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Sarah J. Harper, Jenn M. Burt, Laura K. Nelson, Jocelyn M. Runnebaum, Alison Cullen, Philip S. Levin, Karen L. Hunter, Jim McIsaac, and Natalie C. Ban

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Research

Commercial fisher perceptions illuminate a need for social justice considerations in navigating climate change impacts on fisheries systems

[Sarah J. Harper](#)^{1,2} , [Jenn M. Burt](#)² , [Laura K. Nelson](#)³ , [Jocelyn M. Runnebaum](#)⁴ , [Alison Cullen](#)⁵ , [Phillip S. Levin](#)⁶ , [Karen L. Hunter](#)⁷ , [Jim McIsaac](#)⁸ , and [Natalie C. Ban](#)¹ 

ABSTRACT. Climate change will amplify stress on marine systems already challenged by conflicts and inequities relating to fisheries access, management decisions, and ocean uses across sectors. Understanding how those most connected to fisheries perceive the risks associated with climate change is critical to developing effective responses and establishing management priorities. Adaptation planning efforts may be hindered by perceptions of unequal or unfair distribution of resources and the processes in place to manage them. In contrast, adaptation planning that is more inclusive, transparent, and addresses social dimensions and perceptions of fisheries is more likely to garner support from fishers and fishing communities broadly. We elicited fisher perceptions of climate change impacts on fisheries, and responses to these impacts, through an online survey of commercial fishers in Canada's Pacific region. The survey highlights substantial concern for climate change, the impacts it will have on fishers' livelihoods and well-being, and some of the key challenges that may interfere with the ability of fishers and fisheries management to adapt. We frame the findings of the survey drawing from concepts of social justice, focusing on distributive and procedural justice, as necessary considerations, and context for climate change adaptation planning. Developing plans and processes to respond to climate change impacts on fisheries requires not only understanding ecological impacts and challenges, but also the social and institutional considerations that could help or hinder efforts to respond effectively and equitably to a changing ocean.

Key Words: *adaptation planning; climate change impacts on fisheries; distributive and procedural justice; equity and perceptions of fairness in resource management*

INTRODUCTION

Changing climate is impacting fish populations and the ecosystems that sustain them, with potentially profound consequences for the fisheries and communities that they support (Cheung et al. 2015, Savo et al. 2017, Bell et al. 2020). Climate change is already affecting the distribution and abundance of commercially fished species around the world, with impacts projected to increase substantially in the coming decades (IPCC 2021, English et al. 2022). Warming oceans will affect fish productivity and may cause fished species to migrate, move into deeper waters, or experience impacts related to ocean acidification and hypoxia (Poloczanska et al. 2016, Pershing et al. 2021). These changes will have implications for existing and future management decisions, which in many contexts are based solely on ecological objectives. Although there is increasing understanding of the impacts of climate change on marine ecosystems and fisheries (Smith et al. 2021), much less is known about the effects on fishers and fishing communities.

The ability of fisheries management to respond to climate change will require solutions that are timely and effective, but also considered equitable and fair (Friedman et al. 2018). Public perceptions are important in shaping and legitimizing public policies (Slovic 1997, Dieckmann et al. 2021), and influence decisions related to climate change (Cullen and Anderson 2017, Cullen et al. 2018). Therefore, fisher perceptions are pertinent to

developing effective responses to climate change in the context of fisheries, where diverse actors are involved and engaged. Fair governance is considered an important component of institutional adaptive capacity in managing resources and mitigating climate hazards (Gupta et al. 2010, Grothmann et al. 2013), while perceptions of fairness are important because they relate to individual and collective willingness to respond to environmental change (Adger et al. 2016). Perceived unfairness can foster conflict and undermine cooperation (Gurney et al. 2021) and may elicit strong emotional or behavioral responses with implications for human well-being (Prilleltensky 2012), trust in management institutions (Ordoñez-Gauger et al. 2018), compliance with rules (Turner et al. 2016), and social engagement (Gurney et al. 2021). Conflict is inevitable given the plurality of actors, interests, values, and uses of marine spaces, and can become heightened when resources become scarce. Unresolved conflict may impede governance objectives and threaten the sustainability of social-ecological systems (Parlee and Wiber 2018); however, conflict can be an important part of improving systems, generating new ideas, and learning to work together (Ripley 2021). Being aware of existing conflicts and managing emerging conflicts is therefore a critical component of climate adaptation planning (Levin et al. 2021).

Increasingly, literature on environmental governance engages concepts of social and environmental justice to understand and

¹School of Environmental Studies, University of Victoria, Victoria, BC, Canada, ²Nature United, North Vancouver, BC, Canada, ³School of Environmental and Forest Sciences, University of Washington, Seattle, Washington, United States, ⁴The Nature Conservancy in Maine, United States, ⁵Evans School of Public Policy and Governance, University of Washington, Seattle, Washington, United States, ⁶School of Marine & Environmental Affairs, University of Washington, Seattle, Washington, United States, ⁷Pacific Biological Station, Fisheries and Oceans Canada, Nanaimo, BC, Canada, ⁸T. Buck Suzuki Foundation, Victoria, BC, Canada

navigate inequalities in the distribution of harms associated with environmental degradation, such as climate change, and to assess the inclusiveness of decision-making processes (Paavola 2007, Schlosberg 2013, Adger et al. 2016, Turner et al. 2016, Bennett et al. 2019). Engagement with these concepts in the climate change planning discourse has increased substantially in recent years, including language first appearing in the Fifth report produced by the Intergovernmental Panel on Climate Change (IPCC 2014:17), which states, “Mitigation and adaptation raise issues of equity, justice and fairness.” Climate justice has emerged as an area of scholarship that deals specifically with how climate change will impact people differently, unevenly, and disproportionately (Sultana 2022). While scholars and activists may be increasingly engaging with concepts of social and environmental justice in climate change debates, there is a lag in mainstreaming these considerations into adaptation planning and policy at national or regional levels, and particularly those relating to fisheries.

It is broadly recognized that the impacts of climate change and the policies to address them will be unevenly distributed across society (Klinsky et al. 2017, Jardine et al. 2020, Sultana 2022). Existing inequalities and issues will likely be amplified by climate change, with notable consequences for the uneven distribution of fisheries costs and benefits, and perceptions of fairness related to management processes and outcomes. The varied socioeconomic conditions, values, and interests of fishers also have a bearing on their ability to respond in ways that either confer resilience or that can amplify negative impacts (Cinner et al. 2011) and the range of adaptation choices available to them (Szymkowiak 2020). Changes to fished species due to climate change (e.g., abundance and distribution changes) are expected to exacerbate issues such as the distribution of access and the associated benefits, requiring responsive and adaptive management to mitigate the impacts of climate change on fisheries-related livelihoods and well-being (Pinsky and Fogarty 2012, Bell et al. 2020, Jardine et al. 2020, Parlee et al. 2021, Smith et al. 2021). We argue in this paper that planning for climate adaptation in commercial fisheries must attend to, among other considerations, existing and emerging inequalities. We focus on the case of commercial fisheries in Canada’s Pacific region, with an exploration of fisher perceptions of climate change impacts and the capacity for individuals, communities, and institutions to respond in a developed country, temperate region context.

Canada’s Pacific region will experience, as with other temperate regions of the world, both positive and negative impacts of climate change on fisheries. Although the predicted impacts to the Pacific region may not be as stark as some other temperate regions (Lam et al. 2016) impacts are already being felt (Talloni-Álvarez et al. 2019, Whitney et al. 2020a). Although there are some efforts to understand and plan for these changes (Whitney et al. 2020b), overall, climate change adaptation strategies have yet to be integrated into commercial fisheries management in this region (Whitney and Ban 2019). Existing challenges to commercial fisheries systems in Canada, such as access, have been articulated as a threat to the future of the commercial fishing industry, with calls for reforming policies and processes in order to maintain the range of fisheries-related benefits to society, and especially to harvesters and coastal communities (Standing Committee on Fisheries and Oceans 2019, Bennett et al. 2020a, 2021a).

Ongoing processes in Canada that influence commercial fisheries access and operations include reconciliation with Indigenous peoples, Integrated Fisheries Management Planning (IFMP), Marine Spatial Planning (MSP), and Marine Protected Area (MPA) processes. Reconciliation in the Canadian context is a process that is in response to the colonial dispossession of lands and waters, and historical and ongoing mistreatment and marginalization of Indigenous peoples in Canada (Truth and Reconciliation Commission of Canada 2015). In Canada’s Pacific region, Fisheries Reconciliation Agreements are being signed with First Nations to directly address and enhance access to, governance of, and benefits from fisheries (Brown 2021). All fisheries in Canada’s Pacific region have IFMP processes where stakeholders raise concerns, provide insights, review science advice, access and allocation decisions, management objectives, conservation concerns, compliance plans, and commercial harvest plans to provide advice to the government minister. MSP and MPA processes have increased around the world in response to the many compounding uses of, and stresses on marine environments and how best to navigate them. In the Pacific region of Canada, existing and ongoing MSP and MPA processes have added to the complexity of fisheries management. Although these processes are meant to provide clarity on competing ocean uses (McGee et al. 2022) and important protection for vulnerable habitats or species (DFO 2014), they can lead to increased conflict when some groups feel that their interests are not being considered in these processes and their outcomes (Bennett et al. 2020b).

Here we engage concepts of social and environmental justice to frame and understand commercial fisher perceptions of the impacts of climate change, and the ability of commercial fishers and fisheries management in Canada’s Pacific region to respond to these impacts. We focus on commercial fisheries because of their economic importance in the region (Teh et al. 2022), and because of interest by both commercial fishing organizations and the fisheries management agency (Fisheries and Oceans Canada, DFO) in this research. This study responds to calls for better integration of human dimensions and perceptions into climate adaptation thinking in Canada (Whitney and Ban 2019, Foley et al. 2020), and contributes new insights and examples of how concepts of social justice can inform climate adaptation planning in fisheries.

METHODS

We elicited commercial fisher perceptions about climate change through an online survey (March 2020 to September 2020). The survey was based on questions developed by the University of Washington (as described in Nelson et al. 2023), drawing on earlier work on perceptions of climate change risk broadly (Ballew et al. 2019), and in the context of natural resource-based livelihoods, including agriculture (Cullen and Anderson 2017, Cullen et al. 2018), and fisheries (Schumann 2018). It also includes established indicators of well-being in coastal social-ecological systems (Breslow et al. 2017) and was adapted to the commercial fisheries context of the Canadian Pacific region in a collaboration between the initial designers and those with knowledge of the local context (Harper et al. 2022). This project was a collaborative effort by academic, government, and industry partners, and non-governmental organizations, with a shared interest in the outputs. We sought input and engagement on survey design, delivery, analysis, and interpretation from the BC Commercial Fishing

Caucus, the BC Seafood Alliance, the United Fishermen & Allied Workers' Union (UFAWU-Unifor), the First Nations Fisheries Council of British Columbia, the Native Fishing Association, and Fisheries and Oceans Canada (DFO) climate adaptation researchers. The survey focused on questions related to perceptions of climate change impacts on commercial fisheries and the ability of individuals, communities, and management to adapt to these changes (see Appendix 1 for survey questions). Questions about the perceived ability to adapt solicited views on management flexibility, effectiveness, and equity, as important components of institutional adaptive capacity (Cinner and Barnes 2019, Bahri et al. 2021). Additional questions addressed the ease with which individuals and communities could anticipate, respond to, and recover from changes in fisheries species composition, distribution, or abundance, and their ability to take advantage of emerging opportunities (Barnes et al. 2020). The survey included both Likert style and open-ended questions.

The sampling frame for the survey was commercial fishers in Canada's Pacific region. We asked survey participants to provide information on demographic and other characteristics including age, port of call, fishing experience, and target species. We also asked questions regarding observations of changes in ocean conditions (ocean temperature, severe weather, and availability of target species over the past five years), and whether fishers felt their ability to catch fish had been or would be impacted by climate change and other activities and processes, which we refer to here as cumulative impacts. When asking about perceived fishery-specific impacts of ocean warming, we asked respondents to select from a 5-point Likert scale from negative to no-effect to positive, in addition to offering the selection of "I don't know." This was done to enable separating the scaled responses (people who feel they have knowledge about species impacts) from the responses that reflect either lack of climate-impact knowledge or less familiarity or knowledge about a given fishery. We display the results as proportions of the Likert responses only, along with the sample size of fisher respondents that this reflects.

The study and survey were reviewed and approved by the University of Victoria Ethics office (RAIS Application # 20-0462). The survey was supported technologically, and responses collected by a professional survey firm: Pacific Market Research Ltd; however, we were responsible for the distribution of the survey. We invited fishers to complete the survey online or via the phone. We sent invitations by mail to Pacific region commercial license holders and by email to fisher associations and networks by industry partners. The survey was initially mailed out to approximately 1200 unique addresses for Pacific region commercial license holders, but in a follow-up communication, the online survey link was shared more extensively, by reaching out through fisher networks and First Nations harvesting associations to try to increase Indigenous participation. Based on the initial mail out, the response rate to the survey was approximately 9%; however, in the end, the sample size of possible respondents was larger, thus a lower response rate.

We visualized responses to Likert questions using R (R Core Team 2021) and analyzed open-ended questions using NVivo software (QSR International Pty Ltd 2020). We coded open-ended questions about management flexibility and future concerns using themes that emerged from participants' responses (see Appendix

2 for codebook). We further grouped these themes into concerns and considerations that relate to distributive justice and procedural justice concepts drawn from theories of social and environmental justice (Schlosberg 2007, 2013, McDermott et al. 2013). Distributive justice is defined here as fairness in the distribution of benefits or harms associated with decisions and actions across groups (Bennett et al. 2019). Procedural justice refers here to the level of (or perceptions of) participation and inclusiveness in decision-making or governance processes (Bennett et al. 2019).

Environmental justice considers both distributive and procedural justice in terms of the distribution of environmental costs and benefits, and ease of engaging in environmental decision-making processes (Schlosberg 2007, 2013). In this study, applying an environmental justice lens translates into understanding perceptions about the distribution of costs and benefits associated with changes in commercial fisheries and aspects of the management of those fisheries. Environmental justice theory also includes a third consideration, recognitional justice, which focuses on respect for cultural difference and has been articulated most in terms of Indigenous cultural identity and self-determination (Martin et al. 2014). Although all three dimensions of environmental justice are important in the context of fisheries, here we focus on distributive and procedural aspects, selecting illustrative narratives from the survey responses and connecting these to existing literature to highlight the relevance of the concerns and considerations raised to climate adaptation planning.

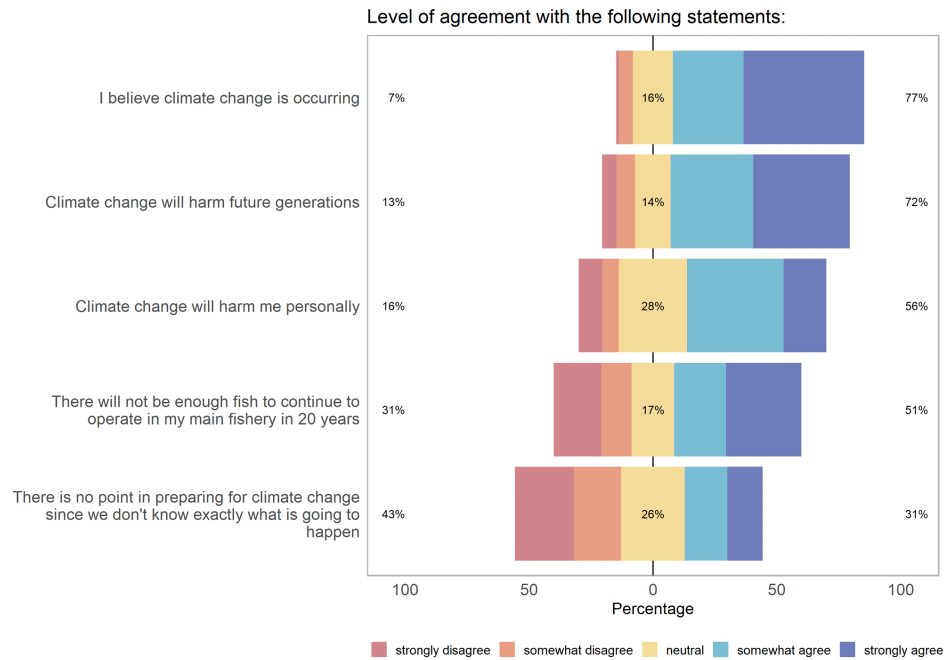
We presented preliminary results and analysis of the survey to industry partners, government collaborators, and stakeholder groups in a series of four online workshops to invite feedback and insights to assist in the interpretation and validation of the results. We then incorporated feedback and insights elicited through this process into the study, adjusting interpretations where necessary.

RESULTS

Out of the 105 commercial fishers who responded to the survey, the majority have been engaged in fishing long term; 82% reported that they have been fishing for over 25 years, and 72% reported having lived in their current community for over 25 years. Survey participants were engaged in a range of Pacific region fisheries, and they often participated in multiple fisheries, with 68% participating in salmon, 43% in other pelagic species (i.e., Pacific herring, tuna, hake, and sardine fisheries), 44% in groundfish (i.e., groundfish, halibut, sablefish, rockfish, lingcod, and dogfish fisheries), and 31% in invertebrate fisheries (i.e., shrimp, prawn, geoduck, sea urchin, and sea cucumber fisheries). They also fished all around the region; 57% fished in the North Coast, 43% in the Strait of Georgia, 42% along Northern Vancouver Island, 42% in Haida Gwaii, including Hecate Strait, and 40% along the Central Coast.

The demographic characteristics of the fishers who responded indicated that 77% of survey participants were 50 years or older, 6% were women, and 94% were men, and people identifying as Indigenous represented 10% of survey participants. Although the age profile of the sample reflects the general commercial fisher population, the number of women and those identifying as Indigenous underrepresents the demographics of the actual

Fig. 1. Survey responses on perceptions of climate change impacts. Percentages on the left correspond to combined responses “strongly disagree” and “somewhat disagree” and on the right to combined responses “somewhat agree” and “strongly agree.”



fisher population, which is 20% and 24%, respectively (Canadian Council of Professional Fish Harvesters 2018). The sample size was insufficient to analyze the results by age, gender, or identity, so are presented here in an aggregated format.

Fisher perceptions of climate change impacts

Of the 105 fishers who responded to the survey, 77% agreed that climate change is occurring, while 72% thought that climate change will harm future generations, and 56% indicated it would harm them personally (Fig. 1). Half of those surveyed indicated there may not be enough fish to continue to operate in their main fishery in 20 years. Although most fishers surveyed indicated concern over climate change impacts on their livelihoods, well-being, and on future generations, their concern for climate change impacts was just one of many concerns they had over threats to fisheries. One of the fishers surveyed reflected this in saying, “global warming is definitely having an impact but at the same time, for the same species, so might regulations, markets, costs... etc.”

Fisher perceptions of the impact of warming waters on specific fisheries varied widely across fisheries. For example, for some fisheries (e.g., salmon) over two-thirds of participants perceived negative effects, whereas for other fisheries (e.g., albacore, hake, geoduck) there was a larger proportion of participants who perceived positive effects or no effects (Fig. 2). Salmon fisheries were perceived as the most vulnerable to the impacts of ocean warming, with sockeye salmon being perceived to be the most negatively impacted of the Pacific salmon species (Fig. 2). A considerable percentage of those who responded indicated that they thought ocean warming would not have any effect on dogfish,

geoduck, and sea cucumber fisheries (Fig. 2). As for fisheries that would experience a positive impact, over half of the participants who responded to this question indicated a positive impact on the albacore tuna fishery, and a quarter of those who responded indicated a positive impact for the hake fishery (Fig. 2). These findings elucidate the impacts that fishers perceive climate change will have on particular fisheries, while also highlighting there is considerable fisher uncertainty in feeling confident about the direction and scale of the impact on fisheries with only a third of survey participants providing a categorical response for some fisheries (fisheries with $n < 35$ in Fig. 2; also see Harper et al. 2022).

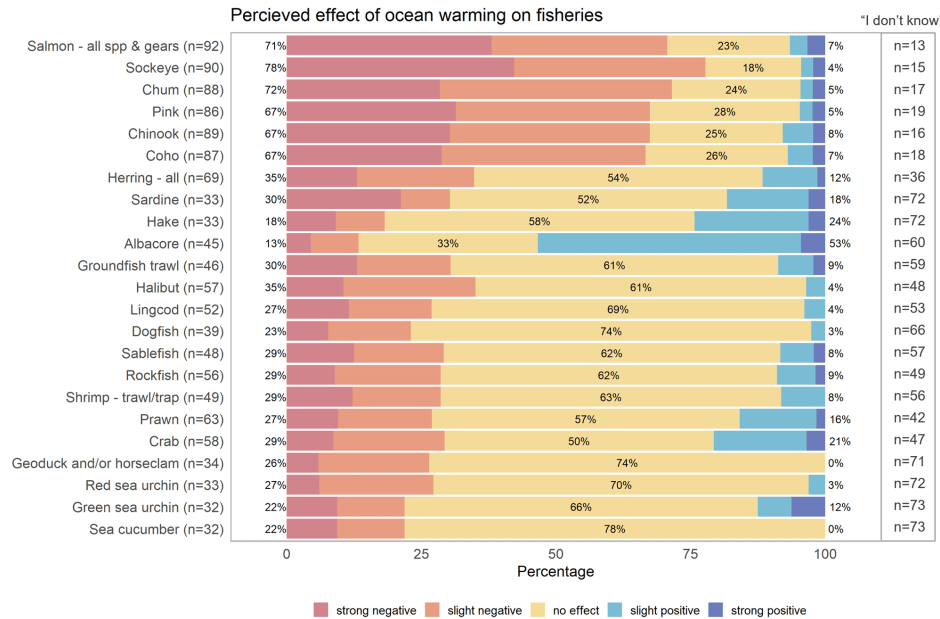
Cumulative impacts and conflict

Responses to survey questions related to additional stressors suggested existing challenges with other fisheries sectors and marine uses and processes. A large proportion of participants indicated that aquaculture (70%), recreational fisheries (70%), marine protected areas (70%), coastal development (62%), and marine spatial planning (56%) negatively impacted their fishery (Fig. 3). Many of the fishers surveyed (64%) agreed with the statement, “there is internal conflict within my own fishery.”

In response to an open-ended question about concerns for the future of fishing or their community, one-third of survey participants brought up issues of competition and conflict within and across marine sectors and groups. Some quotes that highlight these sentiments include the following:

Coastal fishing towns are dying, too many cuts to commercial fishing opportunities, and sports fishing is not replacing the lost revenue that commercial fishing used to generate for the coastal communities.

Fig. 2. Perceived effect of ocean warming on Pacific region commercial fisheries. The number of participants (n = x; out of the 105 total number of survey participants) who responded with a categorical rating is included in brackets beside each fishery and the number of survey participants who responded “I don’t know” in the far-right column. Percentages listed on the y-axis along the left-hand represent negative responses (strong negative + slight negative), while the ones of the right-hand side represent positive (strong slight positive + strong positive) responses.



We are overrun by the so-called recreational fishery here. Where their boats are getting bigger, and they are getting more aggressive every year I would like to see some control put on them like we have. They show no respect to us who have lived here all our lives. Their boats throw one hell of a swell and when we let them know about this, they just swear back at us. It seems us commercial fishermen are targeted when there is no fish by DFO, and others get a free pass.

The above responses reflect negative sentiments toward the recreational fishery, while the following relates to processes of Reconciliation and Marine Protected Area (MPA) establishment:

... my concern is First Nation Reconciliation and MPAs. I would like to see more First Nation involvement in our fishery, so they work with us not against us. The fair way to do this is to buy their way into the fishery with federal money so all of Canada pays not just a few fishermen that have put everything on the line to fish. MPAs are good but they don't work for us [Invertebrate - dive fishers] since our fish don't move, it takes anything in the MPA zone right off our TAC [total allowable catch].

Access to and benefits from current and future resources: distributive justice

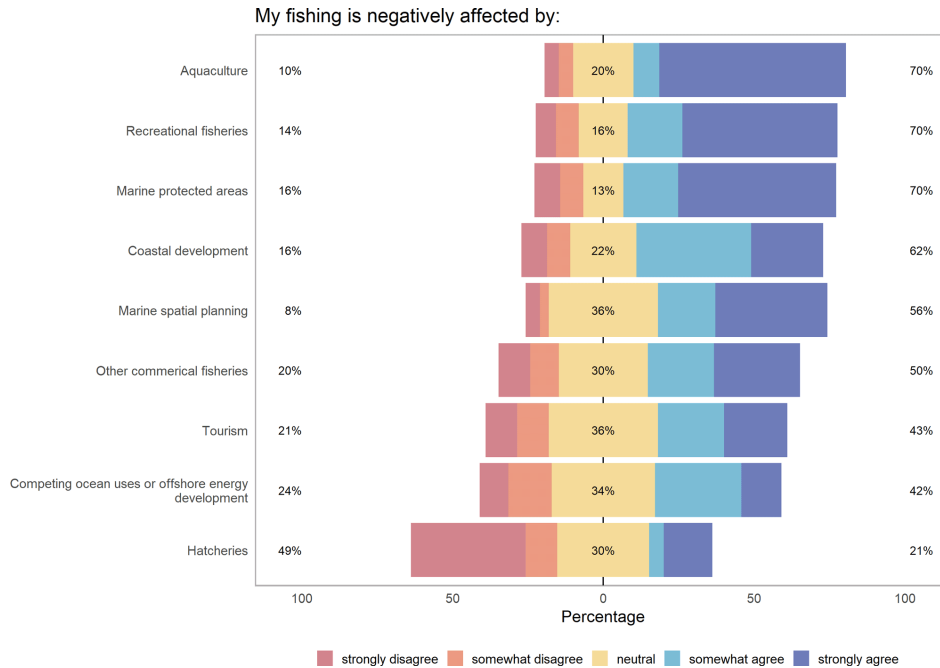
Perceptions related to equity were reflected in various survey question responses, including those specific to access and allocation of resources for current and future generations, and

the associated distribution of benefits, relating to concepts of distributive justice (Table 1). Perceptions about equity were articulated in various ways throughout the survey. These included the expression of concerns over barriers that exist for young fishers and new entrants to the fishery, particularly considering the greying of the fleet that is visible from the demographic data of the survey participants and from the actual fisher population. The most recent available estimate indicates the average age of captains on the Pacific coast is 56 years and crew 43 years (Canadian Council of Professional Fish Harvesters 2018).

In terms of the ability to access and benefit from emerging opportunities, approximately 70% of survey participants indicated that moving into a new fishery or finding work in another natural resource industry would not be easy (Fig. 4). In responses to open-ended questions, 41% of fishers surveyed expressed concerns related to allocation, i.e., who gets what/how much? Some non-Indigenous fishers indicated a perceived lack of clarity around fisheries reconciliation processes and their impact on allocation to Indigenous and non-Indigenous fishers.

When it came to intergenerational equity considerations, 72% of participants agreed with the statement, “Climate Change will harm future generations” (Fig. 1), and 60% of participants said they would not encourage their children to be fishers. One participant elaborated on this by saying, “my concern is about the next generation of young fishermen. Most will have a hard time finding financing for the exorbitant prices to buy a boat and quotas and earn an honest living.” This is also reflected in the

Fig. 3. Fisher perspectives on the impact of other fisheries sub-sectors and ocean uses on their ability to fish. Percentages on the left correspond to combined responses “strongly disagree” and “somewhat disagree” and on the right to combined responses “somewhat agree” and “strongly agree.”



responses to questions about adaptive capacity, with half of survey participants indicating that alternative income sources are not easily accessible and 46% suggested getting loans or other financial support is not easy. Additionally, 45% of survey participants disagreed with the statement, “I believe my community has a strong and viable future” (Fig. 4). This lack of optimism for the future of fisheries and fishing communities is further reiterated in this statement, “Nobody I know in the industry with children wants their kids to be fisherpeople.” The fact that many of the fishers surveyed said they would not encourage their children to become fishers is likely reflective of other issues in addition to climate change, reinforcing sentiments that fisheries are not a reliable livelihood for future generations, and that future generations may disproportionately bear the cost of changes that impact fisheries, including climate change.

Perceived ability to respond: procedural justice

Perceptions related to the capacity to respond to change, for individuals or institutions, were captured through various survey questions. Over half of participants surveyed indicated that they thought climate change should be considered in fisheries management (Fig. 4). A similar proportion (56%) felt they did not have a strong voice in fisheries management and 64% indicated that they felt fisheries were not managed effectively (Fig. 4). Additionally, 72% of fishers surveyed perceived fisheries management as unable to adapt and respond quickly to changing environmental conditions (Fig. 4) with 60% of participants agreeing with the statement, “I feel constrained in my ability to adapt to changes because of regulations,” while 68% of participants disagreed with the statement, “the fisheries I

participate in are managed in an equitable way,” which was asked as part of a series of questions about sensitivity to changes in fisheries.

When asked what would make management more flexible, many pointed to the need for more inclusive and participatory processes, representation of fisher’s knowledge and voices in decision making, and an overall increase in transparency and communication around management processes, which we frame here as a procedural justice consideration (Table 1). One fisher responded to this survey question by saying the following:

I am concerned we will not balance our conservation, economic and social goals moving forward. Each pillar is necessary to keep our industry afloat; and villainizing each other (within the fishing community and towards DFO) will only serve to weaken us.

These quotes point to the need for more inclusive processes and approaches that reduce conflicts when addressing competing objectives and interests, both of which can be useful for advancing climate adaptation in fisheries.

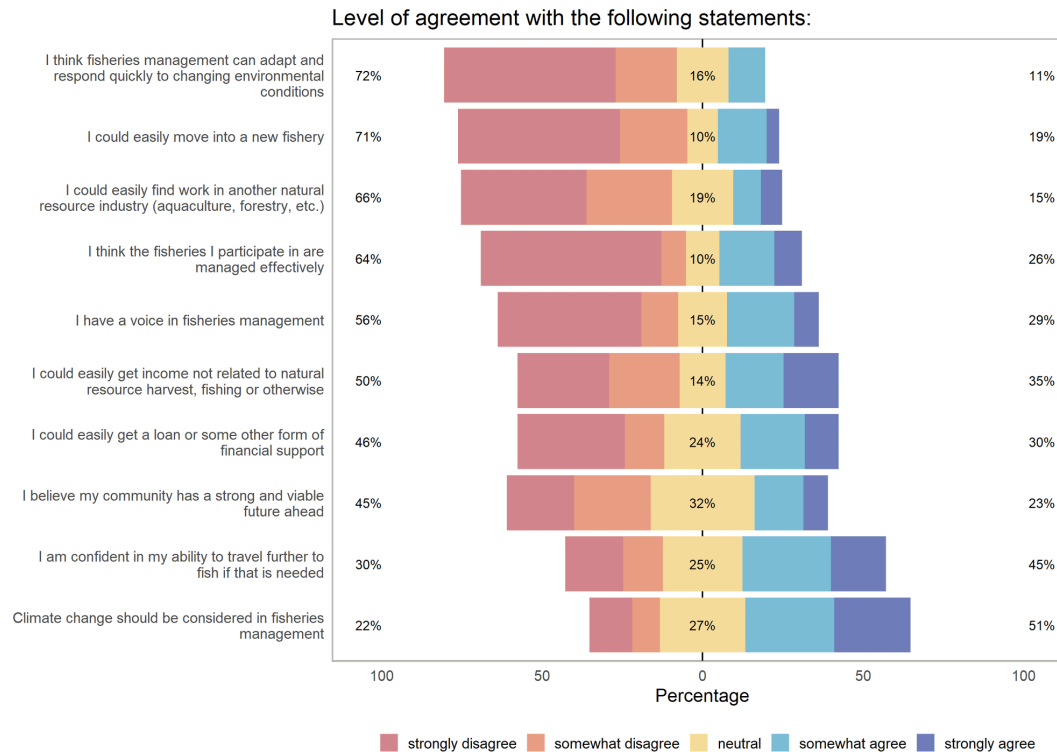
DISCUSSION

Drawing on insights that emerged from a survey of commercial fishers in the Pacific region of Canada, we engaged with principles of procedural and distributive justice to identify key perceptions for consideration in climate adaptation planning (Table 1). As impacts of climate change amplify pre-existing stressors (e.g., Cinner et al. 2011), they put further constraints on fisheries and the potential for conflicts among user groups increases

Table 1. Themes that emerged from the open-ended survey questions grouped into distributive and procedural justice concerns and considerations for improving fisheries management with relevant links to climate adaptation literature and concepts.

Themes	Suggestions from fishers for improving fisheries management	Relevance to climate adaptation
Distributive justice		
Young harvesters face barriers and lack incentives to enter fisheries.	<p>“My concerns are about the next generation of young fishermen. Most will have a hard time finding financing for the exorbitant prices to buy a boat and quotas and earn an honest living.”</p> <p>“Young fishermen need to have a stronger voice and access to licences and quota as it is their future, and they are the future of the industry.”</p>	New entrants into a fishery provide intergenerational succession and community resilience, whereby the intergenerational transfer of local knowledge about ecosystems contributes to adaptation (Neis et al. 2013, Donkersloot et al. 2020).
There is a lack of understanding and clarity for commercial harvesters regarding fisheries reconciliation and goals to increase Indigenous ownership and co-management.	<p>“Reconciliation needs to be defined.”</p> <p>“My concern is first nation reconciliation.”</p>	Centering reconciliation with Indigenous peoples in climate adaptation policy (McGregor 2019) in combination with better communication about the intentions, rationale, and implementation of new fisheries management arrangements will increase legitimacy of management and reduce conflicts among groups (Runnebaum et al. 2019).
Marine Protected Area (MPA) establishment limits access to harvesters for the purpose of conservation.	“MPAs are good but they don't work for us since our fish don't move, it takes anything in the MPA zone right off our TAC [total allowable catch].”	MPAs work well for fisheries where fisheries management is limited or non-existent (CPAWS 2015). There is evidence to support that well-designed MPAs can support climate resilience by protecting refugia sites and maintaining key trophic relationships (Micheli et al. 2012, Carr et al. 2017, Hofmann et al. 2021). Ensuring that MPAs have clear, well-communicated objectives, and engage fishers from the beginning in their design and monitoring, may improve how they are perceived by harvesters (Ordoñez-Gauger et al. 2018).
Procedural justice		
Harvesters seek more participatory processes	<p>“Fishermen and communities need to start working together to get their voice heard rather than being in competition with each other.”</p> <p>“Improve upon Gov/Industry collaborative processes which develop co-managed responses to the changes often required for both ecological and socio-economic improvements for fisheries.”</p> <p>“Fishermen-led processes of the last couple of decades have proven to be extremely valuable. Governments should respect and encourage more processes like this rather than just develop policy in Ottawa designed for the east coast only.”</p> <p>“In fisheries where management and stakeholders co-manage to a great extent - i.e., halibut, geoduck, those fisheries are prime examples of successful and sustainable fisheries.”</p>	Stakeholder participation and co-management arrangements can bolster adaptive capacity (Brugere and De Young 2020, Whitney et al. 2020b, Bahri et al. 2021).
Harvesters feel that their on-the-water and experiential knowledge about fisheries and the industry could be better engaged.	<p>“Listen more to the knowledgeable commercial fishers.”</p> <p>“Fishermen should be more involved in decisions made about fish stocks.”</p> <p>“Better communication with fishers who are actually on the frontline who also have valuable information and knowledge of the industry.”</p>	Engaging local, place-based, and Indigenous knowledge can support more effective climate adaptation (Nakashima et al. 2012, Galappaththi et al. 2022, Mclean et al. 2022).
Harvesters suggest cooperation and coordination across agencies and jurisdictions could improve outcomes	“As for salmon, we need more positive cooperation between the Provincial and Federal governments to reduce the negative impacts on watersheds.”	Collaboration and cooperation across departments, scales, jurisdictions, and organizations is a necessity for adaptation (Whitney and Ban 2019, Lomonico et al. 2021).
Harvesters feel that management communication could be improved.	“Better opportunities for DFO to celebrate and communicate their successes ... as this would add more confidence and trust in the department from the general public resulting possibly in better funding from politicians.”	Climate adaptation could be advanced through improved communication and education programs specific to practitioners and communities (Whitney and Ban 2019, Brugere and De Young 2020).

Fig. 4. Level of agreement of survey participants with statements related to perceptions of how fisheries management can adapt to change. Percentages on the left correspond to combined responses “strongly disagree” and “somewhat disagree” and on the right to combined responses “somewhat agree” and “strongly agree.”



(Mendenhall et al. 2020). Perceived exclusion, lack of transparency, or unfairness can stoke conflict (Gurney et al. 2021); therefore, understanding perceptions around the harms associated with climate change and the distribution of fishery stressors and benefits is key to climate adaptation planning that considers a social justice lens. In line with such an approach is to understand barriers to and promote equitable access (e.g., across generations, across sectors, across user groups) to fisheries and sustainable use of these resources. Added to this is a call for inclusive and fair processes for participating in fisheries decision making. Applying a social justice lens that emphasizes equity considerations in climate adaptation planning and policy, requires efforts to better understand differentiated impacts at the outset and mitigating them more effectively, while also finding approaches to reduce conflict.

Rising temperatures, compounding stressors, and heightened conflict

Cumulative impacts and conflicts within and across marine sectors and related activities may become more intense with climate change if appropriate interventions are not engaged and supported (Salas and Hayhoe 2021). Fishers surveyed in this study perceived their ability to fish as being negatively affected by numerous marine-use activities that compete for ocean space and/or fisheries resources. If left unaddressed, the consequences of conflict may become compounded by climate change, especially for fisheries where fishing opportunities may already be limited.

In Canada’s Pacific region, salmon fisheries illustrate the kinds of multiple pressures that fish and fishers are facing (Standing Committee on Fisheries and Oceans 2021). Diverse and compounding stressors have led to salmon population declines and decreased fishing opportunities across the Pacific region. Ecosystem change, including climate-related changes, is outpacing the ability of salmon to adapt (Grant et al. 2019). In response to declining stocks, recent closures have been imposed and allocations shifted, with substantial impacts on fisher livelihoods (Government of Canada 2021a). Meanwhile, there is still some access, albeit limited, for recreational salmon fishers, which has stoked controversy and criticism of fisheries management and friction between groups (Fawcett-Atkinson 2021). Additional pressures on salmon fisheries include aquaculture, which has been recognized as a threat to wild salmon populations on the Pacific Coast (Connors et al. 2012), with efforts underway to transition away from open-net salmon farming in BC (Government of Canada 2022). Although a substantial portion of fishers surveyed recognized aquaculture as a threat to their ability to fish, fewer perceived hatcheries as having an impact on their fisheries, despite evidence that hatchery salmon compete with wild populations and reduce their resilience in the face of climate stressors (e.g., Naish et al. 2007, Ohlberger et al. 2022).

Fishers surveyed expressed concern over the impacts of various planning processes and competing sectors, signaling potential

areas of friction and conflict. For example, numerous First Nations have come together, developed, and signed fisheries reconciliation agreements with the federal government as part of Canada's ongoing reconciliation process (Brown 2021). This involves increasing fisheries access and allocation to First Nations, Inuit, and Métis in Canada to redress past and ongoing injustices. Although the announcements of agreement signing are public (Government of Canada 2021b), there is not a lot of information available on how these processes will proceed. For example, the text of the agreements is not available to parties who are not involved, and the implementation details are still being worked out by the parties. The limited transparency perceived by commercial fishers who participated in this study, may increase speculation and the spread of misinformation among some groups, as has been highlighted with recent friction over the lobster fisheries on Canada's East Coast. Given the plurality of actors, interests, values, and uses across marine spaces, conflict is, to a certain degree, inevitable (Parlee and Wiber 2018). Although some conflict can be constructive, heightened and unresolved conflict can interfere with governance objectives, threatening the sustainability of the social-ecological systems being governed (Foley et al. 2020). It is possible that creating forums for information transmission and dialogue could help harvesters have improved clarity, understanding, and preparedness for forthcoming industry changes. For the same reasons, identifying and understanding points of conflict should be a key consideration for climate adaptation planning. Evidence suggests that enhancing social cohesion among groups through collaborative processes can help avoid or alleviate conflicts in natural resource management (Baker et al. 2021).

Equitable access to fisheries resources

The survey revealed concerns for new entrants and next generation fishers, highlighting existing access challenges and barriers, obstacles that have also been articulated by researchers and organizations representing Pacific Canada harvesters through the national Standing Committee on Fisheries (Standing Committee on Fisheries and Oceans 2019, Bennett et al. 2021a). These concerns may become even more heightened with climate change, as stocks shift and resources fluctuate, especially where access and intergenerational succession considerations do not follow pace, and this includes the ability to take advantage of and benefit from emerging opportunities. Neighboring Alaska, which faces similar access barriers, has proposed solutions that include locally designated, small-scale access and apprentice permits, as well as developing fishery trusts or quota banks (The Nature Conservancy 2021). Some of these approaches, such as quota banks, have been implemented in Indigenous communities along the Bering Sea and elsewhere; however, access and equity issues remain within the current licensing system (Carothers 2011, National Marine Fisheries Service 2016). Constraints that fishers face in access to loans and other financial support reinforce the findings of a recent fisheries labor market study in Canada that suggests the need for mechanisms to facilitate the intergenerational transfers of fishing assets within fishing communities, for example, through license and quota banks or other innovative ways to transition ownership of licenses from retiring harvesters to new entrants, as a necessary intervention for the sustainability of Canada's fishing industry (Canadian Council of Professional Fish Harvesters 2018). Similarly, a recent report

on the future of the BC salmon industry suggests that for young fishers to succeed, they need better access to low interest loans and funding for vessel modifications, in addition to training opportunities, supported through government programming (UFAWU-Unifor 2021).

Institutional considerations to bolster climate responsiveness of management must engage more directly with equity considerations and distributional impacts. In the context of Canada's response to climate change impacts on fisheries, alignment of policy and program objectives across ocean sectors with equity policies will contribute to a more nuanced understanding of the impacts of these initiatives on different groups, while also fostering legitimacy, trust, and support (Turner et al. 2016). This requires applying principles of equity and distributional justice in program and policy development and enhanced engagement with tools such as Gender-Based Analysis Plus (GBA+), a federal government developed and mandated intersectional analysis tool to gain perspective on the differentiated costs and benefits of plans and policies (Daly et al. 2021, Government of Canada 2021c). This tool has yet to be applied consistently and has been criticized for its limited use in ocean economy and climate adaptation planning, despite a mandate to do so (Native Women's Association of Canada 2020). In fisheries planning and decision making broadly, equity and fairness in economic conditions and outcomes need to be established as clear objectives that can be evaluated and measured (Foley et al. 2020).

Toward inclusive and flexible management processes

Fishers surveyed expressed a strong desire for more participatory processes, indicating lack of inclusion of their voices and perspectives in management and decision-making processes. This call is in line with accumulating evidence of the importance of participatory processes for legitimacy and credibility in management institutions, for reducing conflicts and encouraging compliance and positive actions in environmental decision making (Cash et al. 2003). However, participatory processes themselves need to go beyond inviting fishers to participate, to understand the barriers to effective participation and reducing areas of friction (Nordgren and Schonthal 2021). One avenue to enhance participation across groups and the flow of information necessary for management is through collaborative or co-management frameworks where authority and decision making is more equitably distributed, and roles and responsibilities clearly defined (Kearney et al. 2007, Wilson et al. 2018). For example, the co-management of Gwaii Haanas on Canada's Pacific Coast provides a formalized structure for shared decision making that engages broad participation through clearly defined roles (Council of the Haida Nation and Canada 2018). Stakeholder participation in decision-making processes is influenced by many factors, including travel time, opportunity costs, degree in the stake, and trust in the process (Lynham et al. 2017). The high costs associated with attending stakeholder meetings, for example, can result in participation by only those with extreme viewpoints, resulting in outcomes that are not representative of the broader set of interests (Lynham et al. 2017). Also, important to consider are existing power dynamics whereby certain people or groups are either under- or over-represented in decision making (Quimby and Levine 2018).

Where fishers may not participate, either by choice or because of persistent barriers, the role of communication and transparency in decision making is even more important in establishing support for management (Cash et al. 2003, Runnebaum et al. 2019). In this survey, for example, women and those identifying as Indigenous were underrepresented relative to the actual fisher population, which limits the perceptions being represented in the survey results. The conditions for effective governance require participatory, transparent, and openly communicated decision making (Stephenson et al. 2018). Transparency and communication about decisions could foster a better, and much needed, sense of fair process and legitimacy (Runnebaum et al. 2019, Archibald et al. 2021). Additionally, increased transparency of process and communicating decisions to all actors has the potential to reduce ongoing and future conflict. In the context of Pacific Salmon fisheries, testimony from rights holders and stakeholders calls for greater transparency on decision-making processes aimed to protect the long-term health of salmon and those who depend on them (Standing Committee on Fisheries and Oceans 2021).

Although participatory processes exist in fisheries management in Canada, there seems to be a disconnect between what fishers indicated in the survey and what is articulated as a key priority for fisheries management decisions by the federal fisheries management agency in terms of inclusive processes. From the survey results it appears that the bodies representing commercial fishers at participatory management tables (e.g., where input is given on Integrated Fisheries Management Plans) are not reaching some fishers in their report-back and engagement, hence creating the perception that management is not participatory. Although there is considerable evidence to highlight the value of participatory processes to enhance flexibility in the face of social-ecological system change (Cinner and Barnes 2019, Bahri et al. 2021), making this happen requires a better understanding of the context-specific barriers to effective participation in decision-making processes for different groups (Lomonico et al. 2021). Recent research from the East coast of Canada highlights discrepancies between the desired level of fisher participation in management and current involvement (referred to as the engagement gap), providing insights into understanding the nature and extent of participation in management and what some of the constraints may be to closing this gap (Puley and Charles 2022). Partnerships are proving an effective approach for bringing people together across diverse interests in response to fisheries and other environmental governance challenges, as a mechanism for identifying shared goals and values and increasing trust among groups and enhancing participation in decision-making processes (Charles 2018, Lomonico et al. 2021). And, although access to and involvement in decision making is important, not everyone will want to or be able to participate, even as barriers are removed, making transparency and communication around decisions and processes even more critical for developing trust and legitimacy in management in the face of rapid change.

Bringing forward social justice considerations in climate adaptation planning

Adaptation planning that is more inclusive, transparent, and addresses social dimensions and perceptions of fisheries is more likely to garner widespread support. Here we draw on social

justice considerations to illuminate some existing concerns and challenges faced by commercial fishers on the Pacific coast of Canada that, if left unaddressed, may be amplified by climate change (Mendenhall et al. 2020). Although the climate change concerns and considerations that were brought forward by fish harvesters from Canada's Pacific region cannot be generalized, the importance of bringing an environmental justice lens to climate adaptation planning across ocean sectors is applicable broadly (Bennett et al. 2023). The findings of this study reinforce the need to collect and analyze human dimensions data to better understand the social, cultural, and economic context of fisheries systems (Whitney et al. 2017, Bennett et al. 2021b, Szymkowiak 2021). Improved availability, understanding, and integration of socioeconomic data on fisher livelihoods, the distribution of benefits, and well-being indicators is a tangible and necessary step toward mainstreaming equity considerations into fisheries management (Foley et al. 2020). This has particular urgency in the context of a changing climate where the diversity of fisheries actors and interests within the sector mean that there are varying degrees of vulnerabilities and capacities to adapt. Eliciting and understanding the different perceptions and values of fishers can improve management efforts while also reducing social-environmental conflicts (McLean et al. 2022). As the fishing industry, communities, and management institutions around the world navigate a changing climate and its impacts on fisheries systems, acknowledging and addressing the social justice concerns and many complex considerations raised here will be critical for advancing adaptive and resilient fisheries into the future.

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Data Availability:

Data and R code used in plotting survey responses are available at https://github.com/lknelson05/climate_perceptions https://github.com/lknelson05/climate_perceptions

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Appendix 1: Survey questions on perceptions of climate change impacts on commercial fisheries

Background Information

This section will ask a few questions about you, the fisheries you participate in, and the regions where you fish.

1. **What Pacific coast commercial fisheries do you participate in?**

Check all that apply.

PELAGICS

- Salmon - Troll
- Salmon - Seine
- Salmon - Gillnet
- Herring Roe - Gillnet
- Herring Roe - Seine
- Herring Spawn on Kelp
- Tuna – Troll
- Tuna – International
- Tuna – US waters
- Hake - Midwater Trawl
- Sardine

GROUND FISH

- Groundfish – Trawl
- Halibut - Longline
- Sablefish - Longline
- Sablefish - Trap
- Rockfish – Hook & Line
- Lingcod - Hook & Line
- Dogfish - Hook & Line

INVERTEBRATES

- Shrimp - Trawl
- Euphausiid - Trawl
- Prawn and/or Shrimp - Trap
- Crab - Trap
- Geoduck and/o Horseclam - Dive
- Red Sea Urchin - Dive
- Green Sea Urchin - Dive
- Sea Cucumber – Dive

Other:

2. Which species or fisheries generate at least 25% of your fishing income? Check all that apply. Please think of these fisheries when you are asked other questions about your main or primary fisheries.

Check all that apply.

PELAGICS

- Salmon - Troll
- Salmon - Seine
- Salmon - Gillnet
- Herring Roe - Gillnet
- Herring Roe - Seine
- Herring Spawn on Kelp
- Tuna – Troll
- Tuna – US waters
- Tuna – International waters
- Hake - Midwater Trawl
- Sardine

GROUND FISH

- Groundfish – Trawl
- Halibut - Longline
- Sablefish - Longline
- Sablefish - Trap
- Rockfish – Hook & Line
- Lingcod - Hook & Line
- Dogfish - Hook & Line

INVERTEBRATES

- Shrimp - Trawl
- Euphausiid - Trawl
- Prawn and/or Shrimp - Trap
- Crab - Trap
- Geoduck and/or Horseclam - Dive
- Red Sea Urchin - Dive
- Green Sea Urchin - Dive
- Sea Cucumber – Dive

Other:

3. Below is a list of general marine regions. Please check the box of any region where you fish regularly.

Check all that apply.

- Offshore (beyond the shelf break)
- Haida Gwaii (including Hecate Strait)
- North Coast
- Central Coast
- Northern Vancouver Island (north of Campbell River and Brooks Peninsula)
- West Coast of Vancouver Island
- Strait of Georgia
- Juan de Fuca
- International Waters
- US Waters

4. Where is your homeport?

5. How long have you been fishing?

Mark only one oval.

- 0 - 5 years
- 5 -15 years
- 15 - 25 years
- more than 25 years

6. Where do you live? Please include the name of your town/city and your postal code.

7. How long have you lived in your current community?

Mark only one oval.

- 0 - 5 years
- 5 -15 years
- 15 - 25 years
- more than 25 years

8. What is your role in the fishing industry? (check all that apply)

Check all that apply.

- License Owner
- Captain
- Vessel Owner
- Crew member
- Other: _____

9. (If answer to previous question is captain or vessel owner) How many crew do you typically employ during your main fishing season?

Mark only one oval.

- 1-3
- 4-7
- 7-11
- greater than 11
- not applicable

10. What length of vessel do you work on or operate most of the time?

Mark only one oval.

- 25 ft. or less
- 26 to 35 ft.
- 36 to 45 ft.
- 46 to 55 ft.
- 56 to 65 ft.
- 66 to 85 ft.
- 86 ft. or greater

11. Do you currently participate in fisheries in any U.S. waters (Alaska, Washington, Oregon, California, Hawaii) in addition to those off of British Columbia?

Mark only one oval.

- Yes
- No

12. (If yes to previous question) Where and which fisheries?

13. What percentage, if any, of your annual income comes from jobs or sources outside of fishing?

Mark only one oval.

- none
- 10% or less
- 10% to 25%
- 25% to 50%
- more than 50%

14. How old are you?

Mark only one oval.

- Under 30
- 30 - 40
- 40 - 50
- 50 to 60
- 60 to 70
- over 70 years

15. What is your gender identity?

Mark only one oval.

- Female
- Male
- Prefer not to say
- Other: _____

16. Do you identify as North American Indigenous, Aboriginal, Inuk or Metis?

Mark only one oval.

- Yes
- No

Observations of ocean change

This section asks about your observations and understanding of changes in the ocean and how those changes may have impacted fisheries. There is not a right or wrong answer to these questions, we are trying to get a sense of what you have seen or experienced.

17. Please indicate any changes you have observed in the waters off of British Columbia in the last 5 years.

Mark only one oval per row.

	Decrease	No change	Increase
Ocean temperature	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Severe weather	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Availability of your main target species	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Other: _____	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

18. Do you think your ability to catch fish has been affected by climate change?

Mark only one oval.

- Yes, positively affected
- Yes, negatively affected
- No
- I have not observed any changes

19. Please elaborate if you answered yes to the previous question.

Impacts on fisheries

For the next question, you will be asked what, if any, effect you believe ocean warming is having on specific fisheries. For each fishery, we would like you to indicate if you think ocean warming is having a strong or slightly negative effect, no effect, or a slightly or strongly positive effect. You may also answer I don't know. Then you will be asked about your confidence level in that answer.

20. What, if any, effect do you believe ocean warming is having on these commercial fisheries?

Mark only one oval per row.

	Strong negative effect	Slight negative effect	No effect	Slight positive effect	Strong positive effect	I don't know
PELAGICS						
Salmon (all species, all gears)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Herring (Roe herring, Spawn on kelp, Food & bait)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Albacore Tuna	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Sardine	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Hake	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
GROUND FISH						
Groundfish Trawl	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Halibut	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Lingcod	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Dogfish	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Sablefish	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Rockfish	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
INVERTEBRATES						
Shrimp (trawl or trap)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Prawn	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Crab	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Geoduck and/or Horseclam	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Red Sea Urchin	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Green Sea Urchin	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Sea Cucumber	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

21. Please indicate your level of confidence in your responses to the previous question.

The questions will read like this. Using the species listed in the question above.

What, if any, effect do you believe ocean warming is having on these fisheries?

	Strong negative effect	Slight negative effect	No effect	Slight positive effect	Strong positive effect	I don't know
Dungeness Crab	<input type="radio"/>	<input checked="" type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

Please indicate your level of confidence in your responses to the previous question.

	Low confidence	Medium confidence	High confidence
Dungeness Crab	<input type="radio"/>	<input type="radio"/>	<input checked="" type="radio"/>

Continue »

22. What, if any, do you believe ocean warming is having on the commercial fisheries for the following salmon species?

Mark only one oval per row.

	Strong negative effect	Slight negative effect	No effect	Slight positive effect	Strong positive effect	I don't know
Sockeye	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Coho	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Chum	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Chinook	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Pink	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

23. Please indicate your level of confidence to the previous question.

Mark only one oval per row.

	Low confidence	Medium confidence	High Confidence
Sockeye	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Coho	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Chum	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Chinook	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Pink	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

24. Are any of your primary fisheries being affected by changes in other marine species?

Mark only one oval.

- Yes
- No

25. If yes, how is it being affected?

The next two questions ask you to how fishing in recent years compares to 30 years ago. If you were not fishing 30 years ago, please answer based on what you have heard from others or your understanding of what it was like during that time.

26. When you compare the last 5 years to 30 years ago, have you seen changes in the range of your primary target species?

Mark only one oval.

Yes

No

27. If yes, how has it changed?

28. When you compare the last 5 years to 30 years ago, has the time of year of when you fish shifted at all?

Mark only one oval.

Yes

No

29. If yes, how has it changed?

Perceptions of Exposure and Risk

This section asks about environmental, fishing, and community issues; your level of concern about those issues; and how often you think about them.

30. What Pacific coast species or fisheries do you think are most likely to be negatively affected by climate change?

31. Are there any species or fisheries that you think will be positively affected by climate change?

Below is a list of issues that may affect fishing success, your wellbeing, or the wellbeing of your community. For the following questions, please mark 2 answers in each row - 1 indicating your level of concern and 1 for how often you think about the topic.

32. Marine Environment

Check all that apply.

	Not concerned at all	Somewhat concerned	Very concerned	Never	Occasionally	Frequently
Warming waters	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Ocean acidification	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Increases in severe storms	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Sea level rise	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Changing weather patterns	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Ocean water quality (including decreasing oxygen levels)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Harmful algal blooms	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Habitat degradation or loss	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Other	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

33. Fishing

Check all that apply.

	Not concerned at all	Somewhat concerned	Very concerned	Never	Occasionally	Frequently
Size of fish populations	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Bycatch	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Landed value	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Costs associated with fishing (fuel, vessel maintenance, etc.)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
The stock assessment process	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Travel time to fishing grounds increasing	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Access to licences or quota	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Regulation	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Other	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

34. Community and infrastructure

Check all that apply.

	Not concerned	Somewhat concerned	Very concerned	Never	Occasionally	Frequently
Aging labor force	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Community cohesion in the fishing community	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Community cohesion in your residential community	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Coastal and port infrastructure	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Access to markets	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Adequate local processing facilities	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

35. Personal

Check all that apply.

	Not concerned at all	Somewhat concerned	Very concerned	Never	Occasionally	Frequently
Physical health problems	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Mental health problems	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Safety at sea	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Familial relationships	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

36. Please indicate your level of agreement with the following statements.

Mark only one oval per row.

	Strongly disagree	Somewhat disagree	Neutral	Somewhat agree	Strongly agree
I believe climate change is occurring	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Climate change will harm me personally	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Climate change will harm future generations	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
If I had a choice I would leave fishing	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
It is a big risk to move into a new fishery	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
There is no point in preparing for climate change since we don't know exactly what will happen	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
There will not be enough fish to continue to operate in my main fishery in 20 years	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

37. Fisheries occasionally have conflicts with other fisheries or other activities that take place in the ocean or coastal environment. Please indicate your level of agreement with the following statement. My fishing is negatively affected by .

Mark only one oval per row.

	Strongly disagree	Somewhat disagree	Neutral	Somewhat agree	Strongly agree
Recreational fisheries	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Other commercial fisheries	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Internal conflict within my commercial fishery	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Aquaculture	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Hatcheries	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Tourism	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Coastal development	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Competing ocean uses like shipping/transport	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Marine Protected Areas	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Marine Spatial Planning	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

Sensitivity

Below is a list of statements that may indicate the degree to which community and individual wellbeing is sensitive to changes in the health of fisheries and the environment. Please indicate your level of agreement with each statement.

38. Conditions

Check all that apply.

	Strongly Disagree	Disagree	Neutral	Agree	Strongly agree	I have not observed any changes
Changes in fisheries have negatively impacted my overall wellbeing	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Changes in fisheries have negatively impacted my physical health	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Changes in fisheries have negatively impacted my mental health	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Changes in fisheries have raised my stress levels	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Changes in the environment have negatively impacted my overall wellbeing	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Changes in the environment have negatively impacted my physical health	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Changes in the environment have negatively impacted my mental health	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Changes in the environment have raised my stress levels	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Changes in the environment have negatively affected my safety while fishing	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

39. Connections

Mark only one oval per row.

	Strongly disagree	Somewhat disagree	Neutral	Somewhat agree	Strongly agree
I would encourage my children to be fishermen	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Fishing is important to my identity	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Fishermen are supported in my community	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I am passing down fishing knowledge to the next generation	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I feel a connection to my environment	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I feel a connection to my community	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

40. Capabilities

Mark only one oval per row.

	Strongly disagree	Somewhat disagree	Neutral	Somewhat agree	Strongly agree
I make enough money to support my family	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I am able to plan two years out in the future	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I am satisfied with my job	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I think the fisheries I participate in are managed effectively	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I have access to the data and information I need for successful fishing	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I can find qualified crew with the skills they need to do a good job	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I have a voice in fisheries management	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Climate change should be considered in fisheries management	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

41. Cross-cutting

Mark only one oval per row.

	Strongly disagree	Somewhat disagree	Neutral	Somewhat agree	Strongly agree
The fisheries I participate in are managed in an equitable way	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
There are opportunities for people who are not currently fishing to enter into west coast fisheries	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
There are opportunities for deckhands and other lower level crew to advance	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Other external forces positively impact my fisheries (treaties, trade agreements...etc.)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

Adaptive Capacity

Responding to changes, stemming from climate or other issues, will require adaptations by individuals, communities, and governance structures; this section asks for your perspective on their ability to do so.

42. With regard to the future security of yourself, your residential community, or your fishery, please indicate the extent to which you agree or disagree with the following state ments:

Mark only one oval per row.

	Strongly disagree	Slightly disagree	Neutral	Slightly agree	Strongly agree
I could easily move into a new fishery	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I could easily find work in another natural resource industry (aquaculture, forestry, etc.)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I could easily get income not related to natural resource harvest, fishing or otherwise.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I could easily get a loan or some other form of financial support	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I am confident in my ability to travel further to fish if that is needed	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I believe my community has a strong and viable future ahead	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I am concerned that climate change may lead to people moving out of my community.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I think fisheries management can adapt and respond quickly to changing environmental conditions	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I feel constrained in my ability to adapt to changes because of regulations.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

43. What sorts of changes could quicken response time and make fisheries management more flexible as it responds to future challenges?

44. Are there other concerns or thoughts you would like to share about the future of fishing or your community?

Appendix 2: Codebook for analyzing questions about management flexibility & future concerns.

Code/theme	Description
Access to licences & quota	Concerns over equity of access between stakeholders and rights-holders
Barriers to entry	Concerns over the ability of new or young harvesters to enter the industry and/or diversify
Competition from other sectors & processes	Concerns over interactions with and impacts from other ocean sectors such as the negative impacts of salmon aquaculture on wild populations; consequences for fishers of Marine Protected Area establishment
Consolidation	Calls for regulation of quota ownership to restrict corporate consolidation; move to owner-operator policy in Pacific region
Local or devolved management	Desire for increase in local decision-making power; calls for devolved or nested governance
Stakeholder engagement	Requests for more local input from harvesters; fisherman's voices represented; local knowledge
Communication & transparency	Appeals for better communications across government departments, across regions, among stakeholders and with communities; efforts to respond to misinformation; reconciliation better defined
Coordination across agencies & jurisdictions	Calls for better coordination across relevant agencies and jurisdictions, e.g., between Federal, Provincial, local, and/or Indigenous governments