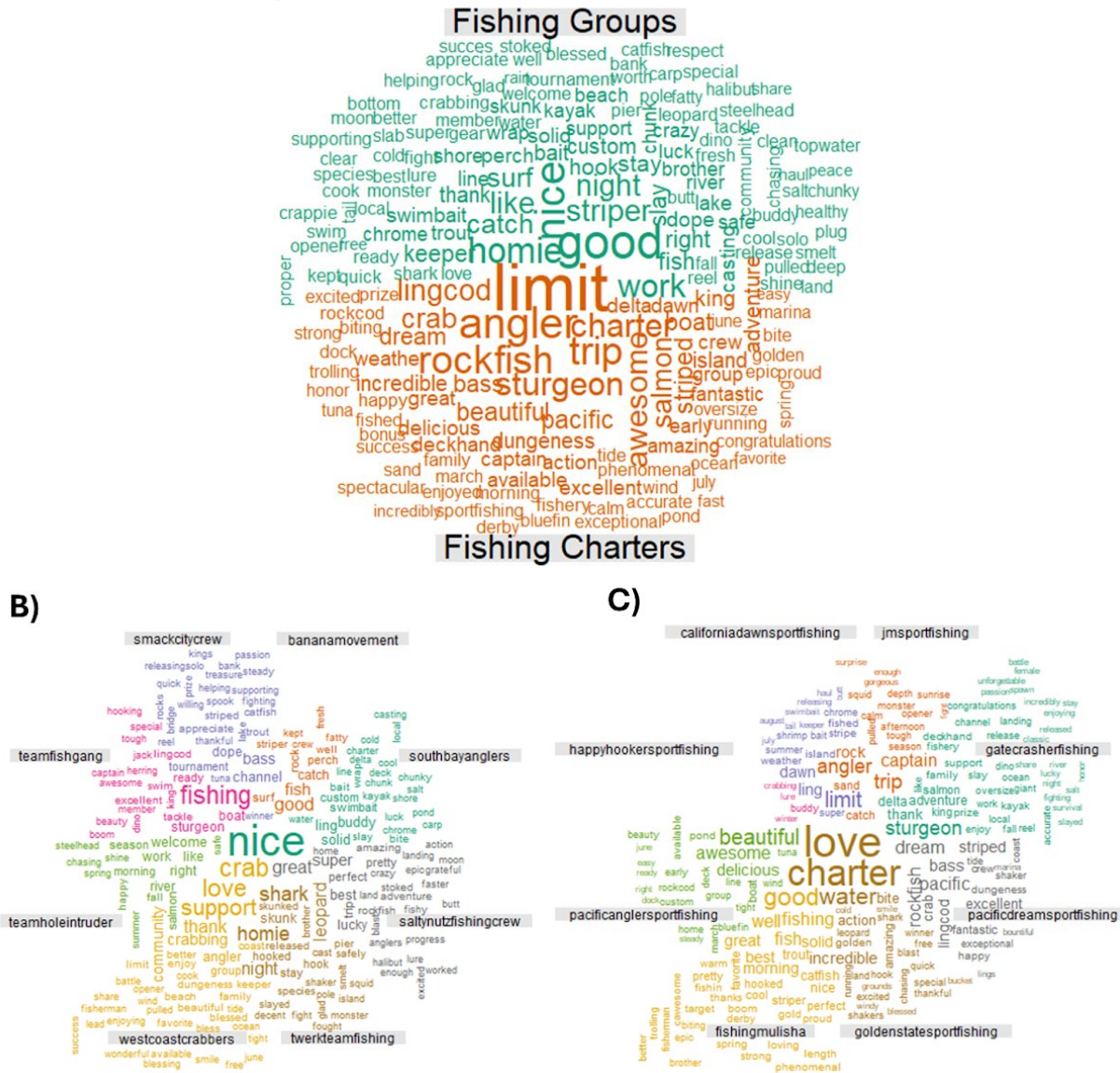
Figure 4. *Word clouds used to compare the relative frequencies of different words used in the captions of the Fishing Charters and Fishing Groups datasets (A). In constructing each comparison cloud, we only retained words from the post captions that were included a list of 2,000 words associated with positive opinions and/or feelings commonly used in sentiment analysis (Liu et al., 2005) and/or list of words (assembled for the purpose of this project) that were used > 50x across all captions in the Fishing Areas dataset and were associated with marine life, nature, and/or fishing. Disaggregated analysis used to compare the relative frequency of words within different data sets (by club, organization, and/or businesses) are shown in panels B) Fishing Groups, and C) Fishing Charters.*

the Fishing Groups data sets, Fishing Charters posts more frequently emphasized "excitement", "adventure", and "action", while using superlative language such as "amazing", "fantastic", "awesome" or "exceptional". In addition, a major focus and goal of Fishing Charters appeared to be competition and/or catch maximization, as inferred by frequent use of "limit" in addition to "success" and "congratulations". In contrast, Fishing Groups more frequently used informal

slang words (i.e., "dope", "stoked" "slayed", "fatty"), emphasizing fishing as an escape from "work" that offered the opportunity to connect with "homie[s]" and "Brother[s]". Expressions of gratitude and connection were more frequent (see "love", "respect", "appreciate", "thank", and "blessed") and, rather than maximizing catch, a primary goal of shore and pier based fishers appeared to be avoiding the "skunk" (i.e., going home with zero catch).

Across the interviews, fishers noted shifts in the environment, regulatory landscape, and fishery participation that had influenced their activities during recent years. There was widespread agreement regarding the growing unpredictability of seasonal runs and species availability. While some respondents described warming waters and ecosystem shifts responsible for changes in migration patterns and population dynamics of salmon and tuna species, others focused on how recent storm events had physically altered nearshore habitat that once supported productive crab and halibut fishing. Policy approaches and interventions designed to address such changes were largely perceived as short-sighted, ineffective, and inequitable, with the 2023 California Salmon fishery closure repeatedly referenced as a salient and timely example of reactive management. With salmon fishing closed, fishing pressure was redirected to halibut across recreational and commercial fishing sectors, resulting in an in-season reduction to the halibut bag limit for recreational fishers. Many interview subjects noted that recent changes in fishing participation had likely functioned to intensify such resource allocation conflicts. With fishing gaining popularity during the COVID-19 pandemic (beginning in 2020) as a socially distanced outdoor activity, many piers and other traditional shore fishing spots were now perceived as overcrowded. Though complicated by differences in the number and type of posts made each year, time series analysis of social media data confirmed many of the large-scale changes to regional, non-commercial fisheries discussed in the semi-structured interviews (**Figure 5**). When comparing species that were mentioned more or less frequently in 2023 in the Fishing Groups and Fishing Charters dataset as compared to other years (**Figure 5B**) overall negative Salmon, Lingcod, and Sturgeon (Charters only) anomalies were most pronounced, while the largest magnitude anomalies were positive as associated with Halibut (Charters) and Striped Bass (Groups).

Implications

This research directly responds to the need for empirical, community-centered studies which illuminate how social-ecological systems are responding to management intervention and climate stress (Hoffman et al., 2021). Despite the San Francisco Bay's extensive coastline and rich maritime heritage, little information exists concerning the modern nature and extent of non-commercial fishing undertaken by its ~ 7.5 million residents. Our analysis reveals a complex social-ecological system in which a rich tapestry of resource users engage in diverse activities in pursuit of numerous consumptive and non-consumptive benefits. Though management approaches designed to maximize the sustainable yield and economic productivity of fish stocks are comparatively well-developed (i.e., catch limits, spatio-temporal closures, etc.), our findings emphasize the need to develop a complementary toolbox to recognize and protect the
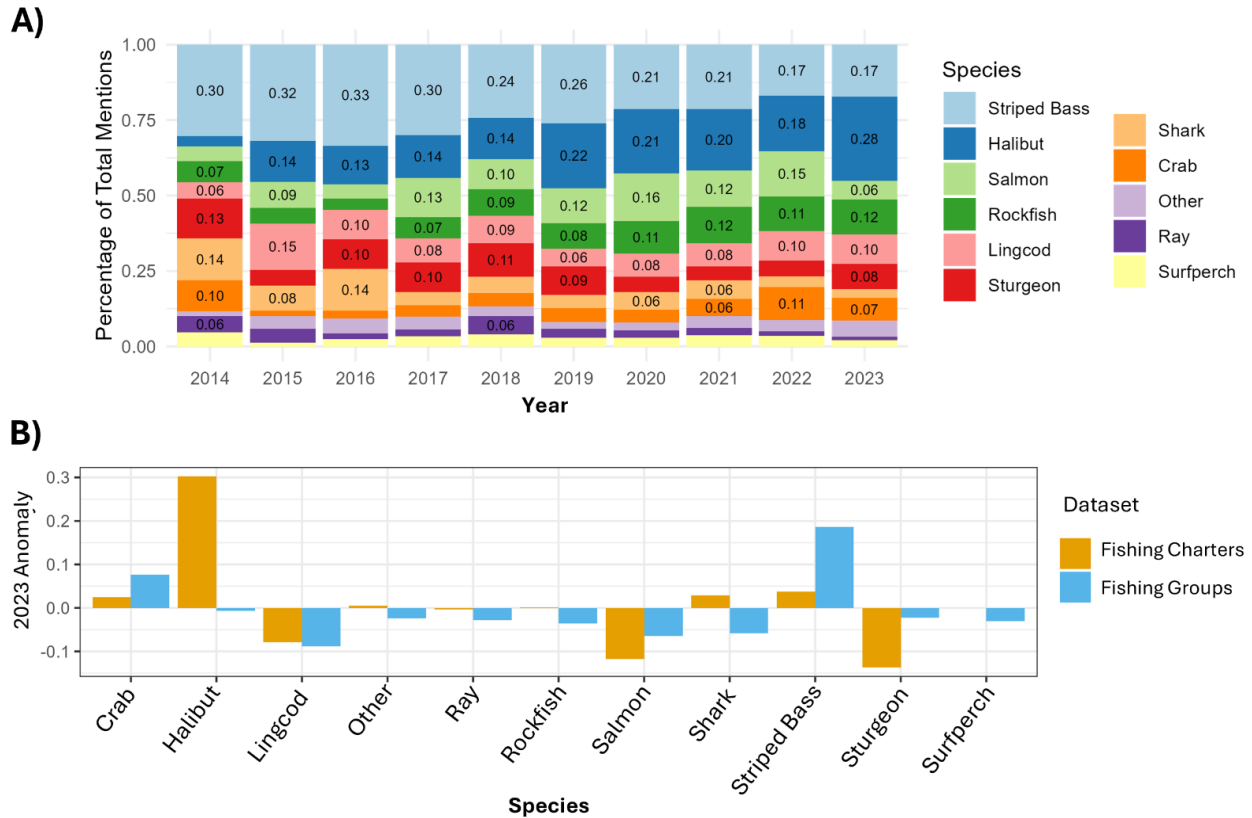
Figure 5. *Changes in the nature of posting activity and number of species mentions over time (2014-2023). A)
illustrates changes in the relative number of mentions in social media posts by species (i.e., percentage of total
mentions) in a single, aggregated dataset (i.e., Fishing Areas + Fishing Groups + Fishing Charters) and B) highlights
changes of the relative frequency of species mentioned in the Fishing Charters and Fishing Groups datasets in 2023
as compared to the annual average. Anomaly values > 0 indicate that the species was mentioned more frequently
in 2023 as compared to other years and anomaly values < 0 indicate that the species was mentioned less frequently
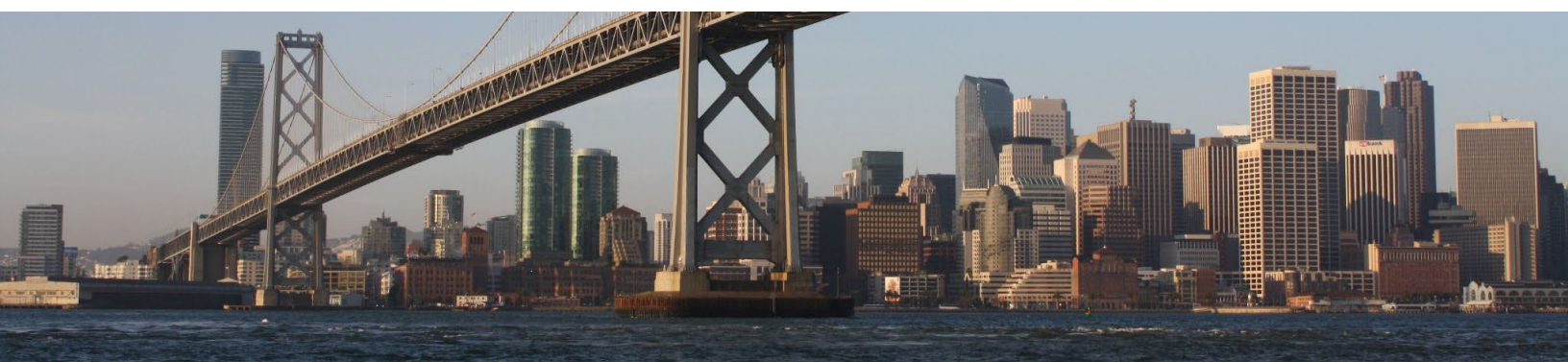in 2023 as compared to other years.*

non-material benefits derived from fishing (i.e., intergenerational knowledge transfer,
community bonding, cultural identity, etc). These benefits, though difficult to monitor and
quantify through traditional data sources and research approaches, are fundamental to the
social fabric of urban coastal communities (Stevenson et al., 2012; Furnman et al., 2023). In
seeking to advance more participatory and equitable marine governance and climate
adaptation strategies, an essential first step may be developing procedures to increase the
scope of who is counted and considered and what practices are seen as legitimate in formal
fisheries management. A continued reliance on top-down management approaches, narrow
data inputs, and formal stakeholder engagement processes may function to further marginalize
underrepresented groups for whom participation in non-commercial fisheries is an essential
part of individual and community wellbeing (Pitchon & Norman, 2012; Quimby et al. 2020).
Though this web-scraping approach is not without limitations, it serves as a valuable proof-of-
concept concerning how user-generated digital fisheries data may be uniquely suited in
democratizing knowledge production and documenting overlooked patterns of participation
and adaptation in near real-time.

Authorship Information & Research Next Steps

The information presented in this section comprises a portion of a student-led research effort in which the primary data collection and analyses were conducted by undergraduates based at the Iowa State University (Maryam Krauss) and Stanford University (Plengrhambhai S. Kruesopon and Roya Meykadeh). The complete, draft manuscript entitled "From Shorelines to Social Media: Mixed-Methods into Urban Fishing Practices, Policy Gaps, and Culture in the Digital Age" is currently undergoing peer-review at a scientific journal and can be accessed as a pre-print at the following link: https://doi.org/10.32942/X2D64X

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1.2. Understanding & Restoring Ocean Access For California's Tribal Communities

Introduction

We recognize that many readers of this report are well-versed in ocean policy and Western governance paradigms through formal training or professional experience. In contrast, fewer may have direct exposure to Indigenous paradigms, including place-based Indigenous Knowledge (IK) from California's central coast, or to contemporary Indigenous communities more broadly. Yet Indigenous peoples, including the authors of this report, are woven through American and Californian society. With this context, we begin by outlining Western and Indigenous approaches to coastal management, reviewing current structures and Tribal communities along the central California coast, before presenting our research methods, findings, and recommendations.

Western ocean management has often been rooted in the view that people and nature are separate, and that natural resources exist primarily to benefit humans. In traditional policy approaches, there has been a dominant focus on economic benefits from the ocean (e.g., Nicolls et al., 2020; NOAA 2024). Over time, this thinking evolved into models such as social-ecological systems, which treat people and ecosystems as distinct but interacting subsystems, though still emphasizing material benefits like food and income (Ostrom 2009). More recent frameworks, such as the well-being approach, expand the Western Paradigm to include non-material benefits (Ota et al. 2023). Western perspectives are also tied to knowledge systems that prioritize generalizable insights over place-based understanding (**Figure 6**).

Indigenous paradigms differ fundamentally from Western ones by viewing the world as a family of living and non-living relatives—including animals, plants, water, rocks, and the ocean—rather than resources for human use (Simpson 2017; Cordero et al., 2019; Topa & Narvaez 2022; Smith 2022) (**Table 1**). Humans are neither central nor superior in this family, but hold responsibilities of care, gratitude, and reciprocity to all their non-human relatives (**Figure 6**). As Chumash elders explain, their cosmology carries a sacred duty to live in knowledgeable, regenerative relationship with the land, waters, and beings (Cordero et al., 2019). Indigenous Knowledge is also deeply place-based: knowledge is tied to specific landscapes and relationships, not generalized abstractions (Wilson 2008; Goeman 2015; Million 2015). This underrepresented perspective - and knowledge system - increasingly is recognized as important in marine resource management, including for California's oceans (Dawson et al., 2021; Reid et al., 2021; OPC 2023; Strand et al., 2024; Teixidor-Toneu et al., 2025).

For millennia (13,000–18,000+ years), California's coastal Tribes have managed and harvested food from the ocean through fishing, gathering, hunting, and burning practices, each tied to distinct laws, traditions, and ancestral territories (Anderson et al., 1997; Erlandson et al., 2007; McGinnis et al., 2014; OPC, 2023; Gamble, 2025). Colonization profoundly disrupted these

Table 1. *Key Terms for understanding the relationship between Tribal communities and the more-than human relatives that inhabit the oceans and coasts of California.*

Indigenous Principles	Definition
Reciprocity	Mutual and reciprocal gifting between humans and the earth, emphasizing a balanced relationship where humans give back in gratitude and care what they receive from the natural world. - Kimmer (2013)
Regenerative	Interactions that foster increases in resource health and abundance. - Cordero et al (2019)

practices through Spanish missions (1769–1834), land grants (1784–1846), disease, state- and federally-sanctioned violence (e.g., Burnett, 1861), slavery (e.g., Act for the Government and Protection of Indians, 1850), boarding schools, and the criminalization of Native practices and religions (e.g., Code of Indian Offenses, 1883). Such colonization practices intentionally erased Indigenous cultures - a practice which persists in mainstream narratives today (Simpson, 2014). Yet Tribal communities are regenerating culture, rebuilding their Nations, and reasserting their values and knowledge systems. Recent ocean management milestones in California include the Tribal Marine Stewards Network (2022), the Indigenous Marine Stewardship Area (the first Tribally led MPA in California, 2023), and the Chumash Heritage National Marine Sanctuary (the first co-managed National Marine Sanctuary in the U.S., 2024). Renewed stewardship and equitable ocean access are central to this process.

Methods & Analytical Approaches

Here, we sought to understand: (1) What are the foundations of Tribal relationships with coasts and oceans?; (2) What are barriers that impede or make it difficult for Tribal members to access ocean spaces, maintain their culture, and/or benefit from the ocean?; and (3) What solutions could strengthen coastal Tribal cultures and relational values, and reduce barriers? To address these questions, we wove together Indigenous and Western knowledge systems (**Figure 6**) (Kimmer 2013; Reid et al., 2021; Strand et al., 2024) and developed an interview protocol for Tribal community members in the central California coast which focused on topics including: relationality and reciprocal care/stewardship; ocean connections, access, & places; climate change experiences & concerns; awareness & experiences with MPAs & Sanctuaries; traditional ocean uses; Indigenous contributions to ocean management; and solutions. This interview protocol (i.e., "Tribal Member Interview Protocol") can be accessed online using the following hyperlink: https://github.com/thfrawley/OPC_Final_Report. We invited 29 respondents from eight central California coastal Tribes to participate (Amah Mutsun, Chalon, Chumash, Costanoan, Esselen, Ohlone, Rumsen, Salinan) with a 34% response rate. We sought to include and represent a variety of experiences within the Tribal community including Federally recognized tribes, non-Federally recognized tribes who are recognized by the California Native American Heritage Commission, and non-affiliated individuals with Tribal heritage. We conducted 10 interviews with 12 respondents. With respondent's permission, we recorded interviews and transcribed them using Grain transcription software. Using our two-eyed seeing

framework (a guiding principle for understanding the world through eyes of both Indigenous and Western knowledge systems; **Figure 6**) (Reid et al., 2021), Indigenous research paradigms
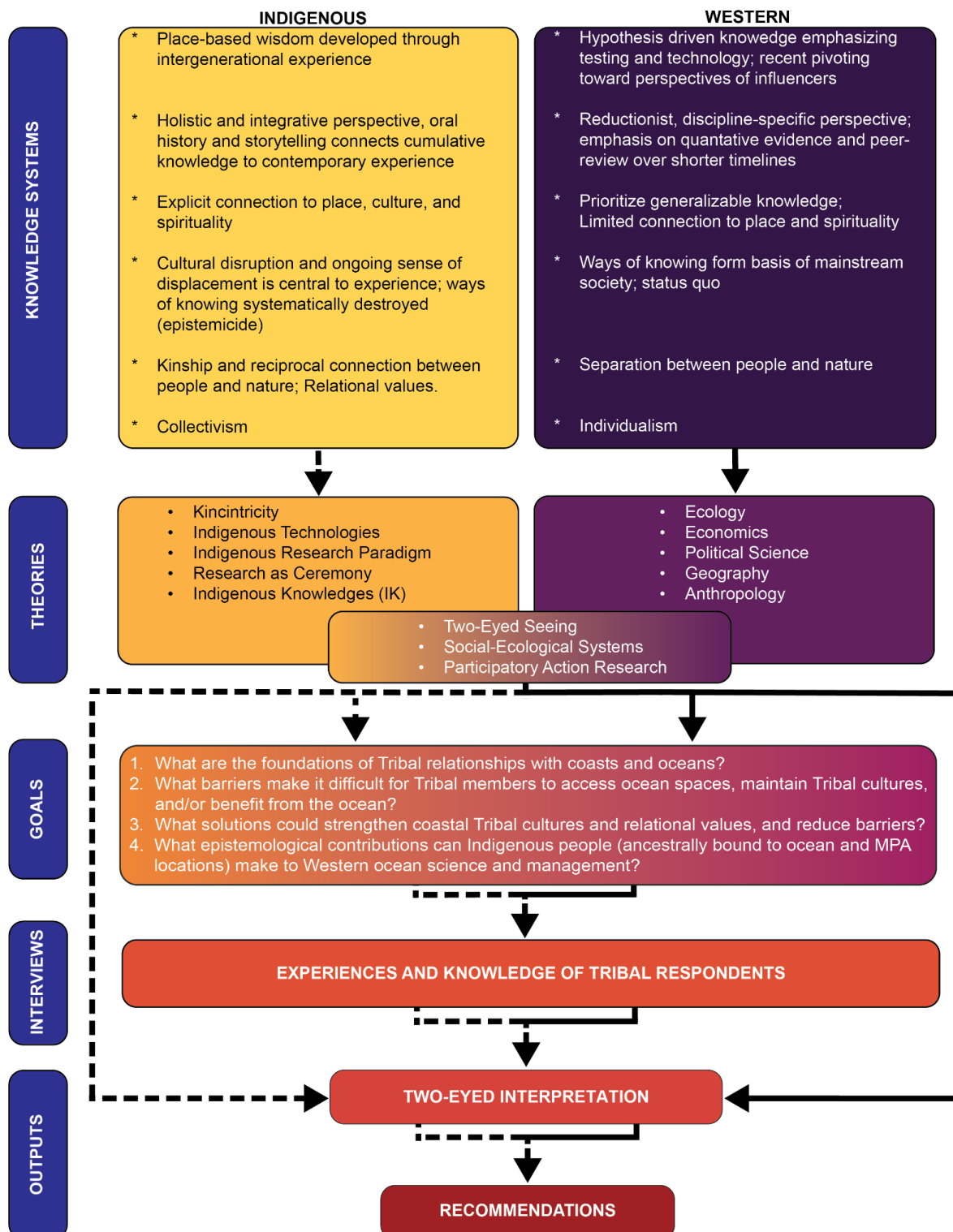

Figure 6*. This project used an Indigenous-Western research framework to develop questions, interpret interviews, and develop recommendations.*

(Smith 2022), and social-ecological systems theory (Ostrom 2009), we developed codes and applied them to analyze interviews (**Table 2**). Interview quotes presented in the results are edited slightly for clarity and to preserve anonymity. While Western scholarship often emphasizes outcomes, Native American and Indigenous Studies (NAIS) scholars highlight the importance of process—long-term relationships, co-creation, iterative questions, and ethical engagement. Research can also surface harms, including grief tied to lost access to homelands, ceremonies, and food systems. Guided by the CARE Principles for Indigenous Data Governance (Carroll et al., 2020), our team worked with a Native American and Indigenous Studies PhD candidate who helped design the framework and was set to code interviews. However, when the trauma of hearing her community's struggles led her to step back from the project, we

Table 2. *Codes, descriptions, and themes used for analyzing transcripts from interviews with Tribal members in central California for relational values, barriers, and solutions.*

Code	Definition	Themes	References
Relational values	Values linking people and ecosystems via tangible and intangible relationships to nature as well as the principles, virtues and notions of a good life that may accompany these.	Relational values, or kincintricity, include a "fundamental gratitude to the land, waters, and living beings of this area for our existence, sustenance, and wellness. Embedded in this gratitude is a sacred responsibility to protect, care for, and live in a deeply knowledgeable, reciprocal, and regenerative relationship with these relatives." Here, relatives are considered to be human and non-human. Non-human relatives comprise animals, plants, rocks, places like the ocean that have spirit/are animate. This is in contrast to inanimate objects such as your water bottle. Relational values include a responsibility for stewardship and care of these non-human relatives, and are a core part of individual and community identity, social cohesion, and livelihoods.	Cordero et al. (2019); Martinez et al. (2023); Pratson et al. (2023)
Barriers	Factors make it difficult for Tribal members to access ocean spaces, maintain their culture, carry out activities, and/or benefit from the ocean.	Barriers include personal, social, knowledge, physical and environmental. For Indigenous communities, barriers also include the social structures that prevent or hinder community access to ocean spaces and activities, and the lack of knowledge by (non-Indigenous) officials and the public about how to interact with Indigenous people involved in practices such as ceremonies and gathering marine life (e.g., seaweed, mussels). Regulations and restrictions are a specific type of barrier, where structural rules from society influence coastal access and practice.	Bennett et al. (2021); Reineman et al. (2016)
Solutions	Shifts that lead to positive changes which create greater wellbeing and more equitable circumstances.	Solutions can lead to changes in policies, priorities, systems, actions, cultures, perspectives, engagement, outreach, community building, indigenous futures, and co-management/co-stewardship.	Sterling et al. (2020)

shifted to employing a structured coding approach in R where keyword searches were used to parse transcripts and highlight content relevant to themes of reciprocity (including species), barriers, and solutions.

Selected Data Summaries, Analyses, Figures & Interpretation

Respondents were from two central California Tribal groups (Chumash and Ohlone; see **Table 3**) and ranged in age from 33 to 80 years old (median age = 50 years). Over half of the respondents fell into the Acutely Low - Very Low Income Levels, reflecting the low incomes of Tribal communities more broadly (CA State Income Limits, 2025). Tribal languages were spoken in varying levels of proficiency by 71% of respondents.

Table 3. *Tribal affiliations of the respondents who were interviewed from central California's Tribal Communities. Note that some respondents were affiliated with more than one Tribe.*

Tribe	Band	Tribe Code	Federal Recognition, State Recognition, & Affiliation	ID	No. of Respondents
Chumash	Chumash - Unaffiliated	CH	Non-Affiliated. No recognition by Federal or State governments.	CH-N-AF	4
Chumash	Coastal Band of the Chumash Nation	CH	Non-Federally Recognized. Recognized by California Native American Heritage Commission.	CH-N-REC	4
Costanoan Rumsen	Costanoan Rumsen Carmel Tribe	CR	Non-Federally Recognized. Recognized by California Native American Heritage Commission.	CR-N-REC	2
Costanoan Ohlone	Indian Canyon Chualar Tribe of Costanoan-Ohlone People	CO	Federally Recognized. Recognized by California Native American Heritage Commission.	CO-REC	1
Chumash	Santa Ynez Band of Chumash Indians	CH	Federally Recognized. Recognized by California Native American Heritage Commission.	CH-REC	1

Tribal Perspectives on Sacred Responsibility, Reciprocity, and Gratitude:

Sacred Responsibility & Care: Many Tribal respondents emphasized a sacred duty to care for the ocean, describing it as a responsibility inherited from ancestors and central to Tribal identity. As one noted, *"We understand that this landscape is not ours… It's the understanding of the footsteps that have been left behind by those who came before us, and the footsteps that are ahead of us, guiding future generations. Knowing that we carry both the lessons from our past and the hopes for our future is what motivates me to continue this work"* (CR-N-REC-01). Responsibility for the ocean also comes from seeing the ocean as part of their family: *"As a family unit, a mother, a father, a child, that's your circle. When you think about [the ocean], as a*

human being, this is [in] our circle. You don't commodify those things if you truly love them" (CH-N-REC-05). The ocean is also a central part of spirituality: "*There is a spiritual connection to the ocean. Chumash people have our spirituality tied to it, similar to how Christianity might have its own spiritual practices. I don't think the details need to be shared. Just knowing that connection exists is enough*" (CH-N-AF-03).

Reciprocity: Respondents spoke about how their responsibility toward the ocean emerges from their experience of reciprocity, a principle that guides how people live in relationship with the ocean and its living beings (i.e., marine life) (**Figure 6**). Reciprocity was described not just as giving back resources, but as maintaining balance. "*We live in reciprocity with the land, which has made us knowledgeable about what the land offers - and what needs to be protected. … [This] knowledge is passed down through generations … that show us how to interact with our landscape and explain why things are the way they are ... Our relationship [with the ocean] will continue to be infinite because we understand that we are the water, and the water is us*" (CR-N-REC-01). These insights frame reciprocity as a way of living that is both ecological and cultural, rooted in knowledge passed down through generations.

Gratitude and Ceremony: Respondents repeatedly emphasized gratitude for the resources and spiritual presence of the ocean. Gratitude was often embodied in offerings and ceremony - a way of acknowledging the gifts of the ocean and reaffirming bonds with place. "*In the ceremony, everything is a prayer for us. Even when we gather, we begin with a prayer and offerings. That's the most important way we interact with the ocean*" (CR-N-REC-01). Ceremony is also central to culture. "*Ceremony is super important to our people because that's our way of life. That's what keeps us connected to our culture*" (CR-N-REC-02).

Marine Relatives & Harvesting: For community members, marine life is part of community and family, often referred to as relatives. "*I don't think "harvesting" is the right word. It's more like having a relationship with the local abalone, clams, and seaweed*" (CH-N-AF-03). Harvesting marine relatives is seen as an intimate part of maintaining culture through spending time in relationship with the environment. "*Our gathering, our harvesting, our fishing—they're not just culture sharing, they're how we monitor the health of our environment*" (CH-N-REC-04). Though Westerners often ask Tribal members to identify the species most important to them, relationships between people and marine relatives were described inclusively, "*I've talked about a lot of the species, but I also think it's important to note that there's no hierarchy. Abalone is just as important as the barnacle or the starfish. It's important because we understand that everything is connected in an ecosystem. Everything has its role … It's about balance*" (CH-N-AF-03).

Barriers to Tribal Ocean Access:
Colonial and Historical Barriers: Participants in our project spoke about the link between present day restrictions and a longer legacy of dispossession and forced separation from the ocean. "*It's been privatized, we have no access... What upsets me most about the privatization [of the beach] by individuals is that they're not even there most of the time… For their momentary pleasure, we're prohibited from our right to access our lands*" (CH-N-REC-01). It's

important to note that laws prohibiting and/or restricting gathering, hunting, and fishing were intended to make Tribal culture - and Tribal food security - illegal (Simpson 2014). "*There's also the fact that there are laws now about not harvesting abalone or clams. It's a tough subject because those laws were passed to target our people's ability to survive. They didn't want us to harvest our food, they wanted us to buy bad food at the grocery store, which is what we're doing now*" (CH-N-AF-03). Although contemporary lawmakers may not recognize that darker side of such legal history, laws targeting Tribal access to natural resources continue to be widespread across the US, including in California.

Dispossession and Limited Access: Dispossession of Tribal culture and ocean connections are visible through the absence of Tribal rights in California's coastal areas. Along the entirety of California's coastline, there are only six coastal reservations/ conservation reserves providing dedicated Tribal coastal access: (Tolowa Dee-ni' (Smith River); Yurok; Pulikla Tribe of Yurok People (formerly Resigini Rancheria); Big Lagoon, Cher-Ae Heights (Trinidad); Wiyot; and Kashia Band of Pomo Indians). All six are small, and located in northern California, away from California's most densely populated regions. One respondent shared "*I want to also acknowledge all the other coastal Indigenous people, historically, who keep trying to come back [to our traditional land and ocean]. We keep coming back… as much as we can… It's kind of heartbreaking*" (CH-N-REC-05). Several Tribal members spoke about the difficulty of maintaining connections to the ocean after being displaced inland, far from their ancestral coastal homes, and being scattered elsewhere across the state. "*I think that a lot of people found it really difficult to talk about those things because of the trauma involved with being removed from the islands*" (CH-N-REC-01).

Financial Barriers: Travel, Parking and Fees: For many Tribal community members, the cost of parking, site use fees and permits represent an unjust barrier to their inherent rights. "*Parking is really difficult at most of our beaches … Some people say, "Oh, you can't afford $8 to park all day?" But it's not about the $8! It's about the fact that we, as Indigenous people whose land was stolen, are being asked to pay to be on our own land. That doesn't feel good. We do it anyway, but it still doesn't feel right*" (CH-N-REC-04).

Permitting Cultural Activities: Challenges with permitting and fees surround other cultural activities (e.g., permits for gathering and harvesting marine life, permits to light fires and burn incense that are a central part of ceremony (including plants such as sage)). Permits regulate the ability of communities to gather at the beach in the evenings or overnight, and to keep traditional boats near the water. "*Even docking a boat, or keeping a traditional Tomol [a traditional Chumash canoe] on the beach, was something we had to fight for… We still have to pay for a license or permit to keep a Tomol on the shore, which feels wrong. When Cabrillo came here, there were hundreds of Tomols on the beach. Now, they want me to pay to put mine there-*" (CH-N-REC-04). Respondents talked about times when staff at state and local levels had opportunities to create easier pathways for Tribal practices - and refused. "*When we spoke to the city [about keeping Tomols at the beach], they said, "We can't do that because everyone will want to do it." We asked, "What do you mean everyone?" … They said, "Well, other organizations"*" (CH-N-REC-04). This highlights a common excuse of officials - that a Tribal

exception would create problems due to the lack of support and understanding by the general public. This refusal suggests that the officials are unaware of distinctions between stakeholders (e.g., most nonprofits and community groups) and rightholders (Tribes and Tribal members) (UN 2007).

Enforcement and Recognition: In cases where Tribal members have obtained the required permits, respondents shared that cultural activities remain fraught with challenges from conservation/ enforcement officers. Enforcement officers often lacked awareness of Tribal rights, Tribal exemptions, and the cultural context behind Indigenous practices at the ocean. "*Unless you already have a previous relationship or unless they've met a native person, the majority of the time they're just following the rules that they've been taught. … I want them to prioritize things like needing cultural sensitivity training and awareness training with historical land acknowledgment and history awareness*" (CO-REC-01). Although the state has created harvesting exemptions for Federally recognized tribes in a limited number of MPAs, this does not apply to most communities recognized by the California Native American Heritage Commission. *"For the Chumash community at large, we don't have the [Tribal harvesting] exemption*" (CH-N-REC-01). Another respondent emphasized the damaging influence of the distinction between Federal vs Non-Federal recognition: "*Whenever I hear or read … that [the Federally recognized Tribe] is representing everybody, it doesn't make sense to me. As a matter of fact, it goes against a lot of traditional understanding that everyone who is involved has a right to speak. … That's the colonization that gave the dominant culture the right to define who is and who isn't*" (CH-N-AF-02).

Gatekeeping and Objectifying: Beyond conflicts with formal authorities, Tribal community members also described feeling policed by the general public acting as righteous gatekeepers of coastal spaces. One respondent shared an example. "*Before we began [a ceremony], our spiritual advisor lit a sage … and an elderly woman, who seemed to walk that [coastal] trail daily, yelled at us to put out the fire, claiming we would start a fire… She called the police… The biggest obstacle we face is the gatekeepers - local residents who call authorities whenever they see us gathering. We have to prove who we are and why we're there. It's not that authorities are patrolling, but that people are watching us and assuming we don't belong*" (CR-N-REC-01). Such incidents illustrate how Indigenous presence near the ocean is uniquely scrutinized. Respondents described how part of their experience in coastal spaces was navigating interactions with the curious public. "*People have this tendency to make an exhibit of us in their mind... It's like going back in time and seeing something that they've never seen before and having real, physical access to it. So they can't help themselves. …The one that gets us is when people say, "Oh, this must be a replica. I remember when I was younger, and my aunt was like, 'Yeah, we're replica Chumash'*" (CH-REC-09). Together, these experiences reveal a layered system of exclusion — from officers enforcing rules without recognition of Tribal exemptions to community members questioning Indigenous people's rights. The theme of gatekeeping has arisen in other aspects of this project when minority communities seek to enter predominantly White ocean spaces (for example, see *Section 2.3*). Further work could consider these intersections.

Solutions to Expand Tribal Ocean Access

Across these interviews, Tribal respondents emphasized the importance of restoring and protecting their inherent rights to access, steward, and maintain relationships with the ocean and coast. Cultural values and place-based science, deeply rooted in relationship and care of the natural world - a foundation that would enrich all ocean policy and management - underlie knowledge solutions and desires of Tribal respondents. Participants called for secure and culturally appropriate spaces for ceremony, gathering, and prayer, as well as the recognition of traditional harvesting, fishing, and fire practices. Many envisioned cultural and educational centers where knowledge sharing, regalia making, and community teaching could thrive alongside opportunities for the broader public to learn about contemporary Indigenous stewardship. Respondents also highlighted the need for policy reforms, standardized Tribal exemptions, and training for agency staff and enforcement officers on cultural awareness and sovereignty. They underscored that sustainable engagement depends on resourcing Tribal communities—especially non-federally recognized Tribes—through dedicated funding, workforce development, and youth training programs that honor Indigenous knowledge as a form of expertise. A foundation for all of these solutions can be genuine co-management and co-stewardship that authorizes Tribes to have decision-making authority over coastal areas. Collectively, these perspectives provide a pathway towards expanded ocean access that accounts for the rights of Tribes to manage and live in relation with the ocean. We recognize, however, that to-date we have only interviewed a subset of California's diverse Tribal communities and that these perspectives may only reflect the experience of this distinct subset. We provide a summary of solutions based on Themes, with representative quotes and example solutions below (Table 4). A more complete description of the solutions advanced by Tribal members (in their own words) for addressing the specific cultural values and barriers described above will be provided in a forthcoming Tribal report.

Table 4. *Solutions proposed by respondents for allowing Tribes to access, steward, and maintain relationships with the ocean and coast.*

Theme	Description	Representative Quotes	Example Solutions
Protected Temporal & Ceremonial Access	Creating provisions for Tribal members to have broad access to public ocean and coastal spaces for ceremony and gathering.	"I don't think [agency staff] fully understand what we need, or are prepared for the ceremony…When we mention how many people are coming, that there will be a fire, and that it's going to take days, not just during their 9 to 5 hours. That's when they want us to explain everything." (CR-N-REC-02) "People went to the ocean for prayer during the summer equinox and spring solstice, and it would be great if that practice was respected enough to be included in policy." (CR-N-REC-01)	- Establishing a free Tribal pass for individual and group ocean access that integrated across agencies and governments. This could draw from provisions in Assembly Bill 2939. - Dedicated Tribal-only 3-4 day weekends at certain coastal parks and beaches. - Establishing rights of Tribes to have access opportunities without the general public. - Creating a registry of land owners who have property in coastal areas who are willing to permit Tribal access. - Creating a fund for the state to assist Tribes on the California Native American Heritage Commission (https://nahc.ca.gov/) to purchase coastal land in their historical territories. - Dedicated travel funding to support Tribal members - particularly displaced families in non-coastal areas - to access oceans, cultural resources, and ceremonies.
Tribal Harvesting & Fishing Rights	Protecting Tribal rights to gather, harvest, and fish and recognition that these activities are a core part of Tribal culture and Tribal sovereignty.	"Gathering rights would be another priority, and fishing rights would be second because we need to sustain ourselves with nutrients." (CR-N-REC-01) "Fire is sacred to harvesting and collecting plant material and medicine and then utilizing it." (CO-REC-01)	- Create a statewide pathway for a Tribally led process for each Tribe on the California Native American Heritage Commission list to permit Tribal members to harvest, gather, and fish in coastal areas. - Create statewide fire permits for Tribal members to hold ceremonial fires, including burning offerings such as sage.

Theme	Description	Representative Quotes	Example Solutions
Cultural Centers & Education	Create a pathway to permit and fund a network of Tribal cultural centers in beach and coastal areas across the state where community building and cultural teachings could take place.	"Being able to have Tomol houses, where we can teach, where we can maintain our careers, where we can have a space to be ourselves... safe spaces for our canoes to be able to rest, and for our people to be able to come and learn, and for that space to be utilized by our community, so that it can be us and not just an exhibit for the public... "(CH-REC-09)	- Centers should focus on regeneration of Tribal culture and potentially have an outreach component, focused on contemporary Tribal culture. - These co-developed centers should include, for example, basic infrastructure (e.g., places to sleep, bathrooms), a room for community gatherings and cultural workshops, working space (e.g., Tomol maintenance and storage, seaweed and fish processing, tying traditional nets, regalia making).
Co-Management & Tribal Stewardship	Increasing Tribal authority and decisionmaking over coastal areas through co- management and co-stewardship. These are the shared responsibility and decision making around management of ecosystems and natural resources.	"We deserve the opportunity and the right to be involved in all decisions happening in our territories' lands and waters. So that 'stakeholder' phrasing is not a great way to identify native peoples. However, in all things that do impact stakeholders, native peoples need to be in the room. Ideally, we promote conscious decision-making through a consensual dynamic, offering as much education as possible, infused with empathetic storytelling and connection to the data. We need Indigenous insights and consultation to provide such data." (CO-REC-01)	- Create funded positions for Tribal members to be involved in decisions around ocean management and ocean access. - Set requirements for early and meaningful Tribal engagement in ocean decisionmaking. - Invite and fund Tribal members to be involved with working groups and advisory councils. - Create and implement management paradigms and standards that draw on concepts of braiding knowledge structures (also known as 'Two-Eyed Seeing'; see Reid et al., 2021). - Include Tribes recognized through the California Native American Heritage Commission. - Ensuring recognition of Tribal sovereignty.

Theme	Description	Representative Quotes	Example Solutions
Policy & Permits Reform	Formalizing, simplifying, and standardizing Tribal permit exemptions for access, fires, & harvesting. Creating protections for cultural practices to be carried without interruption by enforcement or the public.	"I began to see just how much our grandfather had to go through to get the permits he needed to gather, and how hard it was to navigate all the regulations. I don't want it to be this difficult for us forever, though. We're doing this work now so that when we're gone, it's easier for the next generation." (CR-N-REC-02)	- Initializing a state-led process that creates a streamlined and integrated pathway for Tribal rights to access ocean spaces (e.g., state parks, municipal beaches), including: - A blanket permission for Tribal members to harvest, gather, fish, and have fires for cultural reasons. - Cultural reasons should be defined by the Tribal leadership, but without justification to the state or local agencies. It would be appropriate for such definitions to remain internal to the Tribe rather than becoming public. - We recommend that all Tribes registered with the California Native American Heritage Commission (https://nahc.ca.gov/) be included in this process. - Expand Tribal exemptions in Tribal Take Areas to include all Tribes registered with the California Native American Heritage Commission. - We recommend that the state identify a pathway for providing access for non-affiliated Tribal individuals.
Training for Enforcement and Agency Staff	Training enforcement personnel and agency staff about Tribal topics.	"Making cultural sensitivity and cultural awareness training mandatory for anybody who's going to have some sort of deep impact." (CO-REC-01)	- Mandatory, regional specific trainings for agency staff, including enforcement officers about: + distinctions between Tribal and non-Tribal rights, and Tribal exemptions. + significance of traditional practices and ceremony + successful approaches for protecting Tribal members from gatekeepers and racist community members.

Theme	Description	Representative Quotes	Example Solutions
Youth Engagement, Exchange, & Workforce Development	Developing training and job opportunities for Tribal members in conservation and resource stewardship, and cultural exchanges.	"I don't qualify to be a park ranger because I don't have a bachelor's degree, and that's frustrating. Why shouldn't I qualify to be a steward of the land if I know what's right? … Policies should take into account Indigenous Knowledge, because there's so much depth to that experience, especially in ceremonial spaces." (CR-N-REC-01)	- Train and employ Tribal members as stewards, scientists, rangers, conservation officers, educators, and knowledge holders, ensuring financial support to build Indigenous leadership in ocean management. - Create pathways for Indigenous Knowledge to help people qualify for ocean jobs. - Provide opportunities for learning and mentoring through intergenerational training about oceans. - Create a pathway for Tribal fisheries in California, including funds to support training and mentoring. - Fund cultural exchanges that help communities build solidarity and shared stewardship practices.
Funding and Grants	Creating funding streams to support the proposed solutions through state funding and tax-credits.	"It's hard to sustain who we are and still make time for these ceremonies, especially when it's a challenge to secure funding for them. If those obstacles could be eased, it would make a huge difference." (CR-N-REC-01)	- Grants, subsidies, in-kind donations, and fee waivers that cover the costs of permits, fees, and use. - Grants that fund cultural activities, knowledge sharing, and job training. - Raising funds through revenues such as a Tribal tax and philanthropic support of Tribal cultural revitalization.

Authorship Information & Research Next Steps

The information presented in this section comprises a portion of a collaborative research effort focused on Tribal coastal and ocean access led by Jennifer Selgrath with support from Carlie Dominguez, Teresa Romero, and other members of the research team. A full report with extended Tribal suggestions will be forthcoming from these authors and the work will be submitted as a manuscript to a peer-reviewed scientific journal. We acknowledge that these perspectives are from a subset of California's diverse Tribal communities. We will be expanding this project during Phase II (2005-2027) to include the perspective of coastal Tribes in five new counties.

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PART 2
SURVEY & FOCUS GROUP ANALYSES

2.1. Survey & Focus Groups
Methods and Sample

Survey Design and Administration

The survey instrument was developed and administered as part of a community-engaged research approach. The research team partnered with Central CA-based non-profit organizations (n = 5), dedicated to advancing coastal access and engagement and/or environmental justice in order to obtain feedback on survey content and design, engage respondents, and contextualize and interpret research results. These organizations included Literacy for Environmental Justice (Southeast San Francisco), Regeneración (Watsonville & Pajaro Valley), Sea League (Santa Barbara), Reel Guppy Outdoors (Oxnard), & the MERITO Foundation (Ventura). Initial scoping, designed to identify and explore issues of local relevance related to ocean access and management, took place in the summer of 2023 via a series of semi-structured interviews (n= 10) with the community leaders affiliated with or recommended by these organizations. The relevant interview protocol (i.e., "Community Leader Interview Protocol 2023") can be accessed online using the following hyperlink: https://github.com/thfrawley/OPC_Final_Report. A draft survey instrument was developed and subsequently reviewed by and iterated using feedback from interview subjects.

In addition to a series of questions designed to collect relevant demographic information, the final survey instrument consisted of 31 questions across six primary modules: ocean engagement and activities, contribution of ocean and coastal spaces to human wellbeing, valuation of ocean ecosystems, barriers to ocean access, priorities for area-based marine management, and climate observations & concerns. Overall 2,191 surveys were administered across California, including 1,343 surveys administered in person (via paper, cellphone, or tablet) and 848 surveys administered online (via personal computer or cellphone). In person survey respondents (engaged through tabling at community events or approached via intercept at coastal access points, laundromats, parks, and other public spaces) were compensated $20, while those taking the survey online (recruited through fliers, social media posts, community partners' networks, and/or regionally-focused email lists) were entered in a prize drawing. Using purposive sampling designed to ensure the inclusion of individuals that to-date have been underrepresented in ocean and coastal management processes, in-person survey efforts targeted disadvantaged and/or severely disadvantaged communities as defined by the CalEPA in three focal areas: Southeast San Francisco, the greater Monterey Bay, and Ventura & Oxnard counties (referred to here in aggregate as 'central California'). To increase accessibility and broaden participation, the final survey instrument (revised following an initial round of piloting) was translated and made available in Spanish and Chinese (simplified) in addition to English. All Human Subjects research was conducted following review and approval by the University of California Santa Cruz Institutional Review Board (protocol #HS-FY2023-193) and University of California Santa Barbara Institutional Review Board (protocol #1-23-0470). The complete, English-language version of the administered survey instrument (i.e., "Complete Survey Instrument 2024") is available online at https://github.com/thfrawley/OPC_Final_Report while

information concerning the theory and logic supporting the design of its component modules can be found in the sections which follow.

Data Processing and Transformation

The sample used for analysis (n = 1,691), was obtained following the sequential application of quality control measures to remove surveys that were: less than 60% complete (n = 262), completed in less than 400 seconds (n = 93, with this threshold determined as respondents who took the survey faster than 95% of other respondents), associated with respondents who did not live in California (n=52), and those that did not meet a minimum response variability threshold (n = 86). The minimum variability threshold was assessed based on the five long-format (i.e., each question contained 9 or more prompts), likert-scale matrix questions contained within the survey. Responses from individuals selecting the same response for all the prompts contained within a question for 4 or more of the long-format questions did not meet the minimum response variability threshold. This procedure was developed upon observing in the field that a limited number of individuals, due to survey fatigue or lack of interest, appeared primarily motivated to complete the survey (and collect the incentive) and did not thoughtfully engage. Of the 1,691 surveys included in the final analysis, mean survey duration (i.e., the time that it took to complete the survey) was 19.2 minutes (median duration = 16.5 minutes).

Data obtained from demographic questions asking respondents to report race and gender were transformed into a series of binary dummy variables to accommodate "Select all that apply" responses in which more than one category was chosen (i.e., a unique variable for 'Hispanic or Latino", in which responses including this category were marked as 1 and responses not including this category were marked as 0). Categorical household income and frequency of ocean usage data were transformed into a 5 point ordinal scale with 1 representing the lowest income ($59,999 or less) and most infrequent usage (Less than once a year) and 5 representing the highest income ($240,000 or more) and most frequent usage.

Self-reported zip code of residence was used to derive 3 different geographic variables: community vulnerability, distance to ocean access, and region. Community vulnerability was assessed using CalEnviroScreen data, a combined measure which employs a cumulative impact model in assessing community vulnerability as the product environmental exposure and socioeconomic sensitivity (see https://oehha.ca.gov/calenviroscreen). More specifically, a score assessed for each California census tract is based on a combination of Pollution Burden (i.e., Pesticide Use, Ozone, Hazardous Waste, Traffic Impacts, etc.) and Population Characteristics (i.e., Poverty, Unemployment, Housing Burden, Cardiovascular Disease, etc.) metrics. In our analysis, CalEnviroScreen census tract scores were aggregated at the zip code level (the lowest spatial resolution of the survey data), using population weighted means. To match the format of other demographic variables, and account for the fact that the zipcodes with the highest CalEnviroScreen scores were agricultural areas far removed from the coast (i.e., the Central Valley), zip code-level scores were converted into an equal-interval (i.e., choosing breaks so that the total number of survey responses that fell into each category was approximately equal) 5 point ordinal scale (1 = least vulnerable; 5 = most vulnerable). Continuous distance to ocean

access was calculated by using shortest distance (in kilometers) between the geographic centroid of each ZIP code and the nearest Coastal Access Point (CAP), using ESRI ArcGIS Pro's Closest Facility and Online Routing Services tool (as configured to perform road network analysis rather than Euclidean (straight-line) distance). CAPs included marine protected areas (MPAs), fishing piers and jetties, national marine sanctuaries (NMSs), and all designated coastal access points. The resulting continuous travel distance measurements were binned into a five-point ordinal scale (1 = least travel distance; 5 = most travel distance) consistent with the approach described above. For more information see Selgrath & Lowe *in prep*. Region was inferred based on the latitude of the geographic centroid associated with each ZIP code as parsed by the following cut-off values: latitude $\geq$ 37.25° = Northern Region; latitude < 37.25° & > 35.8° = Central Region; and latitude $\leq$ 35.8° = Southern Region.

Survey Sample

Racial and ethnic demographics of our survey sample were broadly representative of those across California. 40.3% of survey respondents identified as White (as compared to 34.7% of California residents providing information to the 2020 US Census), 29.1% identified as Hispanic or Latino (as compared to 39.4%), 20.3% Asian (as compared to 15.1%), 7.75% Black or African American (as compared to 5.4%), 3.7% American Indian or Alaskan Native (as compared to 0.4%), and 3.1% as Native Hawaiian or Pacific Islander (as compared to 0.4%) (**Figure 7A**). The survey sample was skewed towards younger individuals (51.1% < 40 years old) from low (less than $59,999; 30.1%) and medium ($60,000-$119,999 annual earnings; 27%) income households (**Figure 7B**) that were frequent ocean users. The majority of respondents reported
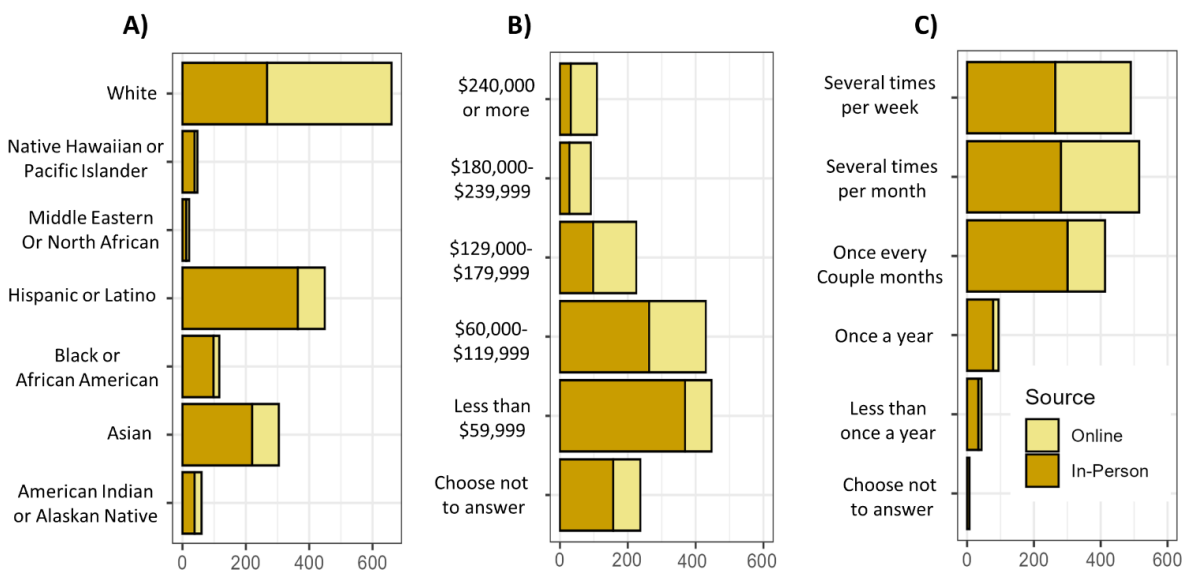

Figure 7. *Barplots illustrating the distribution of survey respondents by **A**) annual household income, **B**) frequency of use of ocean and coastal areas, and **C**) racial-ethnic categories. Bars are color-coded according to the format of survey administration (dark orange = in-person administration; yellow = online administration).*
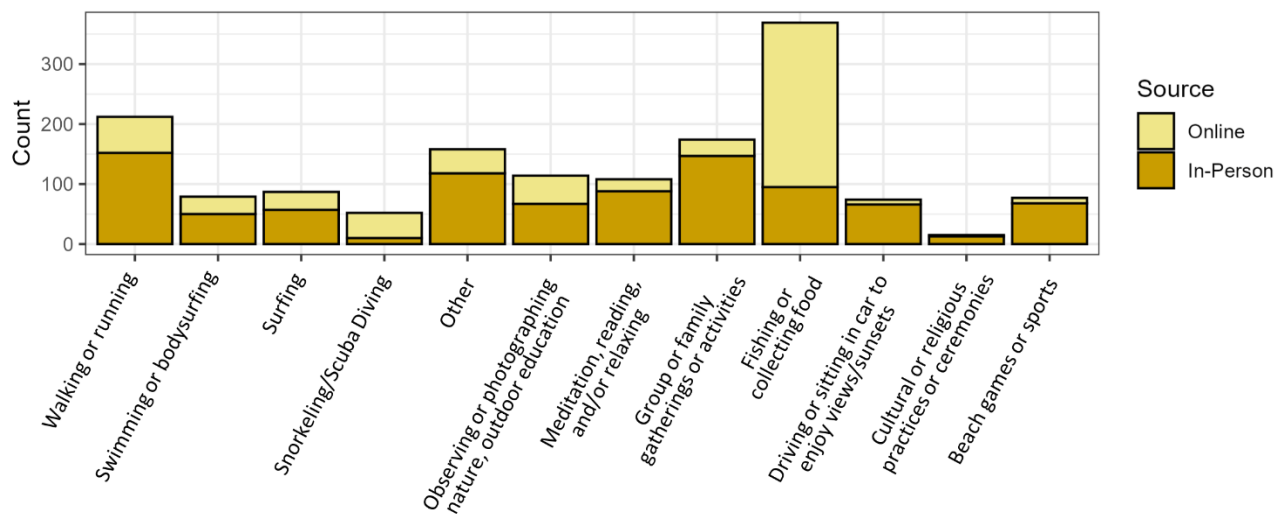
Figure 8. *Barplot illustrating the distribution of survey respondents by the ocean activity they choose as most important to them. Bars are color-coded according to the format of survey administration (dark orange = in-person administration; yellow = online administration).*

that they used ocean and coastal areas several times per month or several times per week (31.9% and 31.4%, respectively) (**Figure 7C**). When comparing the format of survey responses (in-person vs online administration) a comparatively larger proportion of White and Asian individuals from upper- and middle-income households provided information online **Figure 7**). The most valued ocean activities chosen by survey respondents in our final sample were *fishing or collecting food*, *walking or running*, and *group or family gatherings and activities* (**Figure 8**). Of the eight California zip codes most frequently reported as survey respondents' primary residence; three were assessed as having high community vulnerability (Marina, n=36; Santa Paula, n=33; Visitacion Valley/Sunnydale, n=33) and two were assessed has having very high community vulnerability (Watsonville, n= 65; Bayview-Hunter's Point, n= 62) (**Figure 9**).

Focus Group Design and Administration

Following the collection, processing, and preliminary analysis of survey data, the research team conducted a series of focus groups (n=10, **Table 5**) designed to engage the study population in helping to contextualize and interpret research results and co-develop management recommendations. Focus groups were hosted by community partner organizations who prioritized the recruitment of participants from disadvantaged and/or severely disadvantaged communities (as geographically designated by CalEPA) and demographics of relevance to case studies being conducted by members of the research team. Focus group content (in both English and Spanish) was iteratively developed and tailored to each community using several rounds of feedback provided by community partner organizations. Each focus group consisted of 10-12 participants partitioned into 2 breakout groups. Focus groups lasted between 2.5 and 3.5 hours and participants were compensated $75 for their time and engagement. Though the
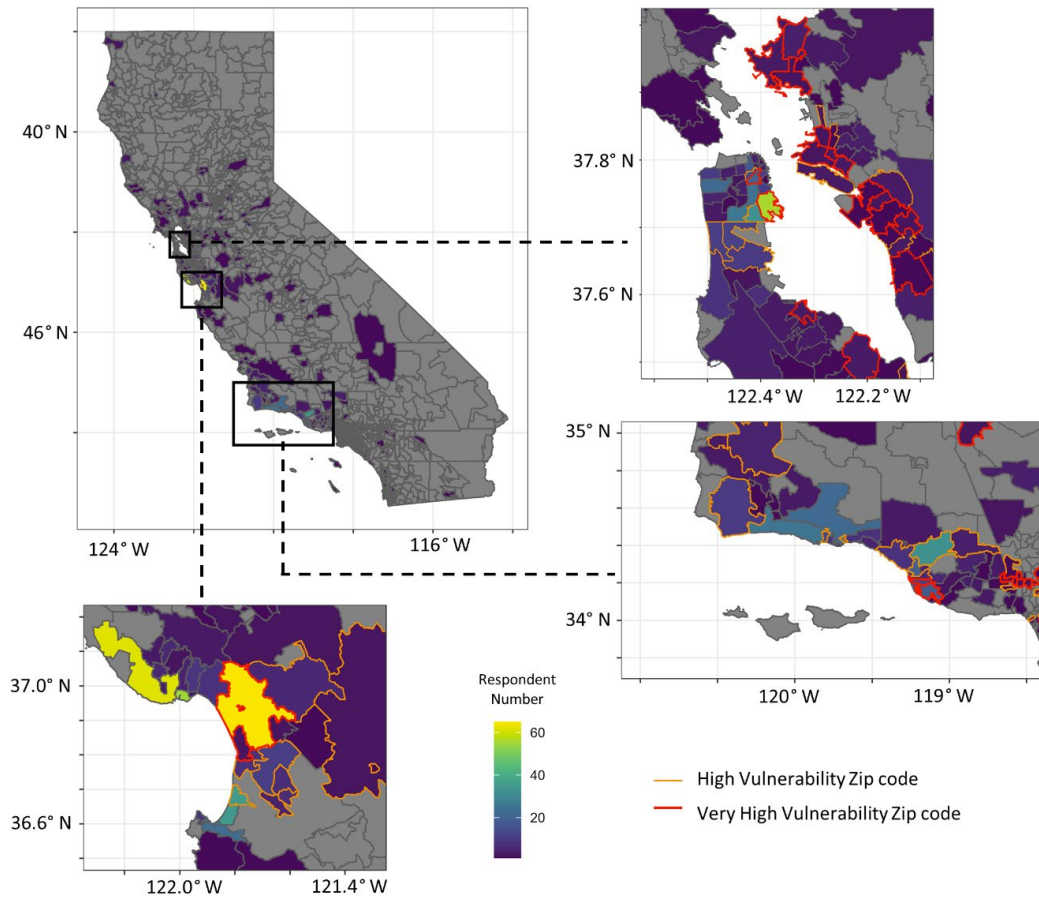
Figure 9. *Map illustrating the distribution (by self-reported zip code of residence) of 1,691 survey responses used for analysis across California at-large with insets highlighting the three focal regions where administration efforts were concentrated: Southeast San Francisco; the Greater Monterey Bay; and Santa Barbara, Oxnard, & Ventura. The zip codes assessed as having high and very high vulnerability (as based on CalEnviroScreen scores; see Methods); are outlined in thin orange (high vulnerability) and bold red (very high vulnerability) lines.*

final programming varied by event and location, the primary structure consisted of a general introduction to the project and its methods and goals followed by three distinct modules: 1) Barriers to Ocean Access; 2) Marine Protected Areas and Management; and 3) Changing Oceans. For each module, focus group participants were presented with a brief overview of the relevant survey questions and theoretical framework; a summary of how results assessed for respondents of their community/demographic compared to results assessed for the overall study population; and a series of open-ended prompts designed to stimulate reflection, discussion, and feedback. Modules 1 & 2 concluded with a priority ranking exercise where participants were asked to generate ideas (and organize them according to their prospective impact and feasibility) regarding how to a) address local barriers to ocean access and b) design and manage a local marine protected area. An example of the presentations used to structure focus group events (i.e., "Focus Group Presentation") can be accessed online at the following hyperlink: https://github.com/thfrawley/OPC_Final_Report. The discussions of the two breakout groups associated with each focus group event were digitally recorded and transcribed and, alongside written ideas/feedback recorded on post-it notes by participants,

inductively analyzed to identify emergent themes and concepts following a grounded theory approach.

Table 5. *Summary of focus groups used to interpret research results and engage participants in the co-development of management recommendations.*

Event #	Date	Community Partner	Location	Participants/Target Demo.	Language
1	March 2025	Literacy for Environmental Justice	Alice Griffith Community Center	San Francisco Bayview residents	English
2	March 2025	Literacy for Environmental Justice	Alice Griffith Community Center	San Francisco Bayview residents	English & Spanish
3	March 2025	Regeneración	Watsonville Public Library	Watsonville and Pajaro residents	Spanish
4	March 2025	Regeneración	Watsonville Public Library	Watsonville and Pajaro residents	English
5	March 2025	The Sea League	Riviera Park	Santa Barbara residents	English
6	April 2025	Reel Guppy Outdoors	Reel Guppy Dockside Learning & Multimedia Center	Oxnard & Ventura residents	English
7	April 2025	Merito Foundation	MERITO Foundation Office, Ventura	Oxnard & Ventura residents	English
8	July 2025	N/A	Redwood City Public Library	Asian-American San Francisco Bay residents	English
9	July 2025	N/A	Sports Basement Berkeley	Asian-American San Francisco Bay residents	English
10	July 2025	N/A	Hopkins Marine Station	Asian-American Monterey Bay residents	English

Authorship Information

The interview, survey, and focus group development were co-led by Timothy Frawley and Jennifer Selgrath and supported by the other members of the research team. Survey data and metadata is available to researchers and students via email request (tfrawley@ucsc.edu).

2.2. Integrated Assessment of Barriers to Ocean Access and Human Wellbeing

Introduction

Oceans and coasts sustain the livelihoods, wellbeing, and cultural heritage of billions of people worldwide. Yet, access to these ecosystems remains deeply unequal, as shaped by historical policies and cultural processes driving economic disenfranchisement and social exclusion (Reineman et al., 2016; Österblom et al., 2023). Geography, gender, class, and race - and the interactions among them - all function to constrain or enhance people's relationship with the ocean. Though recent research has advanced scientific understanding of the links between marine governance and environmental sustainability (Bennett et al., 2025), enduring knowledge gaps exist surrounding the structural factors mediating who is able to access and benefit from ocean ecosystems (de Vos et al., 2023) and/or have a voice in associated decision-making processes.

With new threats to biodiversity and ecosystem services emerging as climate change accelerates, local and regional resource managers are increasingly concerned with resilience and adaptation (IPCC 2022). California's coastal and marine zones are of fundamental importance to the environmental and socioeconomic sustainability of the state, with coastal counties home to approximately 68% of the state's 38.9 million residents (Thorne et al., 2024). In the past decade, warming oceans, rising sea levels, and increases in the frequency and severity of extreme weather events have had a significant impact on marine ecosystems, coastal infrastructure, and human communities across the state (Thorne et al., 2024; Patsch & Reineman, 2024). With the harmful effects of these cascading and compounding events expected to intensify in the coming decades (IPCC 2022), state and local leaders have affirmed that climate justice and frontline community impacts are an important consideration in planning for the future (CJWG, 2017; OPC 2022). Yet there remains a paucity of information concerning the processes and mechanisms functioning to mediate regional ocean access and benefits. Despite recent progress driven by the California Coastal Act (1976), the regional mosaic of ocean health, amenities, and engagement continues to be influenced by legacies of discriminatory policies, uneven regulatory enforcement, and ongoing coastal gentrification (Reineman et al., 2016). Without explicit attention to the racial and economic disparities shaping patterns of ocean use and benefits, and the sociocultural factors in which they are rooted, future interventions may only serve to reinforce the systemic inequalities driving uneven climate vulnerability and adaptive capacity (Chu & Cannon, 2021).

Here, as part of a community-engaged research process designed explicitly to engage communities designated as "disadvantaged" or "severely disadvantaged" by the CalEPA, we use survey data to address the following research questions: 1) How do socioeconomic, demographic, and geographic factors interact to mediate ocean access? 2) What barriers pose the biggest obstacles in limiting different populations' access to and engagement with ocean and coastal spaces? 3) How do the ocean's contributions to human wellbeing vary across our

study population and how do different types of barriers amplify or diminish these contributions?

Methods and Analytical Approaches

In this analysis we leverage previous scholarship advanced by development scholars, human geographers, and marine social scientists to introduce and apply a framework designed to explore the complex, multidimensional relationships between ocean access and human wellbeing across central California (**Table 6**). Long-format, likert-scale matrix questions (each containing 9 prompts with which respondents were asked to indicate their level of agreement using the (5) categories Strongly Disagree, Disagree, Neither agree nor disagree, Agree, or Strongly Agree) were used to assess barriers to ocean access and the contribution of the ocean to human wellbeing. The specific prompts comprising these questions can be found in Question #11 (Ocean Wellbeing) and #13 (Barriers) of the survey instrument available online (see https://github.com/thfrawley/OPC_Final_Report). For each parameter (i.e., Barriers and Ocean Wellbeing) a composite index was derived by finding the mean response value per respondent following the transformation of the likert-scale into numerical values (i.e., Strongly Agree = 5, Agree = 4, etc.). Dimensional subscales for each category (see **Table 6**) were subsequently

Table 6. *Summary of the theoretical frameworks informing the study's conceptualization of the ocean's contribution to human well-being and barriers to ocean access.*

	Category	Definition	Sub-Categories
Barriers to Ocean Access Key References: Wang et al., 2015 Byrne et al., 2009	**Social**	Societal norms, historical practices, and cultural dynamics that influence whether individuals are comfortable or motivated to engage with coastal and ocean spaces	Feelings of Safety, Welcomeness, & Belonging; Existence of Shared Activities, Social Exclusion or Marginalization
	Knowledge	Gaps in information, education, or skills that prevent people from safely and legally accessing and engaging with coastal and ocean environments	Understanding Rules & Regulations, Possessing Necessary Skills or Abilities, Awareness of and Familiarity with Access Points
	Physical-Environmental	Tangible, structural, or environmental obstacles that directly impede the ability to access, use, or safely enjoy coastal and ocean spaces	Availability of Amenities and Infrastructure; Pollution and/or Environmental Degradation; Exposure to Hazardous Natural Conditions, Presence of Threatening Wildlife
	Personal	Individual socioeconomic or geographic attributes that constrain time spent in ocean environments or participating in associated activities	Transport, Proximity, Affordability, Availability of Leisure Time, Interest & Lifestyle

| The Ocean's Contribution to Human Wellbeing

Key References:

Allison et al., 2020
Weeratunge et al., 2014
White 2010	Material	The ocean as a means to an end, an asset, satisfaction of needs and preferences, usefulness for people	Income; Food, Energy & Materials; Ecosystem Creation & Maintenance, Physical Health
	Relational	The ocean as a medium that aids the relationships people have with themselves, the natural world and communities and cultures of which they are a part	Group Identity & Social Cohesion, Intra-household and Intra-community Relations, Local Knowledge & Way of Life, Culture & Tradition
	Subjective	Personal satisfaction or emotional affect derived from the ocean, the inherent worth people assign to the existence of marine life and/or coastal spaces and environments as ends in of themselves	Mental Health & Well-being, Individual Identity, Aesthetics & Awe, Spirituality & Symbolism; Biodiversity, Animal Rights & Welfare

constructed following the same procedure. As many aspects of ocean access and wellbeing are best considered as part of a multidimensional continuum (rather than as discrete categories; see Allison et al., 2023), in certain instances responses to individual prompts were considered in more than one sub-scale. Reliability of each scale and subscale was assessed using both Cronbach's Alpha (α) and McDonald's Omega (ωt). In order to examine the relationship between our derived indices and geographic (i.e., region and distance (km) to ocean access), gender, race, and socioeconomic (i.e., community vulnerability and household income) variables, we used ordinary least squares regressions. Before beginning modeling, we used a pairwise correlation matrix to explore the magnitude and direction of demographic variable associations, and identify instances of multicollinearity. Models were assembled through forward, stepwise selection in which variables were added one at a time and nested models were compared using Akaike Information Criteria.

Selected Data Summaries, Analyses, Figures, and Interpretation

Examining the some of the strongest, most significant associations ($r \geq 0.200$ & $p < 0.05$) between demographic variables (**Figure 10**), survey respondents from the Northern region of our study area had a longer distance to travel to access ocean and coastal areas ($r = 0.311$), particularly as compared to the travel distance of Central region respondents ($r = -0.291$). Individuals having to travel longer distances to access the ocean were likely to reside in more vulnerable communities ($r = 0.213$) as were individuals that self-described as Hispanic or Latino ($r = 0.273$). Identifying as Hispanic or Latino was additionally negatively correlated with household income ($r = -0.297$), while identifying as White was negatively correlated with community vulnerability ($r = -0.312$) and positively correlated with household income ($r = 0.273$). Looking at the relationships with reported frequency of ocean usage, the strongest
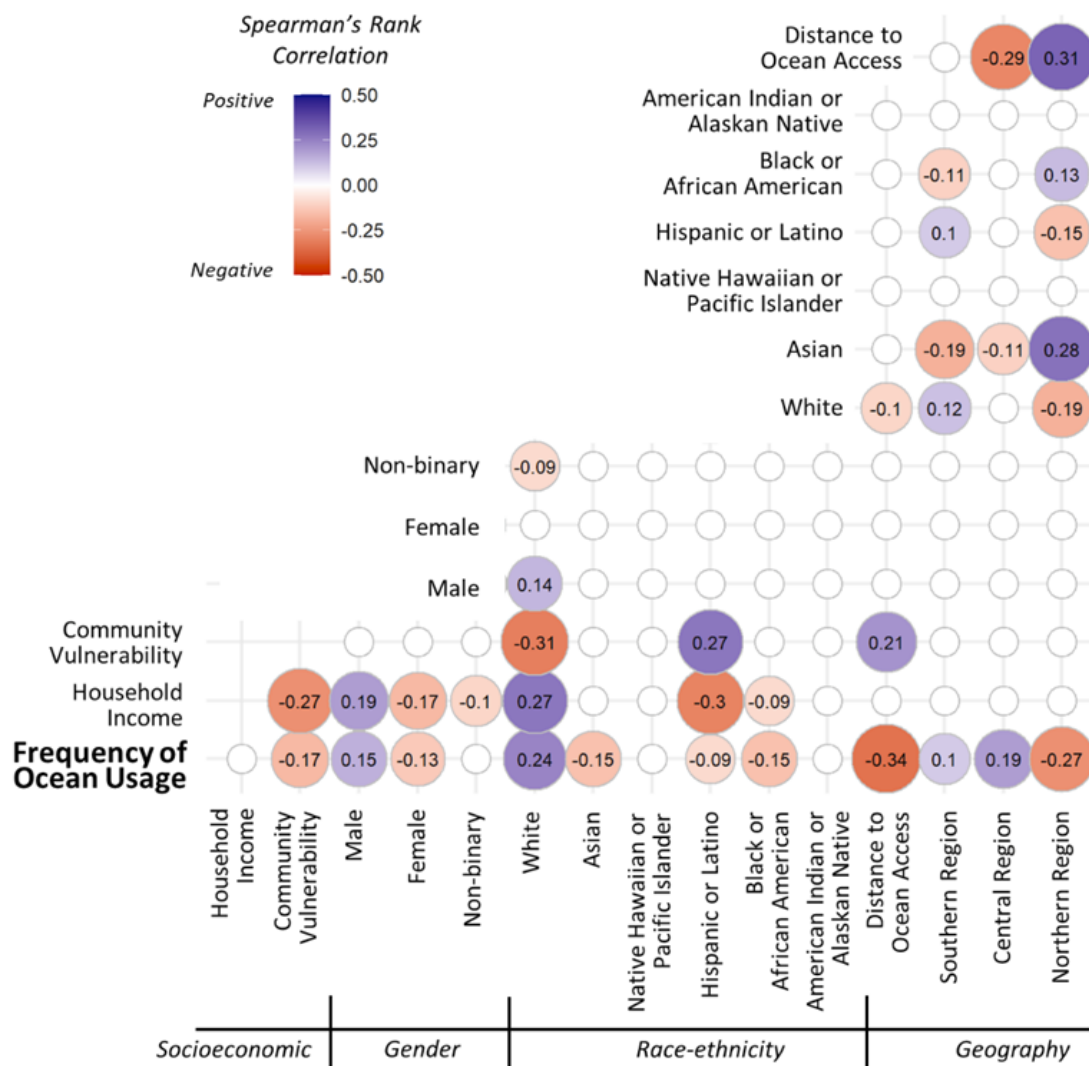
Figure 10. *Correlation matrix displaying Spearman's rank correlation values used to test for correlation between socioeconomic , gender, race-ethnicity, geographic and activity (i.e., frequency of ocean usage) predictor variables. Circles are sized and colored according to the magnitude and direction of the correlation; larger circles indicate stronger associations with blue circles representing positive correlations and red circles representing negative correlations. Only significant correlations (p < 0.05, following a Bonferroni correction to control for the family-wise error rate) are displayed, with correlations within racial-ethnic, gender, and geographical categories (where variables contained redundant information, i.e., Male:Female) omitted to reduce the total number of comparisons.*

negative correlations were with distance to the ocean (r = -0.344) and Northern region (r = -0.268), with a somewhat weaker correlation (r = -0.175) with community vulnerability. The strongest positive correlation with frequency of ocean usage was with those survey respondents identifying as White (r = 0.239).

In considering a composite scale designed to measure barriers to ocean access and dimensional sub-scales composed of personal, social, physical-environmental, and knowledge factors, physical-environmental factors were assessed as representing the largest barriers to ocean access while social factors were the smallest. However, mean item total correlation coefficients suggest that knowledge factors (0.7 ± 0.01), were most influential in mediating differences in the overall barriers score, with this scale being the most reliable and consistent according to scale reliability metrics ($\alpha = 0.72$, $\omega t = 0.73$). OLS regression used to examine the demographic predictors of barriers to ocean access (i.e., the complete scale) found that (when tested as individual predictors) residence in the Northern region, and identifying as Asian or Black/African American were each significantly associated with reporting more barriers (**Figure 11A**). The most significant and constituent contributors to these trends were knowledge and personal factors (**Figure 11B**). Conversely, self-describing as male, Native Hawaiian/Pacific Islander, or reporting elevated household income were each significantly associated with reporting fewer barriers to ocean access (**Figure 11A**). Knowledge factors contributed most strongly to this result for male respondents while personal factors contributed most strongly for individuals with elevated household income (**Figure 11B**). While community vulnerability was not a significant predictor on its own, the interaction with household income was significant (**Figure 11A**, $p < 0.05$), indicating that low income households in vulnerable areas may face unique and/or more pronounced personal and physical-environmental barriers (**Figure 11B**) when accessing ocean and coastal spaces.
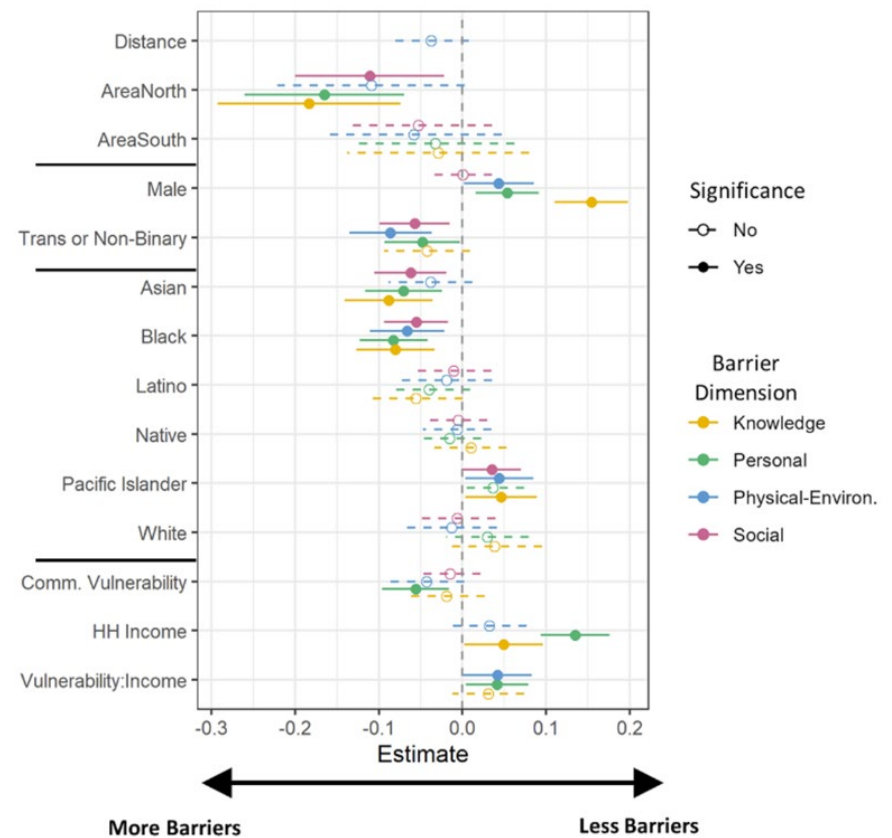
In a parallel analysis designed to measure the contribution of ocean and coastal spaces to human wellbeing, we found that material wellbeing factors (e.g., income, employment, food security, etc.), which are the focus of most management and policy efforts, scored significantly ($p < 0.001$) lower (mean index score = 3.75) than subjective (4.31) and relational (4.02) wellbeing factors. However, the material sub-scale was less reliable ($\alpha = 0.56$, $\omega t = 0.71$) than the subjective ($\alpha = 0.79$, $\omega t = 0.82$) and relational ($\alpha = 0.72$, $\omega t = 0.75$) sub-scales primarily responsible for determining the overall difference in wellbeing scores (relational mean item total correlation = 0.71 ± 0.04; subjective mean item total correlation = 0.67 ± 0.03). OLS regression used to examine the demographic predictors of the ocean's perceived contribution to human wellbeing found that larger geographic distances to the ocean and respondents self-describing as Asian or Black/African American were associated with significantly less ocean wellbeing (**Figure 11C**). In considering variation across dimensional sub-scales, self-describing as Black/African American was associated with significantly lower wellbeing across all three dimensions (i.e., material, subjective, and relational) while only subjective wellbeing was significantly lower for respondents self-describing as Asian (**Figure 11D**). Community vulnerability, the only socioeconomic variable included in the aggregate model, was only significantly associated with lower relational wellbeing.

The ocean barrier index and the ocean wellbeing index were significantly correlated ($r = 0.403$, $p < 0.0001$), meaning that individuals who reported more barriers to ocean access reported diminished contributions of the ocean to their wellbeing. Social ($r = 0.401$, $p < 0.0001$) and
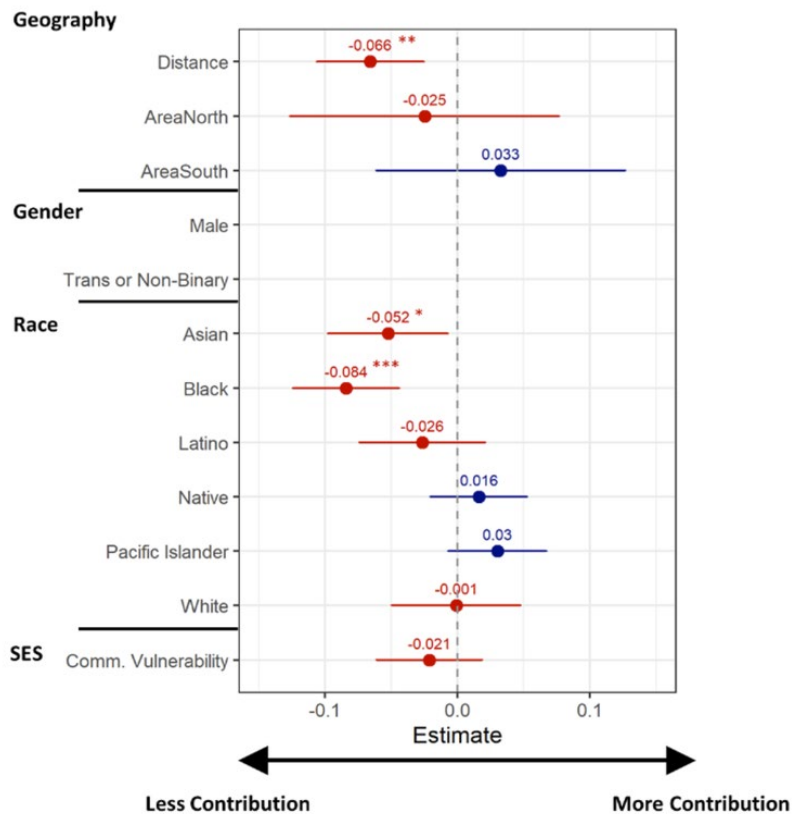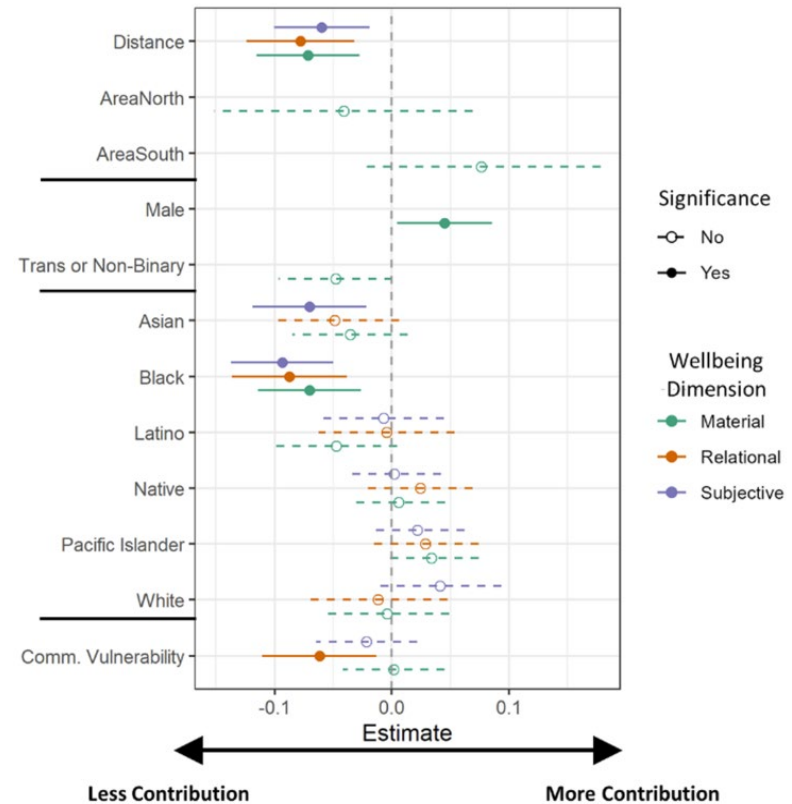
Figure 11. *Barriers to ocean access and perceived contribution to human wellbeing as a function of geographic, gender, race, and socioeconomic (SES) variables as quantified by standardized coefficients (95% confidence interval) of ordinary least squares regression. **A** & **C** show results for composite barriers (**A**) and wellbeing (**C**) scales composed of all relevant prompts (n=9 for both scales) while **B** & **C** represent sub-models for barriers (i.e., knowledge, personal, physical-environmental, and social; **B**) and wellbeing (i.e., material, relational, and subjective; **D**) dimensional scales derived from a subset of those prompts. Points in panels **A** & **C** are colored according to coefficient sign (red = negative estimate, blue = positive estimate) and labeled according to significance (* p <0.05, ** p <0.001, *** p <0.0001). Points in panel **B** & **D** are colored according to the dimensional scale to which they correspond with solid lines and points corresponding to significant coefficients (p < 0.05). Note that not all models include the same predictors as the structure of each was determined by forward, stepwise model selection using AIC criteria.*

personal (r = 0.400, p < 0.0001) barriers played a comparatively stronger role in driving this association compared to physical-environmental barriers (r = 0.287, p < 0.0001) and knowledge barriers (r = 0.347, < 0.0001), with subscale correlations the highest between diminished subjective wellbeing and social (r = 0.407, < 0.0001) and personal (r = 0.413, < 0.0001) barriers. Disaggregated analysis used to examine the relationship between individual prompts suggest this relationship was largely driven by variable interest in ocean activities (a prompt considered in both social and personal categories) across survey respondents. The three highest correlations in examining pairwise prompt associations were found between the barrier prompt designed to assess ocean interest and the three subjective wellbeing prompts. An additional relationship worth noting was the strong correspondence between lack of required skills and abilities (a knowledge barrier) and diminished subjective and relational benefits. Overall, differences in reported interest, skills & knowledge across respondents were most strongly impacted by income and community status as well as race (with Black or African American, Asian, and Latino respondents driving the most variation).

Implications

This study directly addresses research gaps previously articulated by OPC's Science Advisory Team (Hoffman et al., 2018) by establishing a baseline understanding of how structural barriers shape ocean access and the distribution of ocean benefits in California. Though the California Coastal Act establishes the principle of public coastal access, legal rights and physical access alone have failed to translate into meaningful outcomes for underserved and historically marginalized communities. Significant knowledge and personal barriers reported by Black and Asian American respondents reflect legacies of exclusion—ranging from historic displacement and segregation to ongoing gentrification and uneven investment in environmental education—that continue to influence who feels safe, welcome, and connected to the coast (Finney 2014; Jefferson 2020; Ounanian & Howells 2024). Even where historically discriminated and/or underserved communities persist along the coast, legacies of pollution and environmental injustice (particularly across urban and agricultural shorelines) may limit direct engagement with and benefits from the ocean (Kang 2023). Indeed, industrial siting and other urban and municipal planning decisions have often served to reinforce rather than remediate existing inequalities (Pulido 2000).

In addition, our findings underscore the importance of relational and subjective benefits (e.g., connection, cultural expression, contemplation, and healing) which consistently outweighed material benefits across the study sample. A significant correlation between reported barriers to ocean access and diminished contributions to human wellbeing represents a critical feedback loop which may perpetuate inequality and degrade public health. Most marine management frameworks prioritize jobs, income, and food provision, yet our results align with the OPC's call to document and protect cultural, spiritual, and aesthetic values. Whether designed to redress historical inequities or mitigate future climate impacts, efforts to recognize diverse cultural connections to marine environments, and manage explicitly for the social and emotional benefits that they can provide should be a core feature of justice-centered approaches to ocean governance and management.

Authorship Information & Research Next Steps

The data and analysis presented in this section represents a subset of those presented and discussed in a manuscript led by Timothy Frawley (tfrawley@ucsc.edu) as supported by the other members of the research team. The complete, draft manuscript entitled "Racial and Economic Disparities in Coastal Access and Engagement Mediate the Ocean's Contribution to Human Wellbeing" is currently undergoing peer-review at a scientific journal and can be accessed as a pre-print at the following link: https://doi.org/10.31235/osf.io/dw4a9_v1

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2.3. Asian-American experiences of the central California coast: a case study

Introduction

As discussed in *Section 2.2*, people derive a variety of material and immaterial benefits from coastal access. The ocean can be a source of food, income, and enjoyment. Additionally, participants in outdoor marine recreation see improvements in mental and physical health, social bonds (Rocher et al., 2020), and greater knowledge of the ocean (Treviño et al., 2025). Ocean access can in turn benefit marine spaces, as it can cultivate a sense of stewardship and responsibility to the environments in which people recreate (Rocher et al., 2020; Treviño et al., 2025). However, social barriers such as experiences of interpersonal and structural racism can impede ocean access (Wang et al., 2015). On the scale of individual interactions, racism can manifest overtly or in more subtle and potentially unintentional expressions known as microaggressions (Sue et al., 2007). Microaggressions can reduce minorities' sense of belonging and sense of connection to place (Caldwell & Leighton, 2018; Davison, 2023).

Asian Americans represent the third-largest racial group in California (*U.S. Census Bureau QuickFacts*). Within this demographic classification is a rich variety of over 30 ethnic subgroups with diverse migration histories and highly variable levels of economic achievement in the U.S. (Shih et al., 2019). These groups carry a corresponding diversity of relationships to the ocean in the forms of fishing, gathering, and culinary practices (Fabinyi, 2012; Kittinger, 2013), religion and cosmology (Andaya, 2017), national identity (Mukherjee, 2020; Tsutsui, 2013), and more. Despite this diversity, Asian Americans may experience distinct interactions in coastal spaces, given frequent associations between Asian cultures and high-profile conservation issues such as shark finning and the use of endangered animals in other traditional Asian medicinal practices (Liu et al., 2019). In California, the debate around shark fin bans was front-page news in 2011 (Fimrite & Kwong, 2011). Whether this discourse has affected Asian Americans' perceptions of their relationship with the ocean or raised social barriers has remained largely unexplored.

This section investigates how Asian Americans relate to and value the central California coast. We synthesize survey and focus group responses from Asian-American communities in the San Francisco and Monterey Bay Areas to ask: (a) What cultural significance does the coast hold for Asian Americans?, (b) Do Asian Americans experience unique or more frequent social barriers to coastal access?, and (c) What solutions to ocean access barriers do Asian Americans suggest?

Methods and Analytical Approaches

Research questions in this section were supported by two sources of data: (1) a survey with 316 Asian-American respondents from coastal areas in San Francisco through Santa Barbara (see *Section 2.1* for further information), and (2) three focus groups for Asian Americans in the San Francisco Peninsula (Redwood City, n = 6), East Bay (Berkeley, n = 9), and Monterey Peninsula (Pacific Grove, n = 11). We included survey respondents in the Asian American sample if they selected "Asian" for the survey question asking about racial identity, regardless of other races selected. To explore differing experiences within the Asian-American community, we asked survey respondents who identified as Asian American to further identify as one of three groups, or choose not to respond: East Asian (e.g., Chinese, Korean); South Asian (e.g., Indian, Pakistani); or Southeast Asian (e.g., Vietnamese, Filipino). We recruited focus group participants through the email lists of Asian-American affinity groups in the region. We recorded and transcribed the focus group discussions with permission from all participants, and compared responses across participants' stated ethnicities using the same categories as the survey data (East, Southeast, and South Asian). Focus group quotes used in the results are edited slightly for clarity and to preserve anonymity.

To explore the cultural significance of the coast to Asian Americans, we first analyzed the survey data for potential quantitative differences in ocean use frequency and activities. To gain qualitative insight into survey responses, we asked focus group participants (a) whether their racial identity or culture influences the activities they do at the coast and what these activities mean to them, and (b) whether they have cultural uses for ocean plants and animals. We combined inductive and deductive approaches to qualitative coding to identify common activities and meanings in participants' responses.

Similarly, we combined qualitative and quantitative approaches to explore Asian Americans' social barriers to ocean access. For the quantitative approach, we adapted a set of five questions from the 2018 General Social Survey (GSS) designed to encompass instances of microaggressions in everyday life. The GSS is a nationally representative survey conducted biennially by NORC at the University of Chicago. Like the GSS, our survey asked about four aspects of microaggressions: being treated with less respect than others, being treated as if you are not smart, being treated with less trust, and being threatened or harassed in coastal spaces. We did not include a GSS question about being treated unfairly at restaurants or stores because it was too specific. To quantify the responses to these questions, we used a scale of microaggression frequency developed by Douds and Hout (2020) to analyze the GSS questions. The frequency of microaggression for each question was scored on a scale of 0 (never or almost never) to 4 (always or almost always); the sum of these scores represented the total microaggression score, ranging from 0 to 16. In this analysis, we only included survey participants who identified with one race (n = 1,418) for comparability with Douds' and Hout's (2020) analysis. In the focus groups, we asked participants if they felt like they had been treated differently because of their race in ocean spaces, and if so, what effect these instances had on them. Our qualitative coding approach again was both inductive and deductive. In addition to coding for ethnic identity, we also coded for other marginalized identities participants discussed: gender; sexual orientation; and economic class. In our analysis of the focus group

data, we employ the concept of intersectionality (Crenshaw, 1989), which holds that forms of oppression such as racism, sexism, and classism are not additive, but interact and compound.

To answer the final question of this section, we asked participants of the focus groups to recommend solutions to ocean access barriers in any category (social, knowledge, physical/environmental, and personal) to the state of California. Participants were asked to brainstorm solutions and then sort them by their feasibility and impact level.

Selected Data Summaries, Analyses, Figures, and Interpretation

The demographics of Asian-American survey respondents reflect those of the survey overall, skewing younger and lower-income, but with a significantly higher proportion of respondents with a Bachelor's degree or higher (62.4% as compared to 49% overall). Ocean use was slightly less frequent among Asian-American respondents, though the top three most important activities for Asian-American respondents (fishing or collecting food, group or family activities, and walking or running) were the same as the overall sample. Discussions in the focus groups shed more light on the ocean as a highly relational place for Asian Americans. The most commonly discussed value was connection to family, followed by connection to community either through time spent together in ocean spaces or through sharing foods from the ocean. Roughly a quarter of participants mentioned foraging, particularly for uni (sea urchin roe), as a means of connection and excitement. Eight of the 26 participants also stated that ocean access in California makes them feel connected to their homeland. A Southeast Asian participant described the importance of the ocean as a connector across space and across peoples:

> "It's just as an island person, it's in my blood and when I go in the ocean, I feel at home."

Other participants discussed how the ocean serves as a way to create a new home in California. Some participants who forage (searching for and gathering food in nature) explained that foraging is a way to understand the rhythms and patterns of a new land and sea. Another who is a child of immigrants stated that proximity to the ocean and going to the beach is integral to their identity as a Californian. A Southeast Asian participant said of her ocean activities:

> "I think it's a way to feel more part of where we live. We're next to the coastline, but the water can feel like a faraway place unless we can rebuild these connections with it. And so the more we do it, the closer I start to feel to it all."

One of the main goals of this section was to explore whether Asian Americans experience different or greater social barriers than other racial groups on the coast, especially in terms of microaggressions. While social barriers ranked the lowest of the four categories (see *Section 3.2*), experiences of microaggressions by different racial groups were complex and varied (**Figure 12**; α = 0.82, ωt = 0.87). In all categories and in the overall index, White respondents reported significantly fewer microaggressions on the coast than all other categories. Conversely, Black respondents experienced the highest frequency of microaggressions overall. The spectrum of microaggression frequency being bounded by White Americans on one end and Black Americans on the other agrees with Douds' and Hout's (2020) national-level findings. Asian Americans' position on the spectrum, however, was different in our study. While Hispanic

Americans reported the second-highest incidence of microaggressions in Douds' and Hout's (2020), Asian Americans ranked the second highest in our data. On average, Asian Americans' responses were significantly higher than those of Hispanic Americans. It is important to note, though, that Douds and Hout (2020) grouped Asian Americans into a catchall category also including Native American and "Other" respondents.
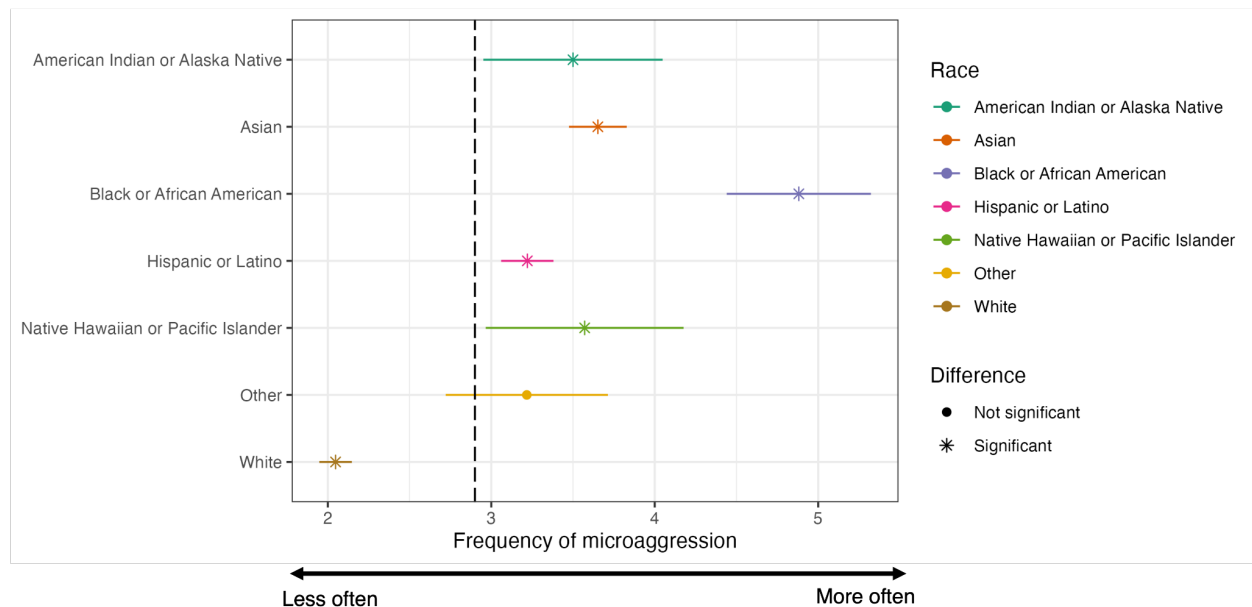

Figure 12. *Survey microaggression scores for the aggregated index. The vertical line represents the overall mean for the index. Error bars are one standard deviation on either side of the group mean. An asterisk indicates the group had a microaggression score significantly different from the average.*

Between the three Asian-American sub-identities (α = 0.80, ωt = 0.85), Southeast Asians (n = 92) reported significantly more microaggressions than East Asians (n = 117); microaggression incidence for South Asians (n = 43) was not significantly different from that of East or Southeast Asians. The difference between Southeast and East Asians was mostly driven by responses to the question of feeling safe from harassment.

Discussion in focus groups yielded a mixture of experiences with regard to microaggressions. Nine of 26 participants, mostly East and South Asian, said they have never felt like they were treated differently in ocean spaces because of their race. The remaining participants discussed feelings of objectification, invisibility, and sometimes direct harassment. A common theme among these participants was intersectionality: that people hold more than one identity that bears salience to their interactions with others. The most commonly discussed intersecting identity was gender, as the focus group sample was heavily skewed toward women. East and Southeast Asian-American women discussed feelings of exoticization and unsafety at beaches, and needing to try to anticipate unwanted interactions. One Southeast Asian participant described this as an almost subconscious perpetual awareness. Several participants also

discussed how their experience of the coast is shaped inseparably by their identities as Queer, female-presenting, and Asian American.

A major contributing factor to the experiences that participants described is that ocean spaces and activities lack diversity in all senses of the word. This creates a general sense of being the other, especially in more niche activities such as surfing. Participants stated that they have experienced judgment and mistreatment for not conforming to the behavioral norms of White men. These experiences range from judgmental glances to interpersonal altercations and are not only perpetrated by White men. An East Asian female surfer spoke of surf retreats:

> "I think in a lot of ways I'm just not that type of American. And so what happens is if I'm not like a big personality or a competitive surfer, usually one woman–the alpha White woman in the group–will almost always have beef with me for the whole entire week [of the retreat]."

The focus groups concluded with a more general discussion of recommendations for the state to address the Asian-American communities' barriers to coastal access (**Figure 13**). Participants' solutions primarily focused on knowledge barriers, suggesting that there be more interpretation (both written and in-person with rangers) of ocean science and ocean regulations and that these materials be translated into more languages. Further, several participants suggested highlighting the relationships between BIPOC and the ocean in interpretive signage to increase appreciation for the different ways in which people engage with the coast. The second-largest barrier category the participants focused on was physical-environmental, suggesting that the state maintain and improve infrastructure such as bathrooms and ramps for greater coastal accessibility.
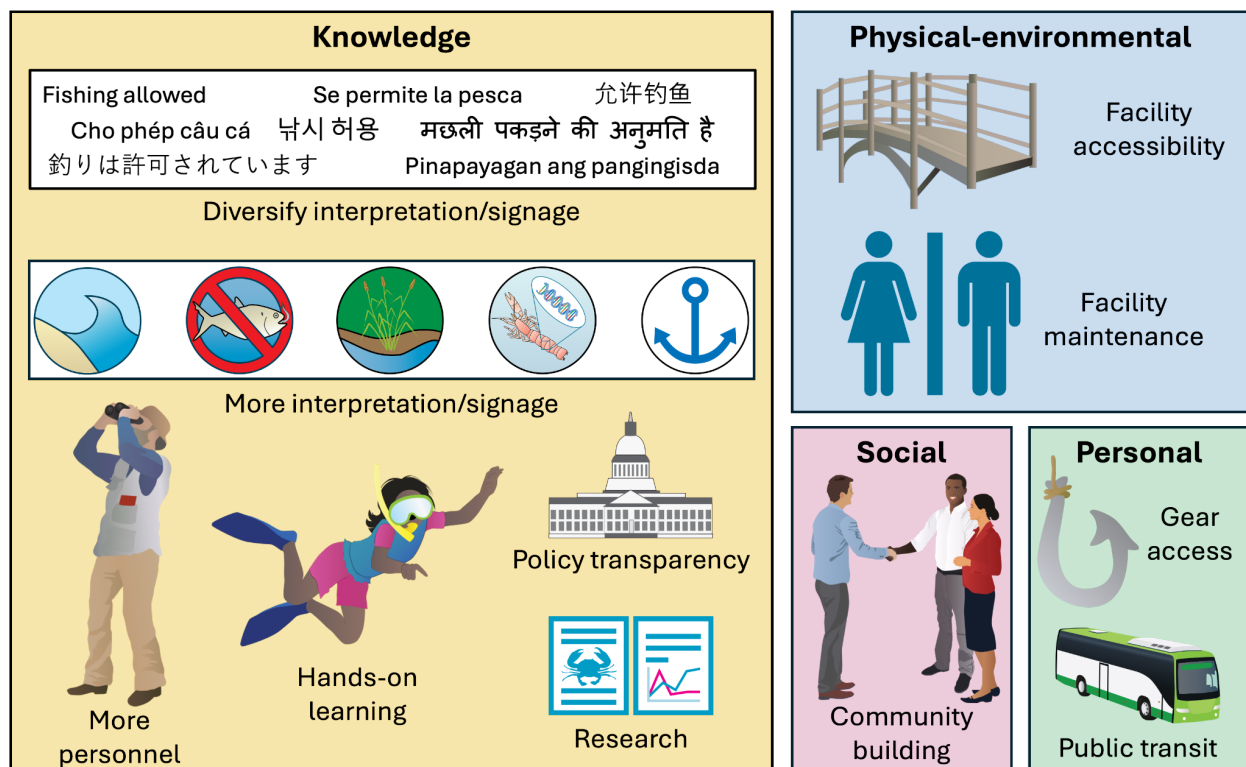
Figure 13. *Most feasible and impactful solutions to ocean access barriers as ranked by Asian-American focus group participants. Image sizes are roughly proportional to the number of times they were suggested. All images from University of Maryland Integration and Application Network (ian.umces.edu/media-library).*

While discussed more specifically in the need for diverse interpretation, participants expressed the importance of diversity and representation throughout the different discussion topics. Several participants discussed how they felt more comfortable and interactions felt more meaningful when they were able to do activities such as surfing and clamming with other Asian people. An East Asian participant who volunteers at an aquarium stated:

> "I have noticed it does make a difference when I have guests who are Asian looking or Asian American. It's almost like there is a different degree of openness or enthusiasm that we're interacting together. Maybe because it's a surprise that I am who I am and I happen to be there interacting with their kids. But I think there is something there, like a surprise and a familiarity or something unexpected that makes the guests perhaps be a little bit more open or linger longer, just feel more comfortable asking questions."

Others had similarly meaningful experiences with members of other marginalized groups. An East Asian surfer who is a member of an affinity group for minority surfers said:

> "Going back to what we were saying about having someone that looks like you […], I feel the same way about surfing. I learned how to surf from White people, and I just

never got good. It's because there's a hierarchy in the water. There's all this stuff that's happening. And it wasn't until I got linked to [affinity group] 10 years ago and surfed with people that were brown and queer that all of a sudden, I just felt like I belonged and my surfing just blossomed."

A more general discussion of solutions discussed across all focus groups can be found in the "Conclusion & Recommendations" section of this report.

Implications

Ocean and coastal spaces are deeply laden with significance for Asian Americans. They serve to connect Asian Americans to family, to culture, and to home. Despite a limited emphasis on the ocean as a source of livelihoods, focus group participants described intertidal foraging and other coastal activities as meaningful ways to connect to family and friends and as a way to understand California as their home. Peters et al. (2016) find that immigrants are able to develop a sense of belonging in new countries by engaging with natural places they find meaningful. East, Southeast, and South Asian respondents all discussed cultural connections to the ocean and to water that had deep meaning to them, from religion to family history to identity as a sea people. Access to nature on the coast is important for all immigrants to feel integrated (Charles-Rodriguez et al., 2022; Lovelock et al., 2023), especially those from coastal places. While some focus group participants had experienced direct incidences of discrimination or harassment, others described indirect mistreatment or a general feeling of unease in ocean spaces because they are dominated by White men. This domination is manifested in both interpersonal instances of racism and in the historical construction of ocean goers and bronzed and blond White people (Wheaton, 2013; Wheaton, 2017). As a result, many of the solutions and facilitating factors discussed by participants involve addressing social barriers by increasing minority representation. When prompted to provide suggestions to the state, participants focused on diversifying signage and sharing minority stories and ocean uses. Though not a substitute for systemic change and material assistance, other research has noted the benefits of increased representation and culturally relevant interpretation in improving outdoor access (Martin et al., 2024; Winter et al., 2019). Indeed, these approaches should be considered essential components of strategies designed to increase inclusivity of California's coastal management and science.

Authorship Information & Research Next Steps:

The information presented in this section represents a subset of the analyses and text being developed by Emma Gee (ekgee@ucsc.edu), as supported by the other members or the research team. The work is being prepared as a manuscript that will partially fulfill the requirements for a Ph.D. in Environmental Studies at the University of California, Santa Cruz and will be submitted to a peer-reviewed scientific journal.

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2.4. Perceptions and Priorities Surrounding Area-based Marine Management across the Central California Coast

Introduction

Coastal and ocean ecosystems around the world face mounting pressures from overexploitation, habitat degradation, and accelerating climate change that threaten marine biodiversity and the social, cultural, and economic benefits that oceans provide to society. As local and national governments seek to protect critical habitats, rebuild depleted populations, and enhance ecosystem resilience, marine protected areas (MPAs) have emerged as one of the primary tools for advancing ocean conservation and sustainable resource management. MPAs can be broadly defined as spatially explicit marine zones where human activities are regulated to achieve specific conservation, management, or cultural goals. A substantial body of evidence suggests that MPAs are a viable tool for protecting threatened species and ecosystems and sustaining marine livelihoods (Jennings, 2009; Micheli et al., 2012). Yet significant variation in performance across diverse study systems and social–ecological contexts suggests that not all MPAs are created equal. Poor alignment of biodiversity objectives with local values, needs, and governance capacity has led to social injustices, non-compliance, and the proliferation of "paper parks" (Claudet et al., 2022). With the international community moving toward ambitious ocean protection goals—such as the "30 × 30" initiative designed to conserve 30% of ocean areas by 2030—the need to carefully consider local social–ecological context and to center equity in area design, implementation, and governance has grown increasingly acute. Indeed, without efforts to ensure that MPAs reflect diverse needs, capacities, and priorities— and that their costs and benefits are widely and fairly distributed—these interventions (a) may lack the public support required to achieve conservation outcomes, and (b) risk reinforcing existing disparities in access, representation, and environmental injustice.

Methods and Analytical Approaches

Though significant effort was made to engage commercial and sport fishers and tourism operators in California's Marine Life Protection Act and other collaborative management processes, the social values and priorities of stakeholders from minority and low-income populations and Tribal communities have received less research attention (Stevenson et al., 2012; Sayce et al., 2013; Hoffman et al., 2018). Here, we endeavor to address this shortcoming by assessing priorities for area-based management across the diverse demographics that comprise our sample of survey respondents. Individuals taking the survey were asked: *"If a local ocean and/or coastal zone were to be managed for the benefit of your community, how important would the following characteristics be?"* and then asked to rank a list of 10 characteristics/attributes from 1 (most important) to 10 (least important). Our final 10 prompts were chosen to reflect diverse ecosystem services, as identified and explored in previously published typologies of area-based marine management benefits (Angulo-Valdés and Hatcher, 2010; Gill et al., 2019). To minimize presentation bias, the order of characteristics/attributes

was varied and randomly generated for each respondent. Purposive in-person sampling, designed to prioritize the engagement of communities assessed as disadvantaged or severely disadvantaged by CalEPA, was a core feature of the research design. However, the distribution and dissemination of the online survey instrument expanded the demographic scope of the study population and offered several valuable opportunities for comparison and contextualization. Of particular relevance to the analysis described below, we recorded approximately 300 online survey responses between 15 September 2024 and 18 September 2024, after the All Waters Protection and Ocean Access Coalition—an advocacy group dedicated to protecting ocean resources and the access rights of anglers and freedivers— disseminated a survey link via their email lists and social media accounts.

Selected Data Summaries, Analyses, Figures, and Interpretation

Of the 10 area-based marine management attributes, survey respondents ranked *Providing protection for threatened plants or animals* (mean rank score = 3.87 ± S.D. 2.71) and *Preventing large-scale industrial and/or commercial activity* (i.e., oil drilling, commercial fishing, etc.) (mean rank score = 4.69 ± S.D. 3.03) as their top two priorities (**Table 7**). Encouragingly for coastal and marine resource managers, these attributes—implicitly associated with biodiversity conservation—are among the primary goals and objectives of California Marine Protected

Table 7. *Aggregate prioritization (n = 1,575) of area-based marine management attributes (1= highest priority, 10= lowest priority).*

	Priority Level (1-10)	Management Priorities from Survey Question	Mean Rank Score	S.D.
	1	Providing protection for threatened plants or animals	3.87	2.71
	2	Preventing large-scale industrial and/or commercial activity (i.e., oil drilling, commercial fishing, etc.)	4.69	3.03
	3	Providing or improving access to coastal areas	4.93	2.64
	4	Providing educational opportunities to improve ocean knowledge	4.99	2.50
	5	Allowing locals to participate in rule-making and/or environmental monitoring	5.44	2.79
	6	Reducing risks of flooding, coastal erosion, and/or sea level rise	5.47	2.77
	7	Increasing the availability of local seafood products	6.23	3.01
	8	Promoting connections between individuals and groups in my community	6.33	2.52

🖼️	**9**	Providing jobs and/or the opportunity to make money	6.46	2.84
🖼️	**10**	Enabling practices or activities that support local culture and/or traditions	6.57	2.58

Areas and National Marine Sanctuaries as currently designed. In contrast, the two attributes explicitly related to socioeconomic and cultural benefits—*Providing jobs and/or the opportunity to make money* (mean rank score = 6.46 ± S.D. 2.84) and *Enabling practices or activities that support local culture and/or traditions* (mean rank score = 6.57 ± S.D. 2.58)—were ranked the lowest overall. Additionally, it is worth noting that the two attributes whose rankings exhibited the greatest variance concerned seafood and/or the harvest of marine animals, suggesting that divergent opinions may surround fisheries-related issues.

Dichotomous comparisons reveal significant differences in priorities by demographic, with self-reported household income, gender, and activity profile among the most significant factors (**Figure 14**). Individuals in the lowest household income category ranked the *Jobs/Income* attribute an average of 1.18 slots higher (± S.E. 0.27, p < 0.001) than those in the highest household income category, while ranking *Local Seafood* 0.84 slots lower (± S.E. 0.33). While the first result is intuitive, the second is somewhat surprising given existing scientific understanding of the demographics for which issues of food security are most acute
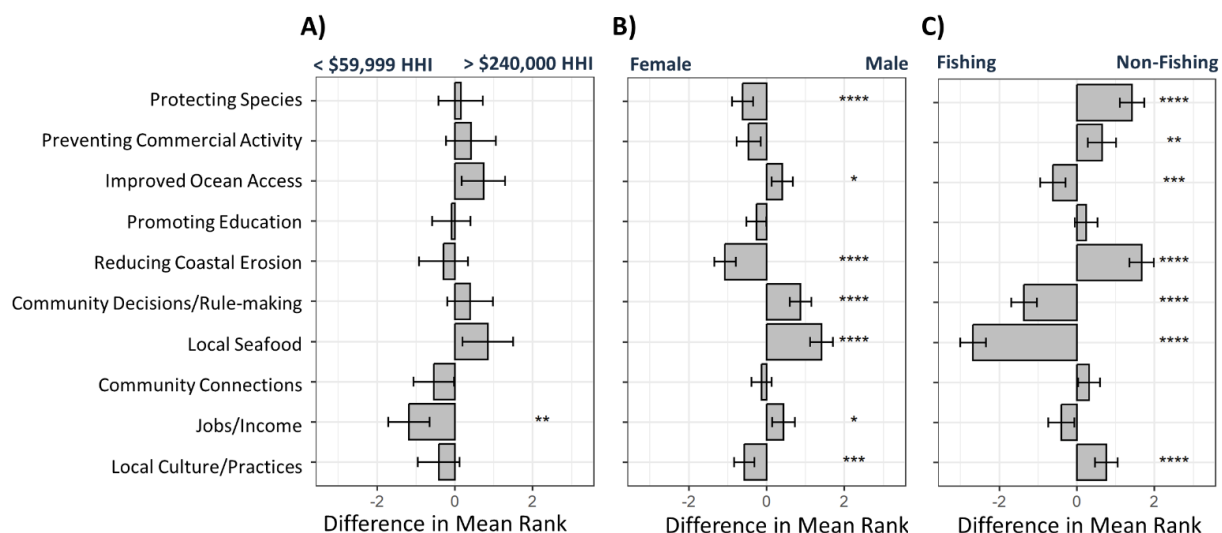

Figure 14. *Dichotomous comparison of management priorities between discrete stakeholder groups based on A) self-reported annual household income (i.e., < $59,999 vs. > $240,000); B) gender (i.e., Female vs. Male); and C) most valued ocean activity (i.e., Fishing vs. Non-Fishing). Bars display the difference in mean ranked management priorities while error bars reflect the standard error of the difference. Bars left of zero (on the x-axis) represent an attribute ranked higher by the first group listed; bars right of zero represent an attribute ranked higher by the second group listed. Asterices indicate the significance of the comparison based upon and unpaired Wilcox Test, following a Bonferroni adjustment to correct for the family-wise error rate (* p <0.05, ** p <0.001, *** p < 0.0001, **** p < 0.00001).*

(McClanahan et al., 2015). When comparing priorities between genders, individuals identifying as female ranked *Protecting Species* (+0.62 ± S.E. 0.14), *Reducing Erosion* (+1.07 ± S.E. 0.14), and *Local Culture & Practices* (+0.57 ± S.E. 0.13) significantly higher than male respondents, while ranking *Community Rules/Decision-Making* (−0.87 ± S.E. 0.14) and *Local Seafood* (−1.40 ± S.E. 0.15) significantly lower. The most substantial differences in priorities were associated with responses to the survey question asking respondents to choose the ocean activity most important to them. Compared to those selecting other activities, respondents selecting *Fishing or collecting food* ranked *Local Seafood* (+2.67 ± S.E. 0.17), *Community Rules/Decision-Making* (+1.36 ± S.E. 0.17), and *Improved Coastal Access* (+0.62 ± S.E. 0.16) significantly higher.

In an effort to move beyond single-variable comparisons, we employed redundancy analysis (RDA) as a multivariate method to quantify and compare the extent to which variation in priorities (i.e., response variables) was explained by different explanatory demographic variables (**Figure 15A**). The largest amount of variance (~37.4%) was explained by whether or not an individual chose fishing as their most important ocean activity (p < 0.001), followed by identifying as male (~5.7% variance, p < 0.001) and identifying as White (~5.4% variance, p < 0.001). All three of these demographic predictors were associated with the bottom right-hand quadrant of the RDA biplot—the same area in which *Improved Ocean Access*, *Community Rules/Decision-Making*, and *Local Seafood* priorities were associated—as were household income and frequency of ocean use, which, while significant (p < 0.01), explained less variance (~3.1% and ~2.1%, respectively). Other significant explanatory variables explaining substantial variance (> 2.5%) included identifying as Black or African American (~4.0% variance, p < 0.001; most strongly associated with *Jobs/Income* and *Community Connections*) and identifying as Asian (~2.7% variance, p < 0.001; most strongly associated with *Protecting Species* and *Preventing Commercial Activity*).

Emergent categories illuminated by the RDA were used to explore differences in awareness of and perspectives regarding ocean and coastal management (as assessed through a separate set of survey questions). Survey respondents associated with Quadrant #4 of the RDA (referred to here as *White, Wealthy, Male Fishers*) were significantly more familiar (p < 0.0001) with California Marine Protected Areas and National Marine Sanctuaries compared to other survey respondents (**Figure 15B**). When prompted to reflect—using a series of 5-point Likert scale questions—on the future of oceans and the role and effectiveness of ocean managers (**Figure 15C**), *White, Wealthy, Male Fishers* expressed significantly less agreement (p < 0.0001) with: (a) having a voice in ocean management; (b) confidence in the ability of those managing ocean spaces; and (c) belief in the ability of MPAs and National Marine Sanctuaries to facilitate climate adaptation. Beliefs regarding the capacity of oceans and coasts to help communities adapt to future changes, and to benefit future generations irrespective of management intervention, were positive and comparable between *White, Wealthy, Male Fishers* and other survey respondents.

Implications

The patterns revealed through both univariate and multivariate analyses underscore how strongly demographics characteristics shape stakeholder priorities for area-based marine
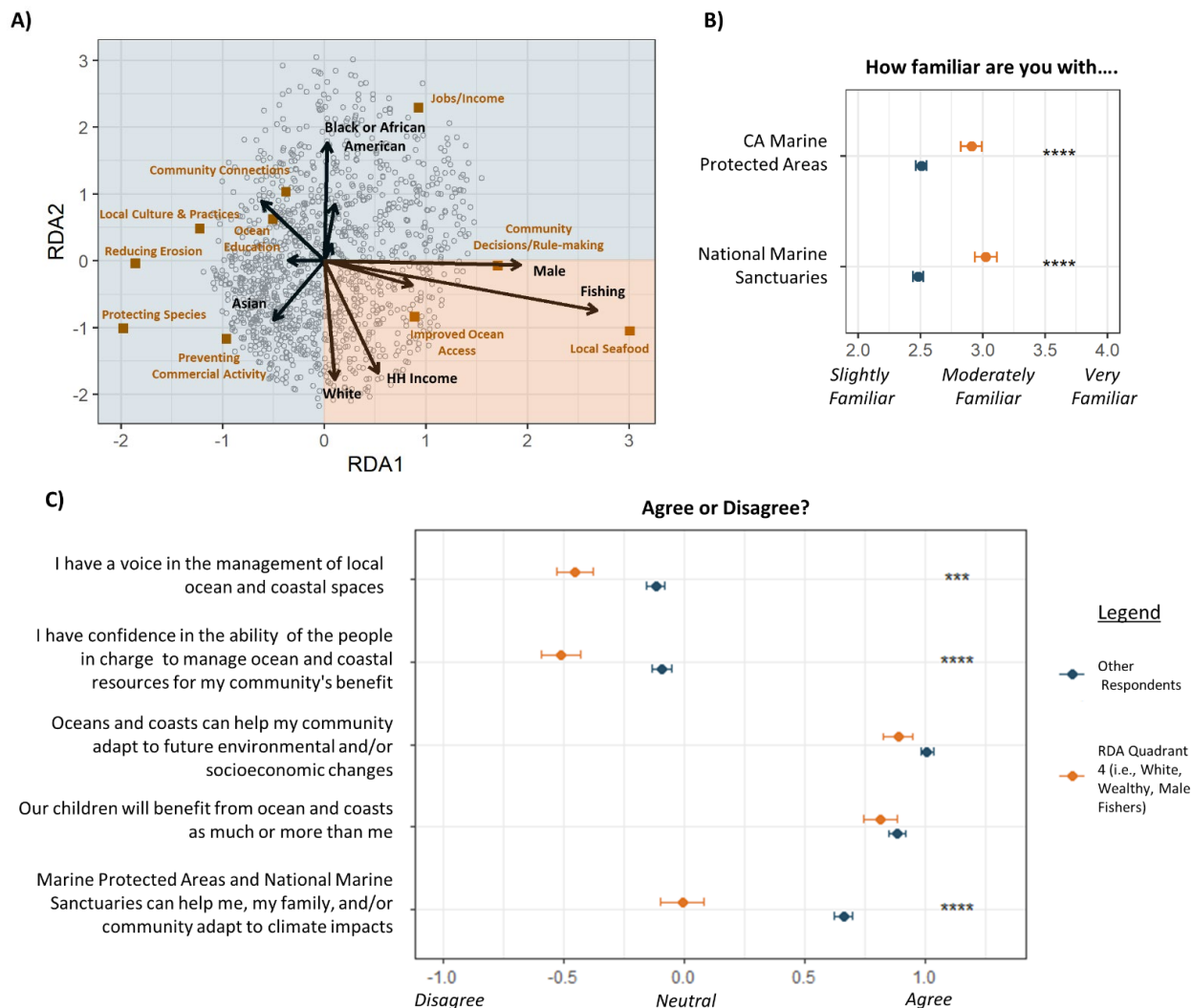
Figure 15. *Perceptions of area-based marine management between emergent stakeholder groups with distinct priorities. A) Presents a Redundancy Analysis used to explore the degree to which gender (i.e., Male, Transgender or Non-binary, etc.), race (White, Hispanic or Latino, Asian, etc.), socioeconomic (i.e., Household Income) and activity (i.e., Frequency of Usage, Most Valued Activity) variables drove variation in the ranking of area-based management priorities (as specified at the level of individual prompts). Only variables (i.e., arrows) explaining > 3% of the total variance are labeled. The RDA used to parse survey respondents into 2 groups with distinct priorities: White, Wealth, Male Fishers (RDA Quadrant #4; n=253) and Other Respondents (Quadrants #1-3; n= 982). These categories were subsequently used to compare awareness of current area-based marine management strategies (B) and perceptions regarding the ocean and coastal management (C). Asterisks in B & C denote the existence and level of significance (* p <0.05, ** p <0.001, *** p <0.0001, **** p<0.00001) when comparing the difference between the mean values of each group using a pairwise t-test, following a Bonferroni adjustment to correct for the family-wise error rate. Note that only individuals choosing to answer the priority ranking question and provide all relevant demographic information were included in this analysis.*

management. These differences have important implications for the design, implementation, and governance of MPAs and other spatial protections, especially in contexts where diverse user groups may hold contrasting views about the value and purpose of marine management.

Previous research of stakeholder perceptions of MPAs in other parts of California has reported low satisfaction with the MPA implementation process and low trust in associated management entities (Grifman and McCreary, 2016; Ordoñez-Gauger et al., 2018). Indeed, as scholarly critique of MPAs has accelerated following the initial wave of enthusiasm for this type of marine spatial planning, the term "ocean grabbing" has gained popularity as a descriptor for acts of dispossession or appropriation that deprive local communities and fishers of the use, access, or control of ocean resources and spaces (Bennett et al., 2015). While the literature contains substantial socioeconomic evidence affirming that spatial protection and other efforts to advance biodiversity targets alone are insufficient to foster human well-being (Gurney et al., 2021; Aburto-Oropeza et al., 2025), our results suggest that the issue—particularly in densely populated regions like the central California coast—is a complex one. A key consideration in designing MPAs, evaluating their performance, and determining whether costs and benefits are equitably distributed concerns the definition of a *stakeholder* (Pomeroy and Douvere, 2008).

In California, as elsewhere, commercial fishers and others whose livelihoods are directly dependent on the existence and/or extraction of marine resources are often the most vocal and engaged participants in area-based marine management planning and evaluation processes (Stevenson et al., 2012; Sayce et al., 2013). Yet despite their outsized contribution to local coastal economies, such individuals represent a relatively small proportion of the broader population that stands to benefit from MPAs—particularly when relational and subjective values and benefits are considered alongside material ones. As California charts a path forward in establishing new spatially explicit management areas and refining its approach to adaptive management, our findings serve as a useful reminder that: a) the loudest voices in the room are not always representative of the values and priorities of Californians at large; and b) explicit consideration of diverse ecosystem services is likely required to advance equity-centered approaches to MPA management.

Authorship Information & Research Next Steps

The information presented in this section represents a subset of the analyses and text being developed by Taylor Triviño (tay16@uw.edu), as supported by the other members of the research team. The work is being prepared as a manuscript that will partially fulfill the requirements for a Master's degree in the School of Aquatic and Fishery Sciences at the University of Washington and will be submitted to a peer-reviewed scientific journal.

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2.5. Climate Impacts on Regional Marine Environments and Coastal Spaces: Observations & Concerns

Introduction

California's marine and coastal environments are increasingly shaped by the accelerating impacts of climate change that are altering ecosystem dynamics. Natural scientists in California (Frawley et al., 2025) and beyond (Boonstra et al., 2015) have emphasized the compounding risks which ocean acidification & deoxygenation, changes in upwelling and circulation, marine heatwave waves and other physical stressors pose to marine ecosystem structure and function. Yet it is difficult to detect and understand changes happening beneath the surface of the water (Thorne et al., 2024). Understanding climate impacts requires attention not only to ecological indicators but also to the lived experiences of coastal communities. Indeed, environmental changes are not experienced in isolation but within the context of accompanying and/or concurrent social changes reshaping coastal communities and economies (Carothers et al., 2014). For many CA coastal residents, abstract and technical physical and biological concepts may be perceived as less relevant than more immediate disruptions to activities and traditions related to housing, employment, food security, cultural practices, recreational activities and/or mental health. While climate and development literature has traditionally emphasized infrastructure and resource constraints in climate adaptation, local subjective capacities (as determined by beliefs and expectations) may be a limiting factor in determining willingness to invest in adaptation (Grothmann and Patt, 2005; Jones et al., 2011).

This section explores how climate change is reshaping how individuals and communities are interacting with and benefiting from ocean and coastal space across the central CA coast. In synthesizing recent observations and future concerns associated with climate change and other socioeconomic drivers, we a) highlight how global environmental change is being experienced differently by diverse communities and user groups and b) identify strategies for supporting climate resilience and adaptation at the local level.

Methods and Analytical Approaches

Here we present information concerning survey respondents' a) general climate beliefs, and b) perceptions of and concerns surrounding seven environmental drivers of change and four socioeconomic drivers of change. The list of survey prompts was informed by semi-structured interviews conducted with community leaders affiliated with or recommended by community partner organizations (see: https://github.com/thfrawley/OPC_Final_Report). A section of the semi-structured interview protocol was designed to explore and identify issues surrounding the environmental and socioeconomic drivers of change with the greatest impact on how disadvantaged communities experienced or interacted with ocean and coastal spaces. For each of the 11 prompts individuals (see Survey Question #15) were asked to assess the direction and magnitude of observed changes (i.e., Strong decrease, Decrease, No change observed, Increase,

Strong Increase) and then, in a subsequent section (see Survey Question #16), asked to indicate their prospective level of concern (i.e., Not at all concerned, Somewhat concerned, Very concerned) after the researchers had assigned a direction to each potential change (i.e., an increase in ocean temperatures). Prior to analysis, categorical responses were converted to ordinal variables in order to facilitate quantitative comparison.

Selected Data Summaries, Analyses, Figures and Interpretation

Survey respondents reported observing a number of substantial environmental and socioeconomic changes which had impacted the ocean and coastal spaces that they used most frequently over the past 5 years. Following conversion of qualitative categories into an ordinal scale (-2 = strong observed decrease, 2= Strong observed increase) the most pronounced changes were associated with increases in the costs of visiting (mean= 0.64, S.E. = +/- 0.021), storm surges and floods (0.62 +/- 0.021), and wildfires (0.59 +/- 0.022); the most pronounced decreases and/or declines were associated with ocean water quality (-0.14 +/- 0.022) (**Figure 16**). Examining reported observations by frequency of ocean usage suggests that, overall, frequent ocean users more consistently observed and reported increases in socioeconomic drivers of change (**Figure 16A**). As compared to infrequent ocean users, frequent ocean
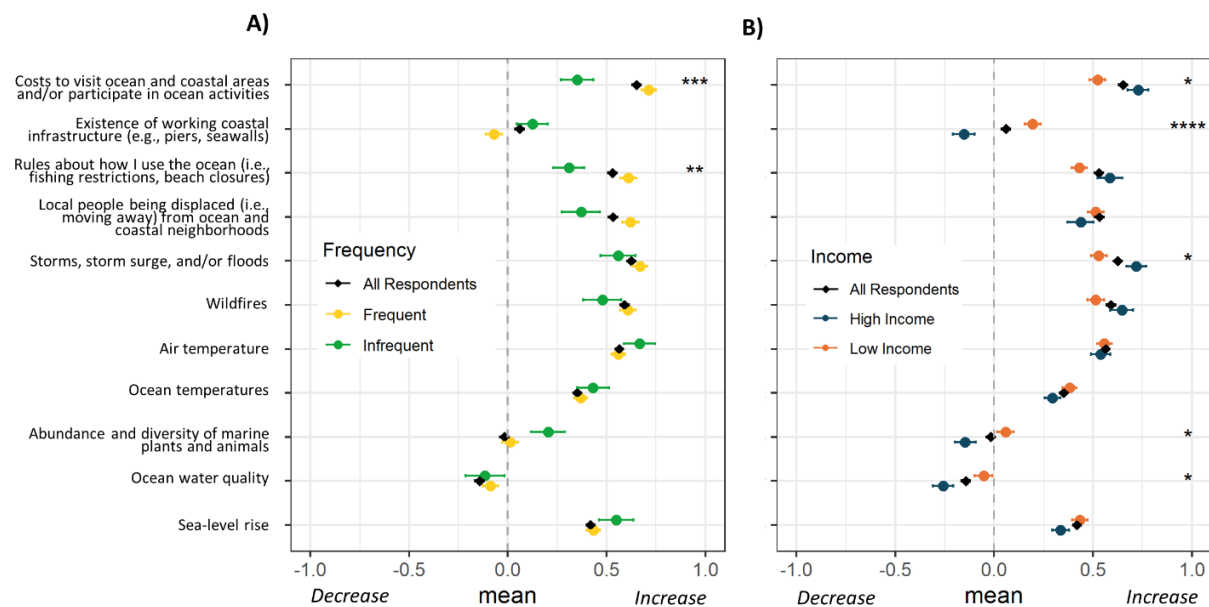

Figure 16. *Observations of environmental and socioeconomic change reported by survey respondents. Respondents were asked to assess the direction and magnitude of changes observed in the ocean or coastal space they visit most frequently over the past 5 years (mean +/S.E.). Qualitative categories (strong decrease, decrease, no change, increase, strong increase) subsequently transformed into an ordinal variable (0 = no change). Colored points represent variation by reported frequency of ocean use (**A**; Several times a week = Frequent, Once a year or Less than once a year = Infrequent) and household income (**B**; More than $180,000/year = High Income, Less than $60,000/year = Low Income). In each panel, significant differences between sub-categories are marked with asterisk (* p <0.05, ** p <0.001, *** p <0.0001,**** p<0.00001) while mean values (across all survey respondents) are shown in black.*

users more consistently reported larger increases in the costs to visit ocean areas ($p < 0.001$), increases in the number or rules governing ocean use ($p < 0.01$), and increases in the displacement of local people ($p = 0.20$). In contrast, infrequent ocean users more consistently reported larger increases in several broad environmental parameters (i.e., air temperature, sea-level rise) though these differences were not significant. Examining reported observations by household income (**Figure 16B**) reveals that individuals associated with high income households more consistently reported pronounced increases in the cost to visit ocean areas ($p < 0.05$) and storms, storm surges, and/or floods ($p < 0.05$), along with pronounced decreases in the existence of working infrastructure ($p < 0.0001$), abundance and diversity of marine animals ($p < 0.05$) and ocean water quality ($p < 0.05$). Across all categories, changes to the existence of working coastal infrastructure and the abundance and diversity of marine animals stand out as unusual, with different demographic categories reporting changes of opposing directionality. Finally, preliminary analyses of observations by user groups (data not shown) suggests that the nature of respondents' interactions with the marine environment influenced the changes they perceived as most pronounced and impactful. For example, scuba divers and nature observers/photographers reported the largest decreases in plant and animal abundance; surfers reported the largest increases in storms/storm surges and floods, and fishers reported the largest increases in costs to visit marine environments and numbers of rules and regulations.

When asked about their beliefs surrounding climate change, ~82% of survey respondents believed it was occurring and it was caused in whole (~42%) or in part (~40%) by human activities. Disaggregating these responses by frequency of ocean usage showed that individuals that frequented ocean and coastal spaces once every couple months or more were overall more likely to recognize human activities as a driving or contributing factor to climate change as compared to other survey respondents (**Figure 17A**). In addition, however, recognition of natural cycles as a contributing factor was most common among more frequent ocean users (though this belief was also common among the small number of survey respondents that rarely or never visited ocean spaces).

When asked to assess their level of concern about the capacity of environmental and socioeconomic drivers of change to negatively impact their use and/or benefits of ocean and coastal areas in the future, declining abundance and diversity of marine plants and animals, decreases in ocean water quality, and more wildfires and & declining air quality were of most concern for survey respondents (**Figure 17B**). More rules governing ocean usage, increases in air temperature, and displacement of local people from coastal neighborhoods were of least concern. When using a heatmap to compare levels of concern by user group, fishers and foragers stand-out as having a unique perspective, with their top concern (more rules and regulations) being the issue of least concern across the overall sample and their item of least concern (declining abundance or diversity of marine plants or animals) being the top concern of the overall sample (**Figure 18**). Other user-group specific concerns of interest to note include a) surfers, known for their distinct and place-based subcultures, expressing high levels of concern regarding the potential displacement of local peoples, rising sea levels, and declining ocean
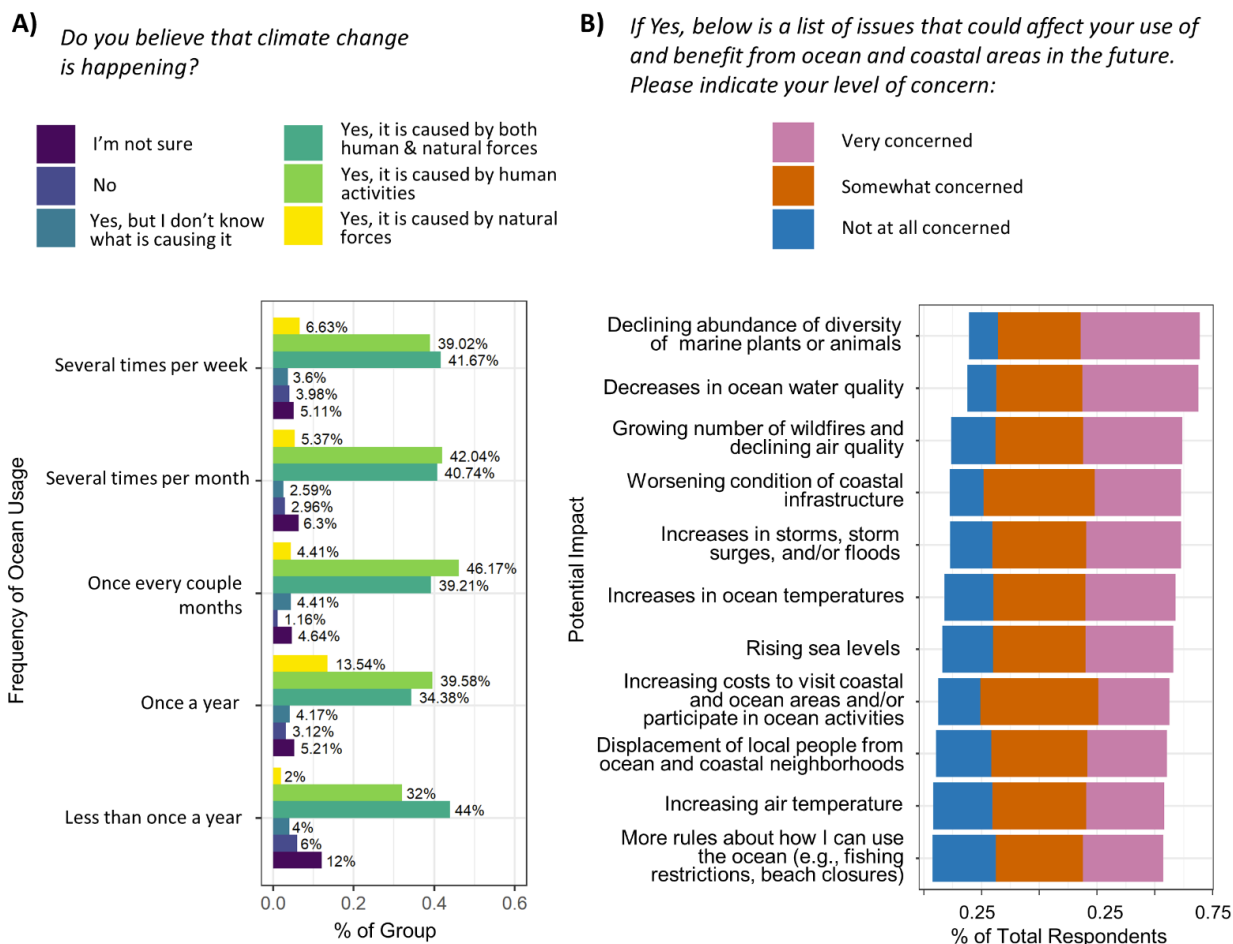
A) *Do you believe that climate change is happening?*

Legend:
- I'm not sure
- No
- Yes, but I don't know what is causing it
- Yes, it is caused by both human & natural forces
- Yes, it is caused by human activities
- Yes, it is caused by natural forces

Several times per week
- 6.63%
- 39.02%
- 41.67%
- 3.6%
- 3.98%
- 5.11%

Several times per month
- 5.37%
- 42.04%
- 40.74%
- 2.59%
- 2.96%
- 6.3%

Once every couple months
- 4.41%
- 46.17%
- 39.21%
- 4.41%
- 1.16%
- 4.64%

Once a year
- 13.54%
- 39.58%
- 34.38%
- 4.17%
- 3.12%
- 5.21%

Less than once a year
- 2%
- 32%
- 44%
- 4%
- 6%
- 12%

X-axis: % of Group (0.0, 0.2, 0.4, 0.6)
Y-axis: Frequency of Ocean Usage

B) *If Yes, below is a list of issues that could affect your use of and benefit from ocean and coastal areas in the future. Please indicate your level of concern:*

Legend:
- Very concerned
- Somewhat concerned
- Not at all concerned

Potential Impact (Y-axis):
- Declining abundance of diversity of marine plants or animals
- Decreases in ocean water quality
- Growing number of wildfires and declining air quality
- Worsening condition of coastal infrastructure
- Increases in storms, storm surges, and/or floods
- Increases in ocean temperatures
- Rising sea levels
- Increasing costs to visit coastal and ocean areas and/or participate in ocean activities
- Displacement of local people from ocean and coastal neighborhoods
- Increasing air temperature
- More rules about how I can use the ocean (e.g., fishing restrictions, beach closures)

X-axis: % of Total Respondents (0.25, 0.25, 0.75)

Figure 17. *Survey respondents' beliefs surrounding climate change, as disaggregated by frequency of ocean usage (A), and level of concern regarding the potential impacts to ocean use and benefits (B).*

water quality; and b) the high levels of concern expressed across potential drivers of change of those valuing engagement in cultural or religious practices and ceremonies (perhaps representative of the existential spiritual threat posed by such changes and/or the distinct perspective of Tribal respondents, see *Section 1.2*).

Overall a majority of survey respondents expressed ambivalence (~35%) or disagreement (~21.1%) regarding the realized impacts of climate change on their physical and/or mental health (**Figure 19**). Yet, when anticipating the future, a majority of survey respondents a) agreed (35.4%) or strongly agreed (26.6%) that climate change would negatively impact their physical or mental health; and b) agreed (38.5%) or strongly agreed (30.9%) that climate change would negatively impact the benefits that they, their family, and or community would receive from ocean and coastal areas. While only ~55% of respondents agreed or strongly agreed that Marine Protected Areas could help them, their family, and/or community adapt to climate impacts; this number increased to ~63.5% when only considering the responses of individuals
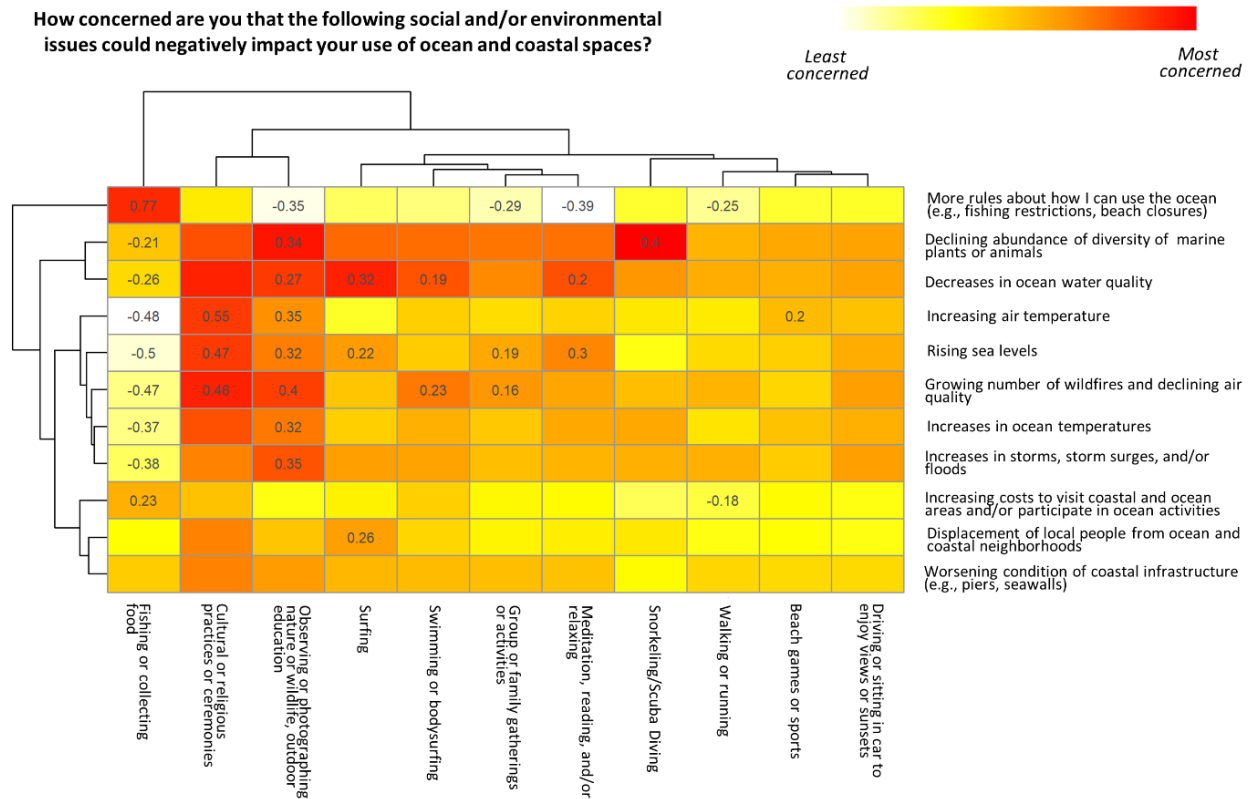
How concerned are you that the following social and/or environmental issues could negatively impact your use of ocean and coastal spaces?

Figure 18. *Heatmap used to illustrate differences in level of concerns by user group (i.e., ocean activities/uses that respondents select as the most important to them). Red shading indicates higher level of concern while white shading indicates lower concern. Cells where the observations of a user group were significantly different (as assessed by a t-test following the application of a Bonferroni correction to control for the family-wise error rate) than those reported by other respondents are labeled with the numerical value that represents the difference between corresponding means.*

Figure 19. *Five-point Likert scale responses of all survey respondents reflecting levels of agreement surrounding prospective interactions between climate change, wellbeing and CA marine protected areas.*

that agreed (n=632) or strongly agreed (n=298) that they were very knowledgeable about climate impacts to ocean and coastal areas in California.

Implications

Understanding and anticipating responses to climate impacts, and developing strategies to support their adaptation, requires information concerning how climate change is perceived (Grothmann and Patt, 2005). Our results affirm that climate change is not experienced as a single ecological driver along the central California coast, but through the intersection of environmental and socioeconomic changes that shape how people use and benefit from marine and coastal spaces (Frawley et al., 2019). Survey responses and focus group discussions reveal a disconnect between the physical and biological phenomena often emphasized in climate science and research funding and the disruptions most salient to stakeholders, such as rising costs of access, declining water quality, and the displacement of local residents. Indeed, a greater attention to lived, human experience may be required to build and restore trust in knowledge producers and resource managers viewed as "coastal elites" by many marginalized communities (Flannery et al., 2018; Thornton 2018), and to make ocean management and climate adaptation planning more accessible and relevant at the local level. While the biophysical processes linking increasing greenhouse gas emissions with changes to marine environments and ecosystems are often abstract, indirect and/or difficult to parse (especially as the discourse surrounding them becomes increasingly politicized), acute events impacting livelihoods and property may have greater resonance (Maltby et al., 2021). Providing two examples from the vulnerable communities included within our survey sample, sea level rise was an issue of significantly greater concern for the residents of the SF Bayview (where king tides had inundated parking infrastructure and destroyed resident vehicles) while floods and storm surge were top of mind for Watsonville residents following the failure of Pajaro River levees in 2023.

The need to link scientific monitoring with the lived experiences, perceptions, and priorities of diverse user groups has been previously identified as a key research gap by the OPC Science and MPA Advisory Team (Hoffman et al., 2018). As biological and ecological data streams proliferate, integrating insights from social science is essential to establish baselines and track change across the human communities that resource managers are mandated to serve. Differences in perceptions between frequent and infrequent ocean users, high- and low-income households, and activity-based groups (e.g., fishers, surfers, cultural practitioners) revealed by our survey demonstrate that climate impacts are experienced unevenly, shaped by how individuals and communities interact with and experience the coast. As California increases its investment in climate adaptation planning, our results suggest that broad-scale efforts are likely to be less effective and equitable than decentralized approaches tailored to the needs and experiences of specific geographies and communities. A critical next step is to examine how variation in knowledge, beliefs, and expectations influences adaptive capacity at the local level, and to identify opportunities where enhancing public understanding of climate–ocean connections could strengthen resilience. Where efforts to resolve the underlying mechanisms driving changes to California coasts become divisive as skepticism surrounding how information

is generated and communicated grows, resources should instead focus upon managing risk and removing barriers to adaptation (Maltby et al., 2021).

Authorship Information & Research Next Steps

The information presented in this section represents a subset of the analyses and text being developed by Timothy Frawley (tfrawley@ucsc.edu), as supported by other members of the research team, in preparation for a manuscript to be submitted to a peer-reviewed scientific journal.

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PART 3
CONCLUSION

3.1. Conclusion & Recommendations - A Policy Brief

Co-developing solutions through community-engaged research makes interventions more legitimate, effective, and durable. By sharing power in problem definition, study design, and interpretation, our research effort has attempted to integrate local knowledge with scientific evidence. In doing so, we uncover community and demographic-specific constraints and opportunities in coastal management that top-down approaches may have missed. Previous research has shown that such collaborations can help build trust, improve data relevance, and increase the likelihood that results can translate into actions that local populations will adopt and sustain (Ban et al., 2019; Jennings et al., 2024). We conclude this report here with policy recommendations that were developed and workshopped during a series of focus group discussions co-hosted with our community partner organizations (see *Section 2.1*). These focus group discussions were designed to provide our study population the opportunity to contextualize, interpret, and respond to the results of the structured survey instrument and to co-develop solutions to the needs and challenges that they highlighted. We hope that this text can inform marine resource management frameworks (across the California MPA network and beyond) that align community values with institutional mandates and help advance measurable and equitable ocean outcomes for underserved communities.

Reducing Barriers to Ocean Access and Enhancing the Contribution of Ocean & Coastal Spaces to Human Wellbeing

California is considered a world leader in protecting and managing ocean environments for public benefit, yet our results add to a growing body of literature that suggests that there is more work to be done (Reinman et al., 2016; Christensen & King, 2017). Despite the mandate of policy to enhance opportunities for recreation, education, and wellbeing through equitable ocean access (e.g., the California Coastal Act, the Marine Life Protection Act, and the National Marine Sanctuary Act), such benefits are disproportionately available to affluent, White communities located in close proximity to the coast. Other demographics–particularly Black and Asian Americans, low-income households, environmentally vulnerable communities, and/or women and non-binary people–continue to face persistent and compounding barriers limiting ocean access that are rooted in historical processes of exclusion and dispossession. For MPAs to fully realize their potential in enhancing human wellbeing, promoting community resilience, and facilitating climate adaptation for underserved communities across the state, they must be paired with or precipitated by investments designed to reduce barriers to ocean access and create, restore, and/or sustain meaningful connections to ocean spaces (Table 8). While current management structures tend to emphasize extractive uses and ecological outcomes, broader and more inclusive approaches are needed to support relational and subjective dimensions of ocean wellbeing and elevate the diverse forms of engagement that support it. Indeed our results indicated that these (often) intangible ocean benefits associated with social connection, identity, healing, and cultural expression are what matter most to many constituencies across the state.

Table 8. *Policy recommendations (developed using input and ideas provided by focus group participants and semi-structured interview respondents) to reduce barriers to ocean access and promote equitable distribution of ocean benefits.*

Intervention Target	Examples	Expected Outcome
Coastal Infrastructure	• Reduce parking and access fees or provide community vouchers or free lots. • Improve affordable and accessible public transit to beaches and coastal areas. • Build and frequently maintain amenities that facilitate access and low-impact use for non-residents and people of all ages and abilities (i.e., trash receptacles, bathrooms, bike racks, picnic areas, accessible ramps, mobi-mats, and pathways, etc.). • Create a network of Tribal cultural centers in beach and coastal areas.	*Increased physical access for all communities; reduced financial barriers*
Funding & Grants	• Conduct equity audits and develop resource reallocation plans to increase investment in neglected coastal areas. • Create or increase grant opportunities to facilitate coastal access, education, and engagement for underserved communities. • Promote and/or subsidize affordable, high-density coastal housing options. • Develop funding to support Tribal land purchases, cultural activities, knowledge sharing, and job training.	*More equitable distribution of resources to underserved and Tribal communities*
Education & Outreach	• Partner with established local NGOs to host inclusive, community-focused coastal events. • Provide priority access (and/or reduced fee) days for underserved and Tribal communities. • Offer free or low-cost swimming lessons and/or equipment rental programs. • Launch public outreach campaigns to raise awareness of local ocean areas, wildlife, and recreation opportunities. • Create multilingual resources and signage that clearly describes local rules, permitted activities, local species, safety information, and environmental hazards. •Develop targeted outreach and education programs designed to connect local communities with neighboring MPAs.	*Increased sense of safety, knowledge, belonging and confidence across diverse communities, improved ocean literacy*
Participatory Governance & Environmental Management	• Emphasize and broaden community consultation when designing, implementing or modifying regulations affecting coastal use and access. • Facilitate Tribal co-stewardship of coastal areas and resources, including streamlined permits for ceremonial practices. • Increase beach clean-ups and litter control in neglected coastal areas. • Support community-based environmental sampling and monitoring programs. • Mitigate run-off impacting urban, industrial, and/or agricultural coastal areas.	*Increased regulatory awareness and compliance; cleaner healthier coastal environments*

Workforce Development	• Provide cultural competency training for coastal public safety and resource protection staff. • Create additional or expanded roles to advance environmental education and support sustainable use. • Prioritize hiring and recruiting local personnel reflective of community demographics; increased emphasis on the value of local and indigenous knowledge systems.	*Increased trust between communities and coastal agencies; improved equity and effectiveness of staffing*

Potential Benefits of Locally Designed and Managed MPA

A primary focus group activity was organized around asking participants to provide their input to state and federal officials in order to guide the design of a hypothetical, local MPA. In a series of prompts, participants were asked to reflect upon and discuss 1) how oceans and local MPAs could benefit their community; 2) considering local needs and values, what types of activities should be allowed and encouraged in a new MPA, and what should be prohibited and why; and 3) What strategies could help increase community awareness of and benefits from MPAs? Focus group participants broadly valued marine conservation and supported the ecological goals of MPAs even if their familiarity with and/or awareness of them was limited. However, when asked explicitly how a local marine area might be managed for the benefit of their community their focus was often on practical, place-based gains that would address everyday conditions across local ocean areas. The most frequently mentioned potential benefits were those surrounding place-based education and improvements in ocean literacy. While some current MPAs are marked with descriptive signage and informational kiosks, focus group participants expressed an appetite for more targeted and expansive programing. Hypothetical local MPAs were envisioned as natural laboratories that could host local school field trips, facilitate hands-on lessons for youth, and support programs designed to teach outdoor activities (i.e., swimming, snorkeling/diving, kayaking, fishing, surfing, etc.) integrated with environmental education and sustainable use.

Though many current MPAs have been sited in areas with comparatively low human impact, many focus group participants felt that such preconditions were inconsistent with the urban, industrial, and/or agricultural shorelines which characterized their communities. Their focus was instead on MPAs as an opportunity to mobilize the public support and political will required to make local ocean areas and coastal zones clean and safe (i.e., reduce water pollution, improve water quality, and address concerns associated with trash and runoff). Where appropriate, such efforts could be paired with targeted restoration efforts designed to improve the quality of local marine habitat (i.e., restoring kelp and seagrass beds, improving estuary health, etc.). Centering local and/or student roles in environmental monitoring, ecological data collection, and other place-based research projects was advanced as a mechanism to build trust with management authorities and to increase participation in (and support of) decision-making and adaptive management. In parallel, a number of respondents emphasized the importance of local ecological knowledge and Tribal practices and ceremonies, framing Indigenous leadership and co-stewardship as essential to legitimacy, relevance, and intergenerational learning.

Another major theme of the focus group discussions was the potential for MPAs to serve not only as ecological refuges but as tools for neighborhood resilience and cohesion. MPAs were envisioned as multi-benefit community assets that would support learning and connection, helping families and community members spend time together outside and learn new skills. Though MPAs were initially envisioned as a means of separating humans from nature, it was believed that consistent engagement with MPAs and everyday recreation opportunities that they might support had the potential to inspire residents as environmental stewards in taking pride and caring for their own, unique stretch of coast. Beyond recreation, MPAs were viewed as potential engines of economic growth and workforce development, providing jobs and training for local residents to serve as rangers, environmental engineers, restoration stewards, nature-based tourism operators, and/or aquaculturists.

The results of our survey (see *Section 2.4)* suggest broad support for biodiversity conservation across diverse demographics (perhaps rooted in a moral obligation to protect threatened plants and animals), yet in focus group discussions consistently reflected the desire for MPAs to address more pressing and immediate social and economic challenges. When long-term rebuilding of depleted fish stocks or invertebrate populations was referenced, it was done so in reference to promoting food security and ensuring opportunities for sustainable and responsible subsistence harvest.

Policy and Governance Implications for California's MPA Network:
Findings from this study underscore the urgent need to re-examine governance structures within California's MPA network to better align conservation goals and MPA accessibility with diverse social priorities. The dominance of privileged groups in decision-making processes (whether they be advocates for marine conservation or commercial and recreational fishing lobbies) has meant that issues central to underserved communities—such as equitable access, community empowerment, and the protection of cultural practices—remain underrepresented in management agendas. Although recent commitments by the Ocean Protection Council (2022) have acknowledged these shortcomings, meaningful progress will depend on moving beyond symbolic inclusion towards participatory governance models that formally allocate-decision making authority to a broader array of stakeholders. Collaborative management processes require targeted reforms (in both design and implementation) in order to broaden who participates and who benefits. Recent commitments, including the state's alignment with the global "30×30" initiative to protect 30% of lands and waters by 2030, demonstrate political will to scale up marine conservation initiatives. However, without embedding equity into all stages of the adaptive management cycle—design, monitoring, evaluation, and iterative adjustment—these ambitious targets risk perpetuating existing deficiencies in representation and legitimacy. The need for ecological data to conduct baseline studies and post hoc evaluations of MPAs and their effectiveness has long been recognized (and funded). Yet, the need for qualitative and quantitative human dimensions data collection and analyses to inform the development and integration of the social indicators into adaptive management processes (and track progress towards achieving equity focused objectives) remains acute.

Our research and analysis echoes broader calls to expand the conservation toolkit in recognizing that MPAs alone, as currently designed and managed in California, may not be capable of delivering the full spectrum of social and ecological benefits across diverse communities and demographics. Complementary models, such as Other Effective Area-Based Conservation Measures (OECMs), offer opportunities to recognize Indigenous, community-based, and sectoral management regimes that sustain biodiversity while supporting livelihoods and communities (Gurney et al., 2021; Alves-Pinto et al., 2021). Likewise, the emerging concept of "Marine Prosperity Areas" reframes conservation success as the joint pursuit of ecological restoration and human well-being, directly addressing the temporal and distributional mismatches between ecological recovery and socio-economic needs (Aburto-Oropeza et al., 2025). Encouragingly, recent bottom-up (i.e., the Yurok-Tolowa-Dee-ni' Indigenous Marine Stewardship Area) and top-down efforts (i.e., the Chumash Heritage National Marine Sanctuary) are may signal a shift in a more holistic approach to area-based marine management. By embedding equity not as an add-on but as a core design principle, California has the opportunity to not only enhance the legitimacy of its MPA system but also to serve as a model for advancing the social dimensions of marine conservation globally.

Through this study we have begun a large-scale survey designed to capture the complex factors mediating ocean use and benefits across California's diverse coastal communities. This effort is now being extended into 5 new counties as part of Phase II of this project (funded in spring of 2025) and, when complete, will serve as a statewide baseline of the ocean uses and barriers, MPAs, the human dimensions of climate change, and the interactions between such factors. Additional data collection will facilitate place-based comparisons and enable future exploration of the differences between non-ocean users, general ocean users, and MPA-specific ocean users, providing insight into opportunities for expanding how ocean and coastal resources - and the MPAs that protect them - can benefit Californians and our ocean.

Looking Ahead

The throughline of this brief is clear: California's diverse coastal communities are more likely to back ambitious ecological goals when they are paired with pathways to ocean access, safety, learning, livelihoods, and cultural vitality that are visible and real. The task now is to translate that mandate into funded pilots, measurable outcomes, and durable governance arrangements while working to scale-up, sustain, and operationalize marine social science research initiatives across the state. As global environmental and socioeconomic change accelerates, equity-centered approaches are foundational for a sustainable future (Gill et al., 2023). Climate change presents not only an existential threat for California's vulnerable coastal populations, but also a rare opportunity for transformative change. With intentional design, coastal adaptation planning can be used as a lever to redress (rather than reproduce or exacerbate) historical inequalities (Hardy 2017) and help build a future based upon universal ocean access, belonging, and wellbeing.
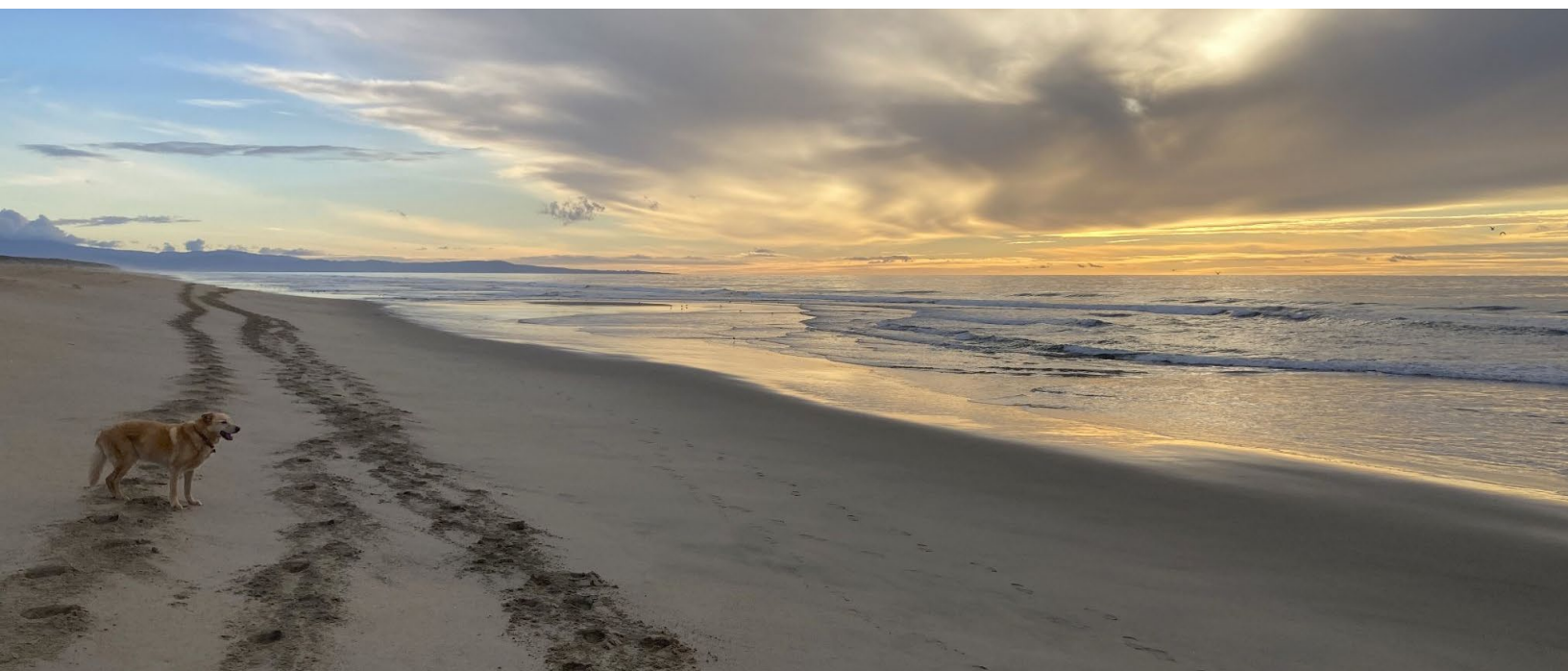
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3.2 Acknowledgements

3.3 Photo Credits