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## EDITED BY

Kit Yue Kwan,  
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Takanori Kooriyama,  
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Lei Zhang,  
Chinese Academy of Fishery Sciences (CAFS),  
China

## \*CORRESPONDENCE

Fleur E. C. Brochut

✉ brochut.fleur@elms.hokudai.ac.jp

## †PRESENT ADDRESS

Nanami Abe,  
Kodansha Co., Ltd., Bunkyo, Tokyo, Japan

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# Human dimension of small-scale fisheries and Steller sea lion conflict in Hokkaido coastal water, Japan: exploring perceptions and attitudes between fishermen groups

Fleur E. C. Brochut<sup>1\*</sup>, Nanami Abe<sup>1†</sup>, Mina Jimbo<sup>2</sup>,  
Shirow Tatsuzawa<sup>3</sup> and Orio Yamamura<sup>1</sup>

<sup>1</sup>Graduate School of Fisheries Sciences, Hokkaido University, Hakodate, Hokkaido, Japan, <sup>2</sup>Central Fisheries Research Institute, Fisheries Research Department, Hokkaido Research Organization, Yoichi, Hokkaido, Japan, <sup>3</sup>Graduate School of Humanities and Human Sciences, Hokkaido University, Sapporo, Hokkaido, Japan

The conflicts between pinnipeds and coastal fisheries are harmful for both pinniped conservation and fishermen's livelihood. In Hokkaido, Japan, negative interactions between Steller sea lions (SSL) and gillnet and set net fisheries have been an issue for decades. Damage control measures have been implemented, but little is known about fishermen's perception of the conflict. The recent increase in human dimension research has demonstrated the necessity of this approach in conflict mitigation and resolution. This study aims to clarify the fishermen's perception of and attitude toward SSL and mitigation methods, and explores the context in which fishermen face this conflict. We conducted 29 on-site interviews with fishermen in several fishing villages along the Sea of Japan and Sea of Okhotsk coasts. We found that most fishermen approved population control as a damage control measure and considered it the only effective method. However, they were open to the development of non-lethal methods. Gillnet and set net fishermen's perception of SSL's ecological role was more complex than just a threat to their catch. Gillnet fishermen showed a more negative attitude toward SSL compared to set net fishermen. We conclude that fishermen need solutions not only to mitigate the conflict with SSL but also to maintain a decent livelihood while practicing their fishing activity. Our findings explored the larger context surrounding conflict with wildlife and provided valuable information for developing strategies to coexist with wildlife.

## KEYWORDS

pinnipeds, human-wildlife conflict, local attitude, coastal fisheries, interview, set net, gillnet

# 1 Introduction

Conflicting interactions between small-scale fisheries and pinnipeds have been reported from all over the world (Tixier et al., 2021). Operational interactions such as depredation, damage to fishing gear or bycatch are detrimental to both pinniped conservation and fishermen's livelihood. Therefore, it is important to establish strategies to open the door for coexistence between pinnipeds and fisheries by finding ways to protect both parties. For example, deterrence tools have been widely implemented in fisheries and aquaculture (Nelson et al., 2006; Götz and Janik, 2013). Modified fishing gear with stronger material or added features like seal exclusion device (SED) (Calamnius et al., 2018; Iriarte et al., 2020) or barriers (Isono et al., 2013) have also been successfully introduced (Westerberg et al., 2006). In some places, the alternative consisted in modifying the fishing technique by changing the fishing gear (Königson et al., 2015). Indirect measures such as financial compensation have also been implemented (Varjopuro, 2011). The strategies have to be adapted not only to the predator species and fishing technique, but also to the cultural and political context of the region where the conflict occurs, as it is the case with adaptations to climate change (Adger et al., 2013).

In the Japanese waters, conflicts between coastal fisheries and Steller sea lions (*Eumetopias jubatus*, SSL) have been the cause of consequent damage annually over the last decades (Sasakawa, 1989). In 2023, the conflict with SSL had cost around 727 million ¥ (4.9 million dollars) accounting for catch loss and damaged gear (Hokkaido Government, 2024b). Coastal fishing in Hokkaido is important economically and culturally, especially in remote and sparsely populated areas. However, due to the difficulty in passing the business to the next generation and the low fishing income, the fisheries are threatened. Especially on the western coasts of Hokkaido, the interactions with SSL have been serious and have impacted fishermen's livelihood. Therefore, SSL-fisheries conflict management is necessary for the continuation of coastal fishery. Despite considerable efforts to mitigate the damage, the level of conflict is still considered unsatisfactory for the fishing communities. Therefore, a different approach is needed.

Conflict with wildlife extends beyond the physical damage caused by animals and is deeply embedded within social contexts (Dickman, 2010). In human-wildlife conflict research, the human dimension, i.e. the social factors influencing how people perceive the conflict, the wildlife involved, and potential solutions, has become increasingly recognized as essential for progress toward coexistence (Dickman, 2010; Guerra, 2019). These factors can often intensify perceptions and reactions more than the actual magnitude of the damage itself, meaning that successful long-term management requires understanding these social mechanisms (Butler et al., 2015).

Despite the severity and long history of interactions between SSL and coastal fisheries in Hokkaido, the human dimension of this specific conflict remains largely unexplored. In particular, how fishermen, the most directly impacted stakeholders, perceive SSL,

the conflict and the mitigation strategies has not yet been investigated. A previous study on human dimension of seal-fisheries conflict stressed that understanding the attitudes toward mitigation measures and their influence on the stakeholder livelihood was an important component of conflict resolution (Waldo et al., 2020). It has also been established that people's attitude toward the conflicting wildlife and perceived ecological roles, including evaluations of both risks and benefits of predators, can strongly shape attitudes toward mitigation measures including support for or opposition to lethal methods (Frank et al., 2019; Jackman et al., 2024).

In this study, we explore the human dimension of SSL-Hokkaido small-scale fisheries. We examined fishermen's (1) attitudes toward existing and potential mitigation measures, (2) attitudes toward SSL, and (3) perception of SSL ecological role. We focused on two major coastal fisheries that differ in their level of interaction with SSL: gillnet and Japanese set net fisheries. To capture a wide range of perspectives from the fishing community, we conducted face-to-face interviews in 12 fishing villages within SSL distribution areas. By opening the dialogue directly with fishermen, we aim to provide the first detailed assessment of the human dimension in this conflict, laying essential groundwork for trust-building and the development of socially supported pathways toward pinniped-fisheries coexistence (Butler et al., 2015; Guerra, 2019).

## 2 Methods

### 2.1 Study area

Hokkaido Island is the second largest and the northern most island in Japan. It is surrounded by the Sea of Japan on the western side, the Sea of Okhotsk on the North-East Side and the Pacific Ocean on the South and East sides (Figure 1). Each coastline is under the influence of different current systems: the Tsugaru Warm Current, the Eastern Sakhalin Current and the Oyashio Current, respectively (Tsujino et al., 2008). This complex oceanography makes the area productive for marine life and fishery. SSL migrate every winter from their natal rookeries in Russia and the Kuril Islands to the waters around Hokkaido (Burkanov and Loughlin, 2005). SSL are opportunistic feeders. From November through May they winter in the Hokkaido coastal areas in the Sea of Japan and the Sea of Okhotsk. Their diet is composed of several species that are important commercial species including giant Pacific octopus (*Enteroctopus dofleini*), Pacific cod (*Gadus macrocephalus*), walleye pollock (*Gadus chalcogrammus*), herring (*Clupea pallasii*), and flounders (Goto et al., 2017). On the other hand, fishing is also active in this area. Two passive gear fisheries, bottom gillnet fisheries and set net (pound net) fisheries are the most affected fisheries by the interaction with SSL (Japan Fisheries Research and Education Agency, 2024). Gillnet fisheries target mainly herring, flounders, cod, monkfish (*Lophiidae* spp.) and Okhotsk Atka mackerel (*Pleurogrammus azonus*). They are generally small-scale family-run operations that generate

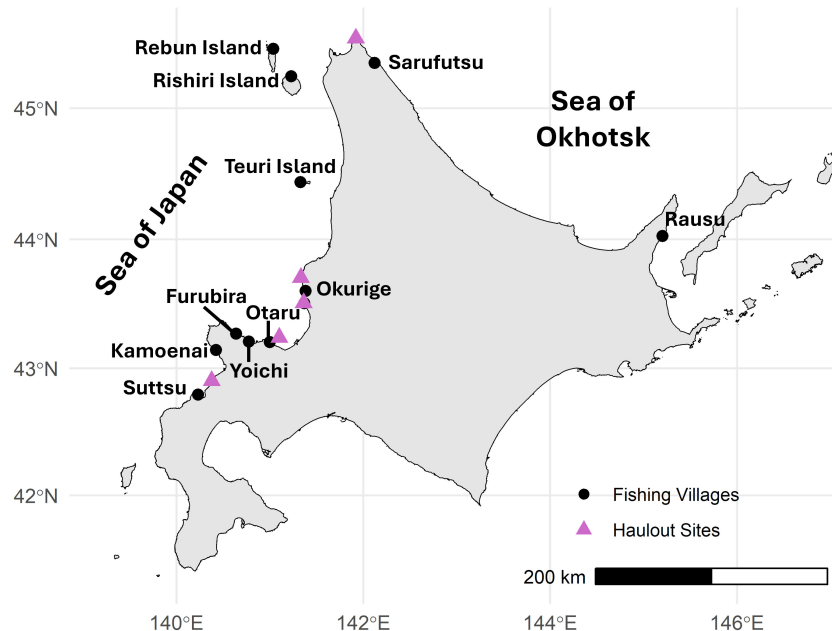


FIGURE 1

Map of Hokkaido showing the visited fishing village and the main known haulout sites of Steller sea lions.

relatively low annual incomes (Hokkaido Government, 2024a; unpublished data). Thus, they suffer high catch and gear damage from SSL interaction. In comparison, set net fisheries mainly target salmon species in spring and autumn, outside of the main migrating season of SSL to Hokkaido waters, therefore suffering less damage. In addition, in areas where the main targets are Pacific cod and Okhotsk Atka mackerel during winter, the use of reinforced net is well established, therefore limiting the damage from SSL (Isono et al., 2013). An illustration of the nets is provided in Appendix A (gillnet) and B (set net).

## 2.2 Research design

We compiled an interview form based on the previous studies (Gruber and Orbach, 2014; Cummings et al., 2019; Waldo et al., 2020) and discussions with fishermen in November 2022. It contained closed- and open-ended questions, aiming to cover most aspects of the interactions with SSL, including respondents' socio-economic information, fishing activities, interactions with SSL, impact of this interaction on their livelihood, attitude toward SSL, management measures, and one final free question enabling them to broaden the subject if necessary. This question form was meant to provide an overview of the human dimension of the fisheries-SSL conflict. From these questions, we focused on 12 question items grouped into four categories: perceived ecological role of SSL (3 items), attitudes toward SSL (4 items), attitudes toward management measures (2 items) and conditions for coexistence with SSL (3 items). The question items for each category are described in Appendix C. All questions were coded

on a 5-points scale ranging from disagree = -2 to agree = +2. We also analyzed the themes brought up in the final open question.

## 2.3 Interview process

Fishermen were recruited either by direct introduction from a researcher known by the interviewee or by requiring the help of the local fisheries' cooperative officers. The interviews were conducted in Japanese by the principal investigator. To minimize the language barrier, at least one Japanese person accompanied the investigator to assist with the interview. Fishermen were interviewed one at a time except for two occasions when three and two fishermen were interviewed together (Appendix D). The participants were given a short explanation of the content of the interview, use of collected data and respect for anonymity. They were informed that they could skip any question or resign from the interview at any time and were asked to allow the interview to be audio-recorded.

From April 24<sup>th</sup> 2023 to August 21<sup>st</sup> 2024, we interviewed a total of 29 fishermen (17 gillnets, 11 set nets, 1 both) in 12 fishing villages. The opportunities to contact participants were very limited. In Japan, it is not well received to ask fishermen to provide information on who could be interested in participating in interviews. Therefore, we could not use the snowball method to increase the number of participants in our study. We cannot assume that the results about attitudes and perceptions presented in this study represent all fishermen in Hokkaido and further studies involving more participants are necessary to confirm our preliminary findings. Nevertheless, 29 participants are considered sufficient for thematic and nuance saturations (Wutich et al., 2024).

Therefore, we can assume that the themes raised during the interviews can provide an adequate framework for further studies.

## 2.4 Data processing and analysis

The interviews were transcribed using the software Notta.ai (Notta Co., Ltd., Chiyoda, Tokyo, Japan) supporting Japanese language. The transcription accuracy was checked by two native Japanese helpers. The data were then translated using two different sources (ChatGPT, OpenAI and Google Translate, Google) to minimize the risk of loss in translation. We verified the internal consistency of our constructs of ecological role, attitude toward SSL and conditions for coexistence with Cronbach's alpha reliability test (Cronbach, 1951). The coefficients were 0.49 for the ecological role, 0.72 for the attitude toward SSL and 0.66 for the conditions for coexistence. Even though the coefficient were low for ecological role and conditions for coexistence, the number of items were small (3 items), thus were considered acceptable (Tavakol and Dennick, 2011; Vaske, 2019). To detect a difference in perception and attitude between gillnet and set net fishermen, we used the potential conflict index ( $PCI_2$ ) as a quantitative measure for the closed-ended questions (Vaske et al., 2010). This index had been developed to facilitate the visualization of data in human dimension research (Manfredo et al., 2003). The index provides information on the potential for conflict between and within groups represented by bubbles of different colors and sizes respectively. The response variables are the answers of each of the 12 question items and the explanatory variable is the net used by the fishermen. The colored bubbles are placed on a vertical axis representing the mean answer for one group ranging from -2 (disagree) to +2 (agree). The bubble size represents the potential conflict ranging from 0 to 1 within the same group. An index of 0 indicates a consensus, meaning that all answers are similar. An index of 1 indicates a conflict, with answers at both extremes. The  $PCI_2$  were computed using the material provided in (Vaske et al., 2010). To test whether the two groups of fishermen were significantly different, we used the Mann-Whitney U test with a p-value lower than 0.05 considered as significant. All tests were performed on R 4.5.1 (R Core Team, 2024).

In addition, due to the explorative nature of this study, the recurrent themes that emerged from the open-ended part of the interview were summarized using thematic content analysis. Using (Burnard et al., 2008) method, we coded the transcription of the respondents' answers into topics which were then grouped into themes. This allows a broader perception of the possible drivers shaping fishermen's attitudes and perceptions of the fishery-SSL conflict.

## 3 Results

We interviewed 17 gillnet fishermen, 11 set net fishermen and one who uses both fishing gears when SSL are present in Hokkaido (Table 1). The latter was included in both groups. The respondent fishermen were all males. Fishing was the main source of income for all of them.

### 3.1 Mitigation measures

We inquired fishermen about their attitude toward SSL population control and the need to develop non-lethal methods. Twenty out of 29 fishermen were in favor of population control as a mitigation measure (Figure 2). Gillnet fishermen had a slight tendency of being more strongly favorable and had less internal conflict than set net fishermen. The main reason for approving population control was that there is no other effective method to deal with the damage. During the interview, three fishermen referred to the killing as target removal, meaning killing only the sea lions specifically attacking the net, rather than as population control stating that protecting the net was what they needed.

Like I just said, there's no choice but to carry out lethal control. To eliminate the damage, there's no other option but to kill them. I've been doing this for decades myself. (Yoichi).

[ ... ] there are individuals nearby the nets causing trouble, so that's probably it. So when we ask hunters for help, they are likely to target the prey nearby. (Sarufutsu 2, the number after the location represents the interview number of this location).

TABLE 1 Socio-demographics and main fishing gear of the interviewed fishermen (n = 29).

| Age category | n  | Gender | n  | Fishing as the main source of income | n  | Main net used    | n  |
|--------------|----|--------|----|--------------------------------------|----|------------------|----|
| 20's         | 1  | Male   | 29 | Yes                                  | 29 | Gillnet          | 17 |
| 30's         | 2  | Female | 0  | No                                   | 0  | Japanese set net | 11 |
| 40's         | 10 |        |    |                                      |    | Both             | 1  |
| 50's         | 6  |        |    |                                      |    |                  |    |
| 60's         | 6  |        |    |                                      |    |                  |    |
| 70's         | 4  |        |    |                                      |    |                  |    |

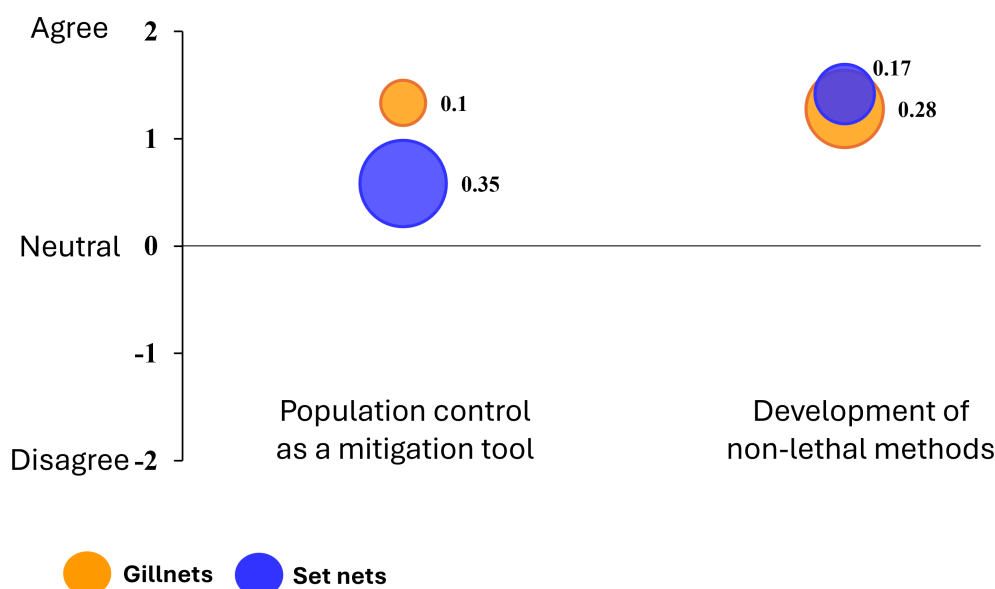


FIGURE 2

Potential conflict index ( $PCI_2$ ) for the attitudes toward population control and development of non-lethal methods for gillnets (orange) and set nets (blue). The vertical position of the bubbles indicates the level of agreement with a statement ranging from -2 = disagree to 2 = agree. The size of the bubbles corresponds to the value of the  $PCI_2$  ranging from 0 to 1, with a lower value representing a higher degree of consensus withing a group.

Among the nine fishermen who remained neutral or disagreed, they pointed out the feasibility and potential impacts of the measure on ecosystems or showed some empathy toward living beings.

I mean, killing a living creature, that's what it means, right? Instead of that, it's better to drive them away, like throwing something at them. (Furubira).

In reality, even if you kill them, it's not like you can wipe them all out. And killing them could also disrupt the ecosystem, there's really no clear answer to that. (Rishiri 2).

Fishermen were generally open to the development of non-lethal methods other than population control. The methods mentioned during the interviews mostly concerned damage reduction, such as sound repellent or reinforced nets, but one fisherman also talked about an idea to help the fishing activity in general. One motivation for this was the need for additional support, as the current situation is unacceptable.

Well, it's that there really isn't much support. (Rishiri 1).

As the fisheries sector is currently on an upward trend, looking ahead to the future, maybe we need to start thinking about different fishing methods compared to the past, not just for herring but for other catches too. We might need new approaches. That's important not only for safe operations but also to increase landings. (Okurige).

On the other hand, fishermen were also skeptical about the possibility of finding such alternatives. These doubts were also brought up by the ones who agreed to the importance of developing alternatives.

No, it isn't [meaningful]. It's not even a matter of whether [developing new non-lethal methods] is meaningful or not, is there really anything at all? (Rebun 1).

### 3.2 Conditions for coexistence

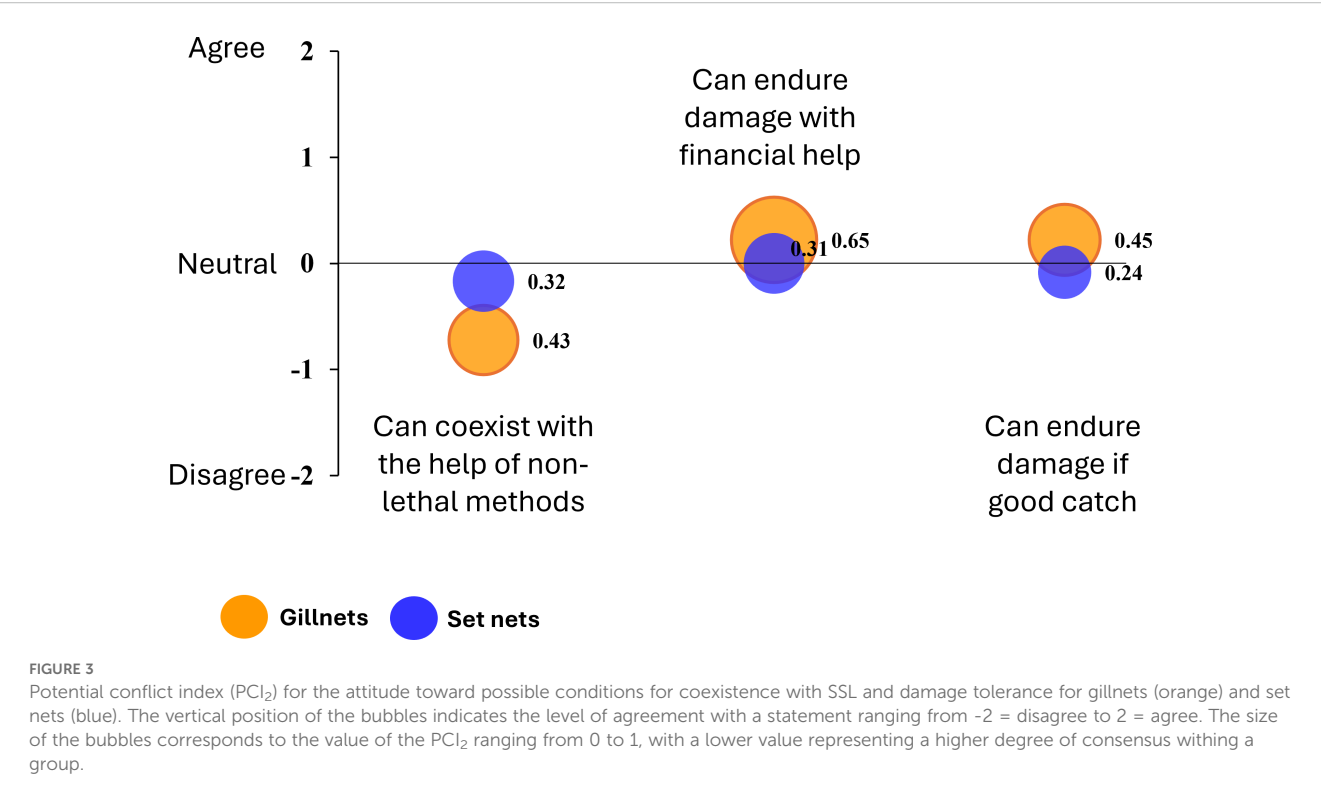
We then explored some possible conditions that could help fishermen coexist with SSL or tolerate the damage (Figure 3). Coexistence with only non-lethal methods was considered difficult in the current situation for the same reasons presented in the above section (3.1).

Fishermen showed a lukewarm attitude toward compensation. Half of the fishermen regardless of gear types said that they would be happy to receive compensation for SSL damage and that it would help to tolerate the damage. The other half showed some skepticism about how the method would be implemented or stressed that they want to practice fishing rather than to rely on compensation.

This is difficult, not in terms of the amount of money, but regarding the catch volume or the value of the catch. If there were compensation for taking those and converting them into money, then that would be fine. However, it feels like relying on that compensation might not be the best approach. (Sarufutsu 3).

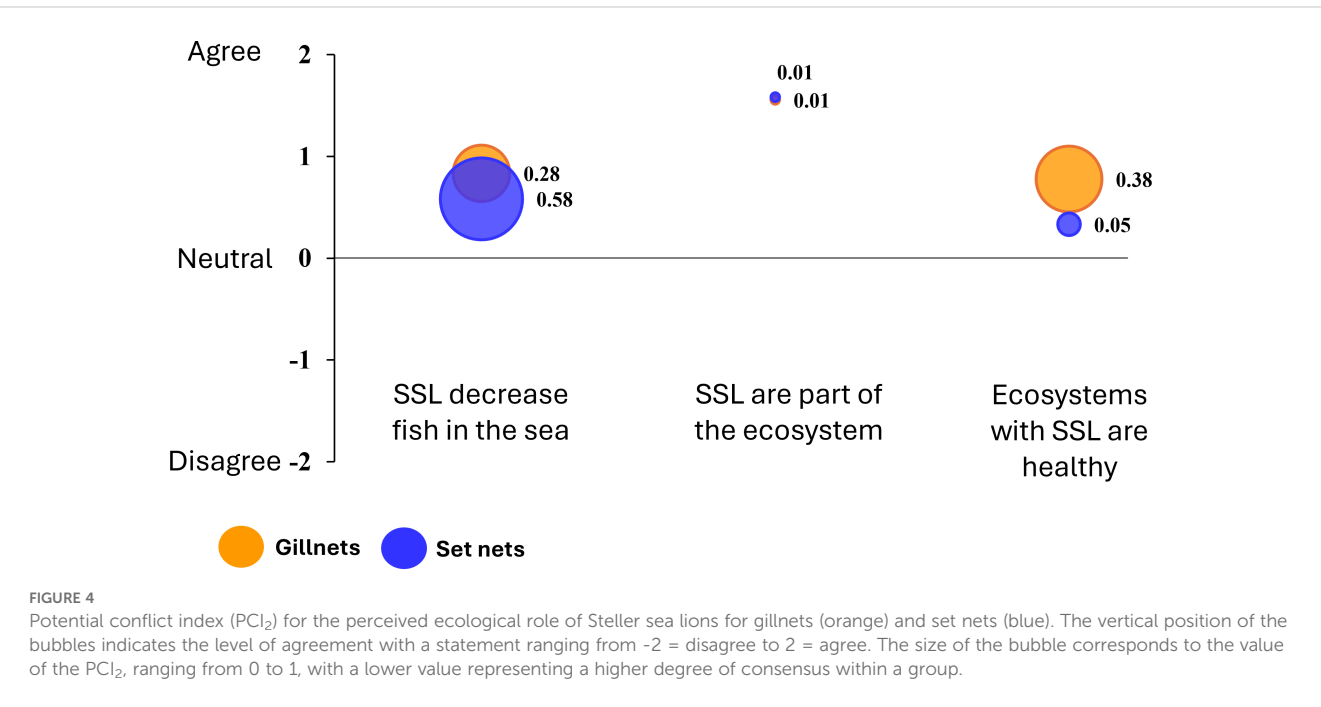
I mean, we want to catch fish, right? That's what it's about. It's not really about what kind of compensation there is, the point is, we're fishermen, and we want to catch plenty of fish. So I'd rather things stay the way they've always been. I don't really like the idea of relying on compensation. If we go down that road, it feels like nothing really matters anymore. Just because there's compensation, it's like I'd start to lose who I am. I'm a fisherman, after all. (Rebun 3).

Finally, we asked about whether a good catch could help them tolerate the damage from SSL. The fishermen interpreted the question in two different ways. Some respondents considered the question of whether the number of fish caught is abundant or not.



Among them, eleven fishermen agreed that an abundant catch would help tolerate the damage. They explained that during “good catch” days, the damage looks smaller even when a lot of SSL are present. In contrast, others remarked that the number of SSL increases with high catch and therefore, the damage also increases

when the catch is high. The second interpretation was whether the catch brings decent money or not. In that second case, the general answer was that, similar to compensation, making more money would not help with tolerating the damage. This confirms the fact that one of the needs of the fishermen is the satisfaction of providing





fish rather than just the financial aspect. About the second meaning, although taking more fish is helpful, no matter the amount of catch, it is not tolerable when the level of damage is too high.

Yeah, so if that happens, the number of sea lions will also increase because there's food for them. (Hamamasu).

I don't know if you can call it 'healthy.' Can you really call the sea lions' situation healthy? After all, they weren't here in the past. (Yoichi).

That's difficult. Perspectives vary by region, but it's definitely not healthy around here. (Sarufutsu 2)

### 3.3 Perception of the role of SSL

In answering the questions about their perception of the role of SSL in the ecosystem, all fishermen agreed that SSL are a natural part of the environment (Figure 4). However, both groups mostly agreed that SSL decrease fish abundance in the sea. Of these, set net fishermen showed a higher potential conflict index within the group (0.58), reflecting the fact that three of them thought that SSL impact on fish stock was unclear or that humans, rather than SSL, were the culprits:

They eat about 30 kilos a day, right? Just one of them, in a single day. (Rausu 4).

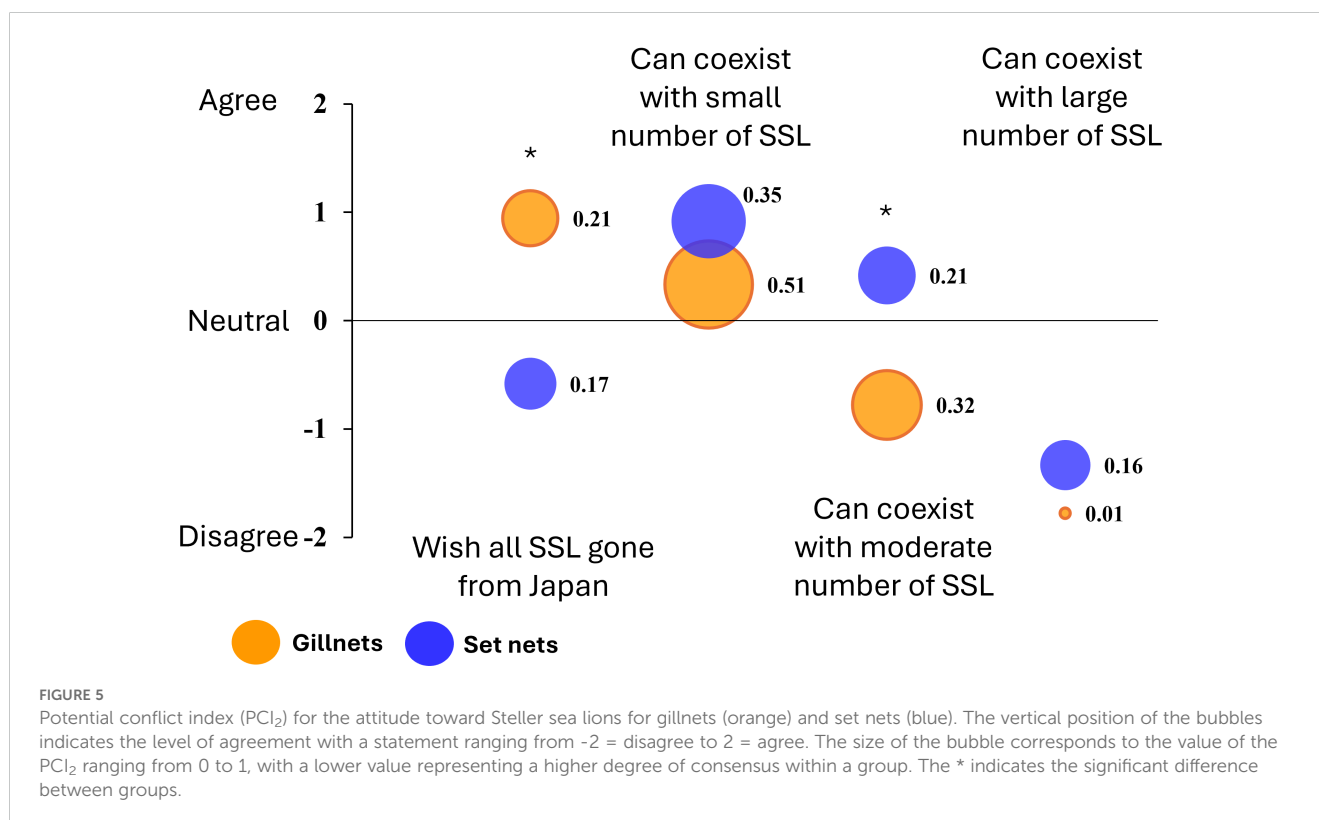
No, that [SSL] doesn't matter. I don't know how many tons of sea lions there are, but I don't think they eat enough to impact the resources. Humans are the ones making a significant impact, right? It's clear that the damage caused by sea lions [to the fishery stocks] is limited. (Suttsu).

Similarly, even though both groups considered an environment with SSL as healthy, the gillnet fishermen presented a higher potential for conflict (0.43), with a few who did not view SSL presence as healthy.

### 3.4 Tolerance toward SSL

The last set of questions inquired about the attitude, here presented as the tolerance, toward SSL (Figure 5). Gillnet and set net fishermen showed a clear difference in tolerance toward SSL. Gillnet fishermen were significantly less tolerant toward SSL as they wished for SSL to be gone from Japanese waters (p-value = 0.002). They also answered that they could tolerate only a small number of SSL (p-value = 0.020). On the other hand, set net fishermen were more accepting of SSL as they did not wish for a total disappearance of SSL from Japanese waters and agreed to coexistence unless there were too many SSL. The conflict within groups was limited, except for the question about the coexistence with a small number of SSL. The main issue raised in this question was the severity of damage to the fishing gear. Several fishermen stated that they could consider coexisting with SSL without damage. On the other hand, coexistence would not be possible even with a small number of SSL if the level of damage is high.

Yes, even if there are many of them, it's fine if they don't cause damage. But even a few, if they cause harm, feels unpleasant. (Teuri 2)



### 3.5 Other recurrent themes

Eighteen fishermen gave comments in addition to what has been discussed during the structured part of the interview. Here we report on the three main themes that emerged from these additions.

#### 3.5.1 The damage and the impact on the livelihood

The damage was a recurrent theme across all interviews and questions and evoked again by 10 fishermen in the last question. Specifically, how this damage is related to the theme of the fishermen livelihood which was mentioned by 6 fishermen in the last question. Fishermen expressed the harshness of their profession and how the conflict with SSL was painfully adding to their burdens.

It's just that, you know, they tear up the nets and snatch the fish, that's the only reason we think, "These bastards!" (Furubira)

But yeah, there's still quite a lot of sea lion damage going on. Even now, catching fish doesn't really bring in money, to be honest. So if the damage gets any worse, I don't think we can keep going, it might just be impossible. (Teuri 3)

#### 3.5.2 Need for help from the government

Six fishermen mentioned that they wished for some help from the government and revealed a negative attitude toward it. They felt that the results of the government's actions were invisible or not properly communicated and that the issue of the SSL conflict was not taken seriously.

So, you know, they're researching things like what kind of behavior the sea lions show, what they come here to eat, what they're after — but whether they've actually reached any real answers or not, we just don't know. It feels like, what are they doing, just killing time and wasting unnecessary money? (Okurige)

But up until now, there's been no support, they just tell us: 'File a damage report. The sea lions will keep eating your fish. Learn to coexist with them.' For us fishermen, that naturally turns into, 'They're eating our catch, so let's just kill them, let's wipe them out.' But in the end, just like with [brown] bears, if we're expected to coexist, then at the national level, they need to recognize, 'Okay, that's just how it is.' Still, when landings are getting smaller, not necessarily because of sea lion damage, but as the overall catch keeps decreasing and we can't make a living, and on top of that we're taking hits from the sea lions, the government should step in and say, 'Let's provide some compensation here.' I think that's what a lot of fishermen are hoping for. (Rausu 1)

## 4 Discussion

### 4.1 Attitude toward current and possible mitigation measures

Our study attempted to contextualize fishermen's perception of the conflict with SSL by investigating their perception and attitudes toward SSL and mitigation measures. Fishermen approved of population control as a mitigation measure and currently saw it as

the only solution. In their study of fishermen and local people's attitudes toward management measures, [Waldo et al. \(2020\)](#) also found that culling was seen as the only option by fishermen. This was also reported by [Cleary \(2021\)](#), who found that when some conservation measures were considered harmful for the fishing communities, culling was considered the unique option. There are often calls for culls in fishing communities where the conflict with seals or sea lions is very intense or when there is a lack of non-lethal alternatives ([Königson et al., 2007](#); [Rauschmayer et al., 2008](#)). Although the difference between groups was not significant, gillnet fishermen were slightly more positive toward population control than set net fishermen. In addition, the consensus about population control among gillnet fishermen was clearly higher than for set net fishermen. Gillnet fishermen suffer higher damage from their interaction with SSL ([Japan Fisheries Research and Education Agency, 2024](#)), explaining their stronger tendency to approve population control. A study comparing the impression of fishermen using trap nets and trawls in Scotland also found that fishermen using trap nets preferred more intensive population control than fishermen using trawls, emphasizing that the damage severity affects the demand for culls ([Moore, 2003](#)). In Japan, most of the efforts dedicated to fisheries-SSL conflict mitigation lie in population control ([Matsuda et al., 2015](#)). This lack of alternatives, especially for gillnet fishermen, partially explains the current position of fishermen concerning population control despite a relatively neutral view about the ecological role of SSL and differences in tolerance discussed below. Population control is not the only lethal method used in fishery-pinniped conflict. Target removal, shooting individuals who came near the nets, rather than randomly culling, has also been used as a mitigation tool. Several studies reported that it was more effective than population control as it is more likely to remove individuals specialized in feeding from the nets ([Lehtonen and Suuronen, 2010](#); [Graham et al., 2011](#); [Königson et al., 2013](#)). As the idea of targeting these specialized individuals has been mentioned during some interviews, this might be a possible alternative to population control.

Both gillnet and set net fishermen clearly voiced the necessity to develop other measures, as an alternative or in addition to population control. Attempts to find alternative damage-preventing solutions such as acoustic deterrence ([Iida et al., 2006](#)) or barriers for set nets ([Sasakawa, 1989](#)) have been investigated in the past, but without convincing results. Acoustic devices showed promising results in some places, in particular when used as an additional tool to other methods ([Fjälling et al., 2006](#); [Harris et al., 2014](#); [Vetemaa et al., 2021](#)), but they have also been criticized elsewhere for not being effective in the long term due to the quick habituation of pinnipeds and being harmful to pinnipeds or other marine mammals ([Westerberg et al., 2006](#); [Findlay et al., 2022](#); [Lehtonen et al., 2022](#)). The most promising non-lethal method has been the introduction of a reinforced gillnet in the Sea of Japan ([Isono et al., 2013](#)). This has been implemented by some fishermen since 2014. The nets are constructed by sandwiching regular netting fabric between coarse netting made of strong fibers. Although the gaps in fishing capacity and handling have been greatly reduced, the high cost remains a problem until the end, and public subsidies are essential for their introduction ([Isono et al., 2013](#)).



Fishermen were not entirely convinced that damage compensation would help to tolerate the current damage level, as relying on compensation is not considered valid for business, which is similar to the opinion of fishermen in Sweden (Waldo et al., 2020). The need to run a business and practice fishing activity in good conditions is also reflected in the answers to the question of good catch. When the damage to their fishing gear is high, they struggle to do their job even if the catch brings a lot of money. The interviews also revealed some concerns that they would lose their identity as a fisherman if they heavily relied on subsidies, as shown in a study of (Cleary, 2021), who interviewed fishermen about the conflict with seals in the Baltic Sea. However, compensation can be effective if the damage is not too extensive like with the Mediterranean Monk seals (*Monachus monachus*) in Turkey and Greece (Güçlüsoy, 2008; Panagopoulou et al., 2017), or a means to shift the perception of a predator from a nuisance to a natural hazard (Varjopuro, 2011). However, this measure is often viewed as a short-term solution and not a replacement for other damage preventing tools (Varjopuro, 2011; Cummings et al., 2019; Johansson and Waldo, 2021).

## 4.2 Perceived role of SSL

Gillnet and set net fishermen showed a contradicting perception of SSL ecological role as they acknowledged both the benefits and the risks of SSL presence in the area. This suggests that fishermen make an important difference between enjoying the value of the presence of sea lions in the area and the struggle caused by the negative interaction they experience. In their study, Ramos et al. (2023) also found a mixed perception of sea lions by fishermen stating that they “find it beautiful to witness the sea lions in their moments of rest in the protected area and on other rocky substrates of the coast, because at this moment the animals do not interfere in the fisheries” (section 4, p 7) but have opposite opinions regarding the interaction with fisheries. The potential for conflict for set net fishermen concerning the ecological risk was high (0.58). The main fish target and the damages differ considerably between the set net fisheries in the Sea of Okhotsk and the ones in the southern part of the study area (Japan Fisheries Research and Education Agency, 2024). This could explain the difference in perception within the set net group. Further studies will be needed to explore the difference between locations. Nevertheless, the mixed perception did not differ between groups. However, a few fishermen in Sarufutsu (Figure 1) and in the southern part of the study area did not think that the presence of SSL meant that the ecosystem was healthy. At the Benten-jima haulout site, near Sarufutsu, there has been a dramatic increase in SSL (Goto et al., 2022) and, in the southern part, SSL has been absent for years before recently appearing in the area. This suggests that the comparison to the past situation can influence the perception of the ecological role of SSL, which is known as the shifting baseline syndrome (Pauly, 1995). This shows that the perception of fishermen is directly affected by changes in SSL distribution.

In our study, even though fishermen associate SSL with a healthy ecosystem, they approved of population control regardless of the fishing technique. This is contrasting with the findings of previous studies on the influence of perceived ecological role of a predator on fishermen’s attitude toward lethal management (Cummings et al., 2019; Jackman et al., 2024). In their study, Jackman et al. (2024) found that fishermen considered seals to be more a risk than a benefit for the ecosystem and were more accepting of lethal management. Similarly, a study in Australia found that 46% of the commercial fishermen did not view sea lions as an essential part of a healthy ecosystem and were more likely to approve of lethal management (Cummings et al., 2019). The mixed perception found in our study is therefore unexpected and might be linked to the different perception of Japanese people for nature compared to Western countries. Indeed, the concept of Satoumi defined as “a coastal area with high productivity and biodiversity due to human interaction” (Yanagi, 2006), emphasizes the importance of the interaction between humans and their natural environment. Though recently conceptualized, it is anchored in the Japanese culture as demonstrated in (Mizuta and Vlachopoulou, 2017; Uehara et al., 2019). Through this lens, considering a predator as a sign of a healthy environment and as a risk for human activity, is not mutually exclusive. Our findings suggest that, in the Japanese context, the perceived role of SSL has only a little influence on the attitude of fishermen toward lethal management.

## 4.3 Different tolerance toward SSL between the two groups of fishing gears

We found that gillnet fishermen were less tolerant of SSL compared to set net fishermen. The interaction with SSL impacted the livelihood of both fishermen groups. However, damage from SSL is thought to be heavier on gillnet livelihood, due to the extensive damage on this fishery and their family-based system. This might influence their stronger negative attitude toward SSL who might be viewed as a direct threat to their livelihood, as fishing is their only source of income (Pont et al., 2016). In contrast, a study in India found that positive attitude toward Irrawaddy dolphin (*Orcaella brevirostris*) was associated with increased income and catch from this interaction (D’Lima et al., 2013). Despite this difference in tolerance toward SSL, we found no difference in attitudes toward the mitigation measures. This contrasts with the findings of several studies investigating the relation between attitude towards a predator and approval of lethal management. Ramos et al. (2023) found that a negative attitude was linked to greater approval of lethal management of South American sea lions (*Otaria flavescens*). Similarly, Jackman et al. (2024) also found a link between negative attitudes toward seal and higher approval of the use of lethal methods. However, Cummings et al. (2019) concluded that personal experience rather than attitude toward the fur seals influenced preferences for mitigation methods. In our study, all fishermen experienced negative interactions with SSL. Still, due to the difference in

fishing technique, the level of interaction as well as the impact of these interactions on their livelihood was not the same between the two groups. Therefore, despite contrasting attitudes toward SSL, they agreed on the mitigation measures.

#### 4.4 Fishermen-government relationship

From the interviews, it became clear that the conflict between SSL and fishermen is included in the broader context of fishermen's livelihood and the harshness of the fishing profession, especially for gillnet fishermen. Fishermen want to practice fishing as well as being able to promise an acceptable future for their successors. Currently, they are struggling to do both. Therefore, they voiced the need for something to be done and better communication with the government. The lack of communication between fishermen and the government, and their need to be listened are not separate issues (Karamanlidis et al., 2020; Waldo et al., 2020). There is also a need for empowerment and inclusion of fishermen in conversations about the fishing system and resolving the conflict with SSL. An issue often raised in studies on the human dimension of wildlife conflict is the lack of trust between fishing communities and authorities that could undermine the possibilities of collaboration (Tonder and Jurvelius, 2004; Matsuda et al., 2015; Waldo et al., 2020). In this study, the lack of trust relies on the perceived minimization of their issues and lack of communication from the government. Such a situation also occurred in eastern Hokkaido when the government could not fulfil its promise to fishermen to reduce the harbor seal (*Phoca vitulina*) population and lost the trust of the fishing community (Matsuda et al., 2015). Appropriate communication and collaboration between the government and fisheries could prevent such an event by prioritizing measures suitable for all stakeholders. This is even more important when there are different perceptions, needs and perspectives represented among a same group of stakeholders. Therefore, including fishermen in the solution-making process might be well received by the Japanese fishing communities. Opening the conversation between fishermen, government and the scientific community has recently been recognized as necessary and effective for fisheries-pinniped conflict management and can help the population to have a better perception of the predator species (Sakurai et al., 2020; Bogomolni et al., 2021; Trukhanova et al., 2021). In their study on cormorant (*Phalacrocorax carbo*) and sea otter (*Lutra lutra*) conflict with fisheries and aquaculture, Rauschmayer et al. (2008) concluded that demands for population management increases with the intensity of the conflict. Still, information exchange and inclusion could reduce the costs of the conflict (Rauschmayer et al., 2008). Studies on participatory management also concluded that including the fishermen in the solution-making process helped find solutions useful for fishermen (Bruckmeier and Høj Larsen, 2008). Therefore, fisheries, authorities and scientists in Japan would also benefit from

improving communication and knowledge sharing (both scientific and cultural) between stakeholders to enable everyone to work toward sustainable fisheries and SSL management. For example, organizing workshops between scientists and fishermen to share cultural knowledge (Bogomolni et al., 2021; Marchini et al., 2021). During these workshops, discussing ways to revitalize fishermen villages could be beneficial for the empowerment of the local communities especially in the context of depopulation of the rural areas (Frank et al., 2019; Enari, 2021). This would enable the scientific community and authorities to build a trust relationship with the fishing communities, which is an initial step toward finding strategies adapted to their needs and constraints.

## 5 Conclusion

We interviewed 29 fishermen working on either gillnet or set net fisheries in Hokkaido, Japan. We found that fishermen showed a complex perception of SSL's ecological role beyond the fact that they cause damage to their catch and gear. As the fishing profession has already been full of struggles, the conflict with SSL only adds to their reality. We also found that the interviewed fishermen are open to trying new measures to find a path toward coexistence.

In Hokkaido, fishing is an essential source of food for the Japanese people, and a source of cultural pride. Thus, protecting fishermen's livelihood by mitigating the conflict with SSL, and ensuring promising perspectives for their successors is crucial for the future. Studies about the human dimension of marine mammals and small-scale fisheries are scarce (Jog et al., 2022). In Asia, studies on the subject have mainly focused on cetacean conservation (Liu et al., 2016, 2019; Whitty, 2016; Kusuma Mustika et al., 2021). This present study is the first step in understanding the human dimension of the fisheries-SSL conflict in Japan. Given the limited number of interviewees, some reservations about whether they represented the set net and gillnet fishing industry must be made. Even though we gathered opinions in villages covering the whole range of SSL presence in Hokkaido, it has been difficult to get the cooperation of fishermen. Thus, we cannot ignore the fact that the ones who agreed to participate in our study might have similar opinions they needed to express. Nevertheless, this points the way forward for future research on the human dimension of wildlife conflict. Rather than focusing solely on the ecology of the animal involved in the conflict, our study included ecological knowledge of fishermen and provide an understanding of the circumstances surrounding wildlife damage. Now that the door is open, further studies should involve more fishermen and include themes that could not be addressed during this study due to the novelty of the approach with the fishermen. In this rapidly changing world, especially in Japan, with reduced fishing resources, aging population and rural exodus, the conflict with terrestrial and marine wildlife will likely intensify. Therefore, investing effort and

working together to find mitigation strategies adapted to the majority's needs will be the key to coexistence.

## Data availability statement

The raw data supporting the conclusions of this article will be made available by the authors, without undue reservation.

## Ethics statement

Ethical approval was not required for the studies involving humans because The participants were given a short explanation of the content of the interview, use of collected data and respect for anonymity. They were informed that they could skip any question or resign from the interview at any time and were asked to allow the interview to be audio-recorded. The studies were conducted in accordance with the local legislation and institutional requirements. Written informed consent for participation was not required from the participants or the participants' legal guardians/next of kin in accordance with the national legislation and institutional requirements because Oral consent was requested at the beginning of every interview. A copy of the cover page of the interview with description provided to the fishermen before the interview is included in the [Supplementary Material \(S2\)](#).

## Author contributions

FB: Conceptualization, Formal analysis, Investigation, Methodology, Visualization, Writing – original draft, Writing – review & editing. NA: Data curation, Investigation, Writing – review & editing. MJ: Investigation, Writing – review & editing. ST: Methodology, Writing – review & editing. OY: Conceptualization, Methodology, Supervision, Writing – review & editing.

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## Conflict of interest

The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

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## Supplementary material

The Supplementary Material for this article can be found online at: <https://www.frontiersin.org/articles/10.3389/fmars.2025.1716630/full#supplementary-material>

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