Ocean and Society
2027 • Volume 4 • Article 13025
https://doi.org/10.17645/oas.13025

cogitatio

ARTICLE

Open Access Journal

Benefits and Threats of Invasive Alien Species: Stakeholder Perceptions of the Red King Crab

Margrethe Aanesen [1], Jannike Falk-Andersson [2], Brooks Kaiser [3,4], Melina Kourantidou [3,5], Ståle Navrud [6], Erlend Dancke Sandorf [6], and Xiurou Wu [7]

[1] Center for Applied Research (SNF), Norwegian School of Economics, Norway
[2] UiT – The Arctic University of Norway, Norway
[3] Department of Economics, University of Southern Denmark, Denmark
[4] Department of Economics, St. Lawrence University, USA
[5] Écosystèmes, Biodiversité, Évolution (UMR 6553 ECOBIO), CNRS, Université de Rennes, France
[6] School of Economics and Business, Norwegian University of Life Sciences, Norway
[7] Department of Natural Resources and Environmental Management, University of Hawai'i at Mānoa, USA

Correspondence: Margrethe Aanesen (margrethe.aanesen@snf.no)

Submitted: 6 July 2026 **Accepted:** 8 October 2026 **Published:** 25 November 2026

Issue: This article is part of the issue "Blue Burdens and Opportunities: Actioning Equity, Sustainability, and Economic Viability in the Blue Economy" edited by Rachel Nichols (University of Wollongong) and Freya Croft (University of Wollongong), fully open access at https://doi.org/10.17645/oas.i527

Abstract

The red king crab is an invasive alien species in the Barents Sea that poses both threats and benefits to existing ecosystems, marine species, and society. To address both, the Norwegian government has set up a dual management regime: The area east of North Cape is quota-regulated, aiming at profitable harvesting for local fishers, and the area to the west is open access, aiming at controlling spread. Recent years' development indicates that in none of the areas has the aim been achieved. This may call for changes. As scientific knowledge about threats and benefits from the red king crab is uncertain, and changes in management may have distributional consequences, we conducted a survey of three relevant stakeholder groups: scientists (18), local commercial small-scale fishers (23), and the local population (56). The results indicate that the public is more concerned about the further spread of the red king crab than the fishers, and about potential threats to existing marine species than the scientists. Small-scale commercial fishers believe the benefits to the fisheries sector are larger than those of scientists and local inhabitants. These results provide evidence that stakeholder concern and perceived trade-offs should be considered alongside ecological and economic factors when evaluating changes to the current management regime.

Keywords

Arctic Norway; ecological threats; economic benefits; invasive alien species; red king crab; stakeholder involvement

© 2026 by the author(s), licensed under a Creative Commons Attribution 4.0 International License (CC BY).

1. Introduction

Fisheries are the core sector of the blue economy, and if managed optimally, can create livelihoods for, and feed people around the globe for, millennia. However, fisheries management is complex, as it must take into consideration ecological (sustainability) goals as well as economic and social goals simultaneously. This was already a challenge for well-established and traditional species, and the introduction or invasion of new, alien species, for which knowledge and experience are scarce, further complicates the management (Kraemer, 2017). Marine invasive alien species have long been known as a threat to biodiversity (Falk-Petersen et al., 2006), but more recently researchers have acknowledged that an increasing number of invasive alien species bring benefits alongside their threats (Kourantidou et al., 2022). The continued presence of such invasive alien species creates attractive economic opportunities for some stakeholder groups, while reducing welfare for others. Emphasizing either the burden or the opportunity of the invasive alien species has different distributional effects, which in turn creates management dilemmas (Kourantidou et al., 2022; Woodford et al., 2017).

Using the invasive red king crab (RKC) in Norway as an example, this article presents results from a survey among three stakeholder groups—scientists, local commercial fishers, and local inhabitants—on their assessment of the spread, threats, and benefits of the RKC. The crucial research question is the degree to which these assessments differ. While scientists and commercial fishers are often heard in traditional fisheries management, the general public is not. Hence, a novelty of the article is the inclusion of a stakeholder group which may have viewpoints different from those normally heard in fisheries management.

2. Background

The RKC was introduced by Soviet scientists off the Kola Peninsula coast, Russia, in the Barents Sea during the 1960s. It was intentionally introduced from the Pacific to serve as a food source for the regional population and to create economic opportunities for the fishing industry. During the following decades, the RKC established and spread westward into the Norwegian exclusive economic zone (EEZ; Sundet & Hoel, 2016). Increasing RKC presence posed two main challenges to Norwegian society. First, threats to native marine ecosystems, in particular benthic organisms (Jørgensen & Primicerio, 2007), and second, threats to commercial fishers, who started to suffer economic losses as the RKC got entangled in their fishing nets while fishing for cod and other whitefish.

To meet the dual challenge posed by the RKC in the Norwegian EEZ, a management regime—unparalleled globally—was introduced in 2008. Norway set a demarcation line at 26°E (North Cape): To the east, a quota-regulated RKC fishery, restricted to fishers suffering losses in the traditional whitefish fisheries, was introduced to compensate these losses, while to the west, there was an open-access fishery aiming at driving the RKC stock extinct (Norwegian Ministry of Industries and Fisheries, 2006–2007). Figure 1 shows the coast off Finnmark county, including the quota-regulated area marked in red. This management regime was evaluated in spring 2015, and a governmental report concluded that it had been successful in preventing further spread of the RKC in Norwegian waters and should be maintained (Norwegian Ministry of Industries and Fisheries, 2014–2015).

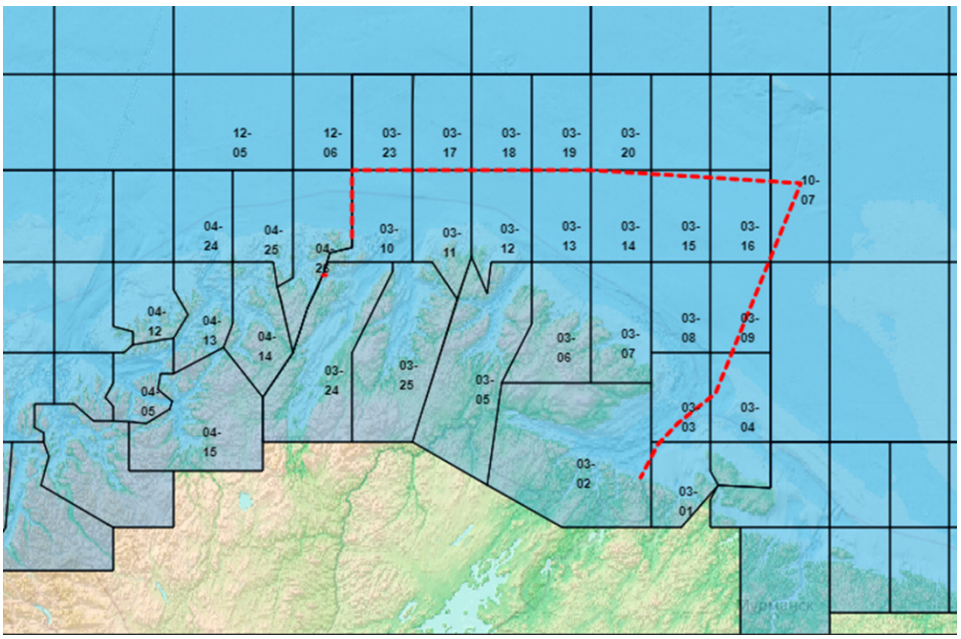

Figure 1. Map of the coast of Finnmark county. Note: The numbered squares show Norwegian fishing statistics locations within ICES (International Council for Exploration of the Seas) areas, used by the Directorate of Fisheries for catch reporting (Directorate of Fisheries, 2018); the red line shows the boundary of the regulated area for red king crab (Directorate of Fisheries, 2024); map created by the authors in Python; data licensed under the Norwegian Licence for Open Government Data (NLOD).

About 10 years later, however, the situation changed. Figure 2a shows total Norwegian RKC catches in the open-access and quota-regulated total allowable catch (TAC) areas, respectively, and Figure 2b shows the number of vessels operating in each area during the years 2004–2024. The green and blue lines in Figure 2a are catches of RKC, measured in tons, by vessels without an RKC quota harvesting in the quota-regulated area (green line; note that up to 2008 there was no quota regulation) and open-access area (blue line), respectively. In a transition period between 2008 and 2009, not all vessels eligible for a quota were registered as a quota vessel, and this explains the high number of landings by non-quota vessels in the quota-regulated area. From 2010, the green line shows unintentional catches of RKC by non-quota vessels, which can be landed as bycatch in the quota-regulated area. The orange line shows landings of RKC by registered quota vessels in the quota-regulated area. In this area, landings reflect the TAC, which, with a few exceptions, was increasing up to 2024. In 2024, landings dropped sharply due to a lower TAC, and this decline continued in 2025 and 2026. In the same period, the number of vessels catching RKC increased in both the quota-regulated and the open-access areas, as shown in Figure 2b. In the quota-regulated area (red line), the number of vessels reached 1,000 in 2024, whereas in the open-access area (blue line), it peaked at more than 500 in 2022 but has decreased somewhat since (Directorate of Fisheries, 2025a).

According to economic theory, an optimally managed stock should enable a long-lasting fishery at a constant rate equal to maximum sustainable yield (MSY), whereas an open-access fishery in the long run will lead to a collapse in the stock. The time series in Figure 2a indicates that from 2015 onward, catches in the RKC fisheries have not developed as intended in either of the areas. The main reason is that the number of fishers eligible for a license to catch RKC in the regulated area has increased, as shown in Figure 2b, thereby increasing the pressure to set a high TAC, which in turn means higher pressure on the stock. A recent note from the Directorate of Fisheries, based on profitability studies by Steinsbø et al. (2024), expresses concern for the

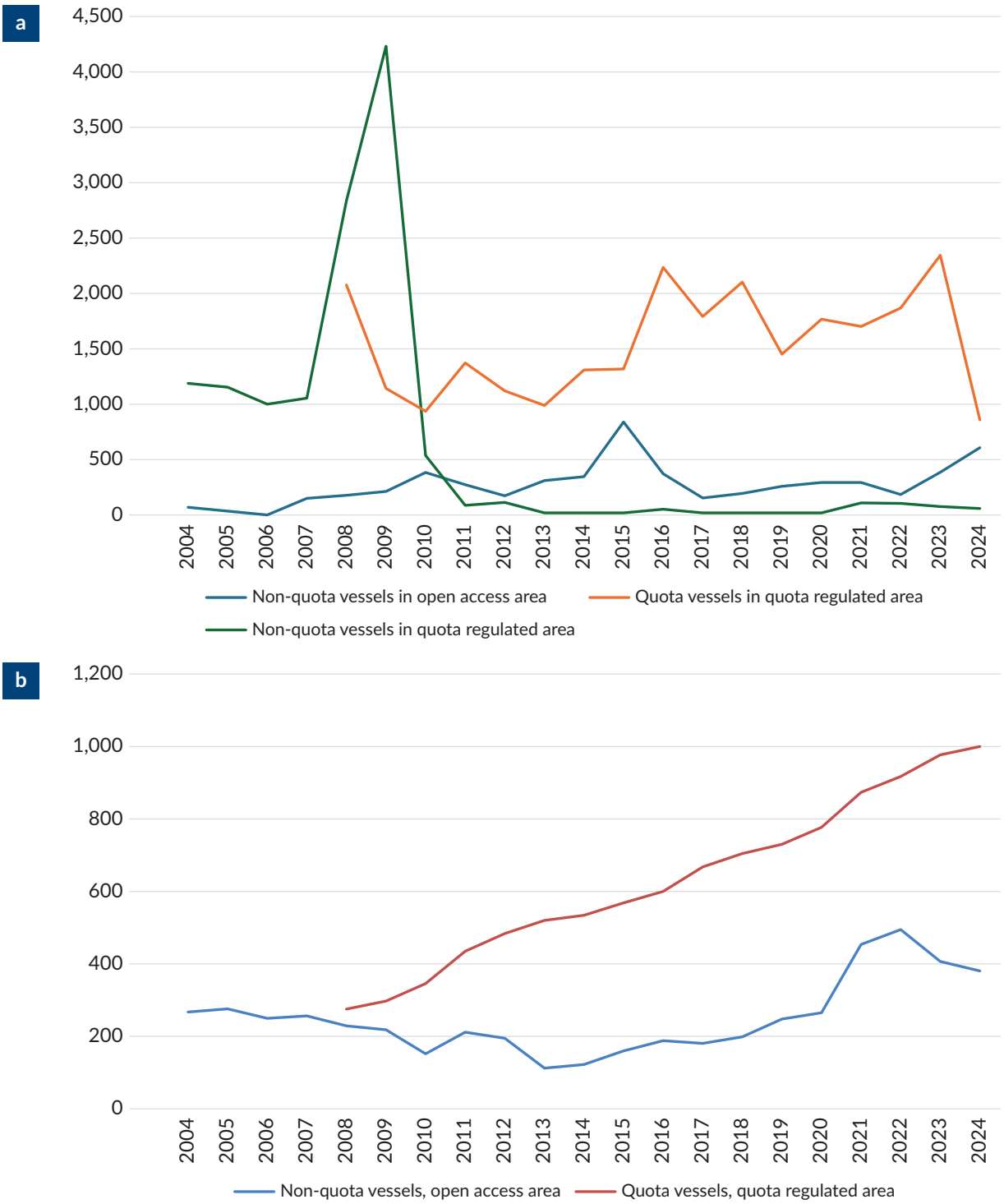

Figure 2. (a) Landings of RKC, measured in tons, during the period 2004–2024; the blue line shows landings from non-quota vessels harvesting in the open access area, the green line shows landings from non-quota vessels harvesting in the area that became quota-regulated from 2008, and the orange line shows landings from quota vessels harvesting in the quota-regulated area (Directorate of Fisheries, 2025b); (b) number of vessels catching RKC. The red line shows vessels operating in the quota-regulated area, and the blue line shows vessels operating in the open access area (Directorate of Fisheries, 2025b).

long-term profitability of the quota-regulated fishery (Directorate of Fisheries, 2024). At the same time, the increase in the number of vessels catching RKC in the open-access area indicates a sufficiently large RKC stock to attract commercial fishers. Hence, although the main aim of RKC management in Norway is still to prevent further spread of the crab, we are in the somewhat paradoxical situation that a main threat is overexploitation in the area where it is considered established and seen as a benefit, and there is ongoing discussion about whether efforts need to be taken to maintain the crabs in this area.

Management of marine renewable resources in Norway is based on expert evaluations and advice, executed by the Directorate of Fisheries and endorsed by the Government. For many commercial fish stocks managed by TAC and/or individual transferable quota (ITQ), commercial fishers are given a voice in the decision-making, and this is also the case in the management of the RKC. While the economic benefit of harvesting the crab is clear, the science is still inconclusive regarding the impact of the RKC on the existing ecosystem, including impacts on traditionally harvested species (Jansen et al., 1998; Mikkelsen, 2013; Mikkelsen & Pedersen, 2012; Oug et al., 2011; Pedersen et al., 2018; Sundet & Hjelmset, 2019). In such a situation, public opinion may play a role, and when it comes to the RKC, Falk-Petersen (2014) is an early example of a study investigating various stakeholders' assessment of the management of the RKC in Norwegian waters. Stakeholders included managers, fisheries organizations, fishers in both management areas, fish buyers, researchers on ecological, fisheries, and indigenous perspectives, and politicians. Two groups of opinion emerged: one that believed the RKC should be managed as an unwanted pest to reduce environmental impact, and one that stressed that given the crab cannot be removed from the system, one might as well earn money from it. The first group was dominated by participants living west of North Cape, i.e., in the area where the aim is to drive the crab to extinction. Both groups agreed that traditionally harvested species were more important than the RKC, that the growth and spread of the RKC should be reduced, that the crab impacted the ecosystem, that the open access fishery wasn't sufficient to stop the spread of the RKC, and that the high commercial value could not justify an increase and expansion of the RKC.

Time has passed, the RKC industry has expanded, and more knowledge on impacts and perceptions of the RKC has been acquired (Sandorf et al., 2025). Given the new situation, which may call for reconsideration of the current management regime, it is of interest to learn how relevant stakeholders assess the RKC and its future presence in Norwegian waters. In addition to scientists and commercial fishers, this also includes the local population. Their assessments are important for at least three reasons: (a) Any change in the management regime will have distributional impacts, and these should be known before changes are implemented; (b) marine resources in Norway's EEZ, including invasive alien species, are regarded as common property and should be managed to the benefit of the whole population; (c) the voice of the local population has so far not been heard in the case of RKC management.

3. Methods and Data

3.1. The Survey Instrument

In 2022, we conducted an online survey among local small-scale commercial fishers, the local population, and scientists, asking how they assess both the potential that the RKC moves into and establishes in new areas, and the opportunities and threats from the RKC should it do so. The survey questionnaire, translated from Norwegian, is in the Supplementary Material.

The three main questions in the survey read:

- How far west and south do you think the RKC will have established sustainable colonies in the next 15 years?
- How large do you think the detrimental impacts of RKC on marine organisms and ecosystem functions will be if it establishes in new areas?
- How large do you think the positive impacts of the RKC on marine organisms, economy, and society will be if it establishes in new areas?

In addition, the survey asked for respondents' knowledge of and interference with the RKC. Finally, the New Ecological Paradigm (Dunlap & Van Liere, 1978) was used to measure respondents' attitudes to the natural environment and its vulnerability.

To inform the survey, in addition to reviewing published studies on impacts on marine habitats, species, and ecosystem functions from RKC, we convened researchers from various disciplines, including the natural and social sciences and humanities, working on the RKC in Norwegian waters for a workshop to discuss potential impacts. Based on the reviewed literature and the workshop information, we decided to focus on eight potential threats and five potential benefits from the RKC in Norwegian waters.

3.2. Sample and Background Variables

The data were collected in two waves. In May 2022, a professional survey company distributed the survey to an internet panel of households in Finnmark county and the northern part of the neighboring county of Troms. Troms county is divided into a southern and a northern part, and the demarcation line is at the city of Tromsø. Communities north of the city have social and cultural ties to communities in Finnmark, including the use of fishing grounds and the dependence on small-scale fishing. The invitation message accompanying the survey link mentioned that the survey was about the RKC, and before the questions, a brief presentation of the current management of the RKC was given. The link was distributed among 212 inhabitants in this region, of whom 56 completed it.

In December 2022, the same survey company conducted an identical survey among scientists and local commercial fishers. The survey company was given a list of scientists in Norway who were known to be involved in research on the RKC, including both natural and social scientists. The list was developed by the scientists of this study, including both Norwegian and international experts on bioeconomic modelling of marine species, invasive species, and the Norwegian RKC management, and of 41 scientists who received the survey, 18 completed it. As it is mainly small-scale fishers who are involved in the RKC fishery, the survey company shared the survey link with Kystfiskarlaget (the Norwegian organization for coastal fishers), who distributed it among its members in Finnmark county and the northern part of Troms county. Altogether, the link was distributed to 105 full-time fishers, of whom 23 completed it.

The number of respondents (23) may seem low when compared to the number of fishers catching RKC shown in Figure 2, and the reason is that those numbers include both part-time and full-time fishers. We do not have information about whether these fishers catch RKC or not. There is a risk that members of Kystfiskarlaget are not representative of coastal fishers in Finnmark and northern Troms counties. Both samples (scientists and fishers) are convenience samples. The scientists constitute a small population, and the fact that they cover

several aspects of RKC research makes it more likely that they are representative of the population. Fishers, like representatives of other industrial activities, represent a group typically difficult to reach for survey purposes (Avemegah et al., 2020; Mailu et al., 2021). However, representatives of industrial groups often have more homogeneous viewpoints than, e.g., the public (Luschei et al., 2009).

To increase the likelihood of answers from both fishers and scientists, we decided not to collect personal characteristics. For the households, the survey company has a standard set of background variables, including gender, age, education, income, household size, and place of residence. An overview of sample characteristics of local inhabitants is given in Table S1 in the Supplementary Material. It shows that while the sample is representative for gender, the mean age is somewhat higher (51.5 years versus 41.8 years in the population) and includes a higher proportion of individuals with a university degree (63% compared to 26.5% in the general population).

3.3. Statistical Methods

The main questions of the survey were answered using Likert scale categories. In addition to measuring the distribution of answers for each of the stakeholder groups, we compare these distributions across the groups. While Fisher's exact test is recommended for comparing the distribution of answers across stakeholder groups in small samples, the exact nature of the test can make interpretation more complex, and the test can be overly conservative, leading to a higher likelihood of type II errors. In our case, this would mean failing to identify differences across the stakeholder groups. Hence, we complement this with the Pearson chi-square test, which is less rigorous but relies on the test statistic following the chi-square distribution. However, when one or more of the (expected) frequencies is low, these small values will inflate the test statistic, and it can no longer be assumed to follow the chi-square distribution (Crawly, 2007). To account for multiple pairwise comparisons based on the relatively small sample, we added a family-wise error rate (FWER) correction of the *p*-values from the pairwise *t*-tests, using the Holm adjustment, which is more powerful than, for example, the Bonferroni adjustment. Finally, we applied Cramer's *V* to indicate the extent of association between the two variables tested in the pairwise tests. The data were organized in an Excel file. RStudio was used to produce Figures 3–5, run tests, and produce Cramer's *V*.

4. Results

4.1. Experience With the RKC and Self-Assessed Knowledge

The survey started by asking respondents about recreational interests in the RKC and their self-assessed knowledge of the RKC. Recreational use of the crab can contribute to tacit knowledge, and two answer categories, in addition to "other use," were used, namely, recreational fishing and eating the crab. While none of the scientists or fishers indicated recreational fishing on the crab, five from the public (≈10%) said they did. Interestingly, only four fishers (17%) indicated eating RKC, whereas the shares for scientists and the public were 55% and 59%. "Other use" included fishers and scientists expressing their professional interest in the crab, but also seven from the public (13%) who had an interest in learning about the crab.

The respondents were asked to assess their knowledge on five topics related to the RKC: biology, ecosystem impacts, fishery and tourism impacts, markets, and management. Each topic included at least one

respondent with expert knowledge and between 10 and 20 knowledgeable respondents, which ensures somewhat informed responses. Some scientists are either experts or knowledgeable within each of the topics, and most scientists have extensive knowledge within management, biology, and ecosystem impacts, while a few have expert knowledge within markets, and fisheries and tourism impacts. The public is most knowledgeable about fisheries and tourism impacts, and least knowledgeable about biology. No fisher defines themselves as an expert in any of the topics, but rather as knowledgeable or with some knowledge in all topics except for market potential. Table S2 in the Supplementary Material displays the mean scores for each topic for each stakeholder group.

4.2. Spread of the RKC

The survey included a map and asked respondents to assess the likelihood of the RKC moving into and establishing in four different areas to the west and south of the quota-regulated area during the next 15 years. From east to west, the divisions are as follows: Area A covers the main part of current RKC catches in the open-access fishery; in area B, RKC is occasionally caught and landed; in areas C and D, RKC are observed, but there are no registered landings. The respondents were given four answer categories with accompanying probability ranges: very large (76–100%), large (51–75%), moderate (26–50%), and small (0–25%). We did not ask the respondents to evaluate such an expansion as positive or negative, just to assess the potential for expanded establishment under the given regime.

In general, about 70–80% of all respondents assess the likelihood of the RKC to be established in the two areas where it is currently occasionally caught and landed (areas A and B) in the next 15 years as large or very large. For areas further to the south (areas C and D), where RKC is currently not landed, less than 50% of the respondents think there is a large or very large probability that the RKC will establish in the next 15 years. However, these numbers vary somewhat across stakeholder groups.

Figure 3 presents the distribution of respondents within each stakeholder group on the four answer categories. None of the scientists think there is a large probability that the RKC establishes in area C in the next 15 years, and neither scientists nor fishers think there is a large probability that it establishes in area D. Among the public, on the other hand, 12% think there is a large probability that the RKC establishes in area C and 11% that it establishes in area D. The main difference is between the public and the fishers. Generally, the public assesses it as more likely that the RKC establishes in new areas. The difference between fishers and the public is significant at the 5% level for all areas. In addition, the difference between scientists and fishers is significant for area B, and between scientists and the public for area A. Adjusting for multiple comparisons using the FWER, all pairwise comparisons, except between fishers and the public in area D, are still significant at the 10% level (Holm-adjusted). If we include the "Don't know" answers in the distribution, most of the significant differences still hold, and now the difference between fishers and the public is significant for area D even when adjusting for multiple comparisons (Holm-adjusted). Cramer's *V* supports the finding that the main difference is between the fishers and the public, with a value above 0.5 for all areas. On the other hand, it is relatively low between scientists and the public, taking values between 0.25 and 0.33. For scientists and fishers, it varies and indicates a strong association for areas B and C, which are those areas with significant or almost significant differences in the pairwise comparisons. The test results and Cramer's *V* are given in the Supplementary Material, Table S3.

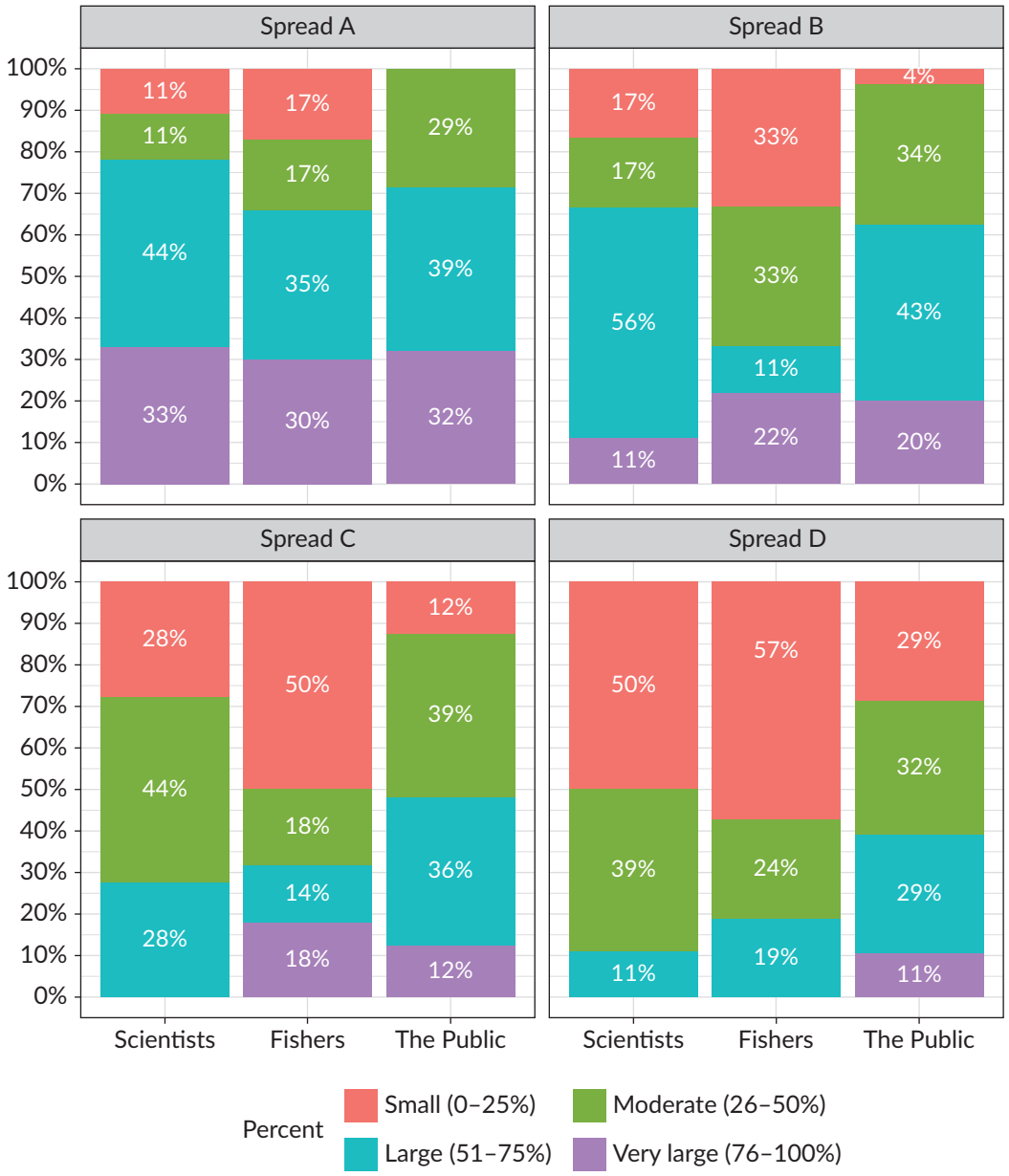

Figure 3. Distribution of respondents within each stakeholder group on the four answer categories, per cent of all respondents within each stakeholder group. The following "Don't know" answers for fishers are excluded: 5 (area B), 1 (area C), 2 (area D). Scientists and the public had no "Don't know" answers. Neither of the groups had any missing values (NA).

4.3. Potential Impacts of a Spread of the RKC Into New Areas

Eight threats and five benefits were chosen to represent the most important ecological impacts of the RKC. These are listed in Table 1, along with a reference to the literature indicating the potential impact and the short name used in the presentation of the results.

Table 1. Potential threats and benefits to existing ecosystem functions, marine species, and human activities from RKC invasion.

	Reference	Short name used in figures
Potential threats (negative impacts)		
Reduced seabed biodiversity	Oug et al. (2011, 2018)	Seabed
Reduced local stocks of coastal cod	Falk-Petersen (2014); Pedersen et al. (2018)	Cod
Reduced stocks of haddock	Anecdotal; Sundet and Hjelmset (2019)	Haddock
Reduced stocks of flounder	Anecdotal	Flounder
Reduced stocks of capelin	Mikkelsen (2013)	Capelin
Reduced stocks of cleanerfish	Mikkelsen (2013)	Lumpsucker
Reduced stock of sea urchin	Kvile et al. (2022)	Sea urchin
Reduced oxygen transmission across layers in the sea	Pedersen et al. (2018)	Oxygen
Potential benefits (positive impacts)		
Increased stocks of wolffish	Anecdotal; Sundet and Hjelmset (2019)	Wolffish
Increased amount of kelp	Kvile et al. (2022)	Kelp
Increased opportunities for commercial fishing	Hvingel et al. (2022); Sundet et al. (2019)	Commercial fisheries
Increased opportunities for tourism activities	Hvingel et al. (2022); Sundet et al. (2019)	Tourism
Increased opportunities for recreational fishing	Hvingel et al. (2022); Sundet et al. (2019)	Recreation

The seabed biodiversity impact is the only verified negative impact of the RKC in Norwegian waters (Oug et al., 2018). Seabed biodiversity and oxygen transport are related, as a reduced number of organisms moving between the seabed and upper layers of the water column will reduce the transportation of oxygen between layers of water (Pedersen et al., 2018). In addition to these threats to ecosystem functions, the emphasized threats concern commercial species utilized by humans. For example, in the early stages of research on RKC impacts on the native ecosystem, researchers feared that the crab may eat cod larvae (Gederaas et al., 2007). No support has been found for this concern. Instead, pieces of RKC have been found in the stomach of large, mature cod (Sundet & Hjelmset, 2019). Still, during the workshop with scientists on the RKC, the focus was more on the threat the RKC posed to the cod than on the fact that the cod potentially could benefit from the RKC.

To take into account ambiguous impacts of the RKC, for each listed threat and benefit, a respondent could choose an answer category indicating that they thought the impact was the reverse of what was stated in the survey. The research on ecological impacts of RKC has revealed interesting ambiguities. While the RKC is proven to prey on sea urchins (Kvile et al., 2022), its presence is a benefit to kelp, as sea urchin is a predator on kelp. In turn, this is a benefit to many fish stocks, as kelp is an important habitat for young fish to hide from predators. These ecological interactions are sometimes complex, and the net effect is not always obvious.

The economic impacts are more straightforward. The RKC is currently the basis for two industrial activities: commercial fisheries and fishing tourism. Both unambiguously benefit coastal communities along the coast where the RKC is present. In addition, among the local population, RKC is regarded as a delicacy, and due to its popularity, in the regulated area there is a limit of 10 adult crabs per adult person per year for their own consumption.

The respondents were asked to indicate how large they assumed each of the eight threats and five benefits to be, giving their answers on a Likert scale from 1 = *very large threat/benefit*, to 6 = *no threat/benefit*, and 7 = *I think this statement is not true and that the impact is the reverse*. There was also the possibility to respond with "I don't know."

4.3.1. Threats

Figure 4 displays the relative share of respondents in each stakeholder group on the seven answer categories, excluding the "don't know" answers. To simplify the reading of the results, the three answer categories "very large," "large," and "moderate" are measured from left to right, starting at 0%, and the answer categories "small," "very small," "none," and "the opposite" are measured from right to left, starting at 0%. Hence, the left-hand side of the bars indicates the shares that are reluctant to accept the posed threat as real, whereas the right-hand side indicates an increasing degree of acceptance that the threat is real.

In general, there is large agreement that the RKC poses a threat to the seabed and the sea urchin, but less of a threat to haddock and capelin. The scientists are the stakeholder group most reluctant to assess a potential threat as large or very large, and more inclined to see it as small, non-existent, or even the reverse, i.e., a benefit, like for the cod and the sea urchin. The public is more inclined to assess threats to commercial species like cod, haddock, flounder, and capelin compared to both fishers and scientists. Tests show that the main differences are between scientists and the public, where the public expresses more concern. These differences are significant at the 5% level for cod, haddock, flounder, and capelin in the pairwise tests, and at the 10% level when correcting for multiple comparisons using the FWER (Holm-adjusted). If we include "Don't know" answers and NA in the distribution, these differences still hold in pairwise tests at the 5% level, but when using FWER, they are significant only for haddock and capelin, and only at the 10% level. Cramer's *V* supports these results, taking values above 0.44 for the four commercial species (cod, haddock, flounder, and capelin). Independent of the methods used and what is included in the distribution of answers, there are no significant differences between scientists and fishers. Still, Cramer's *V* indicates some association between these two groups, with values above 0.4 for flounder and capelin (and cod and lumpsucker when including "Don't know" answers and NA in the distribution). When including "Don't know" answers and NA in the distribution of answers, there is a significant difference between fishers and the public in their assessment of threats to the lumpsucker, where the public is more concerned. Cramer's *V* for comparisons between fishers and the public suggests relatively low associations between these two groups, with values mainly below 0.35. The results of the tests and Cramer's *V* can be found in Table S4 in the Supplementary Material.

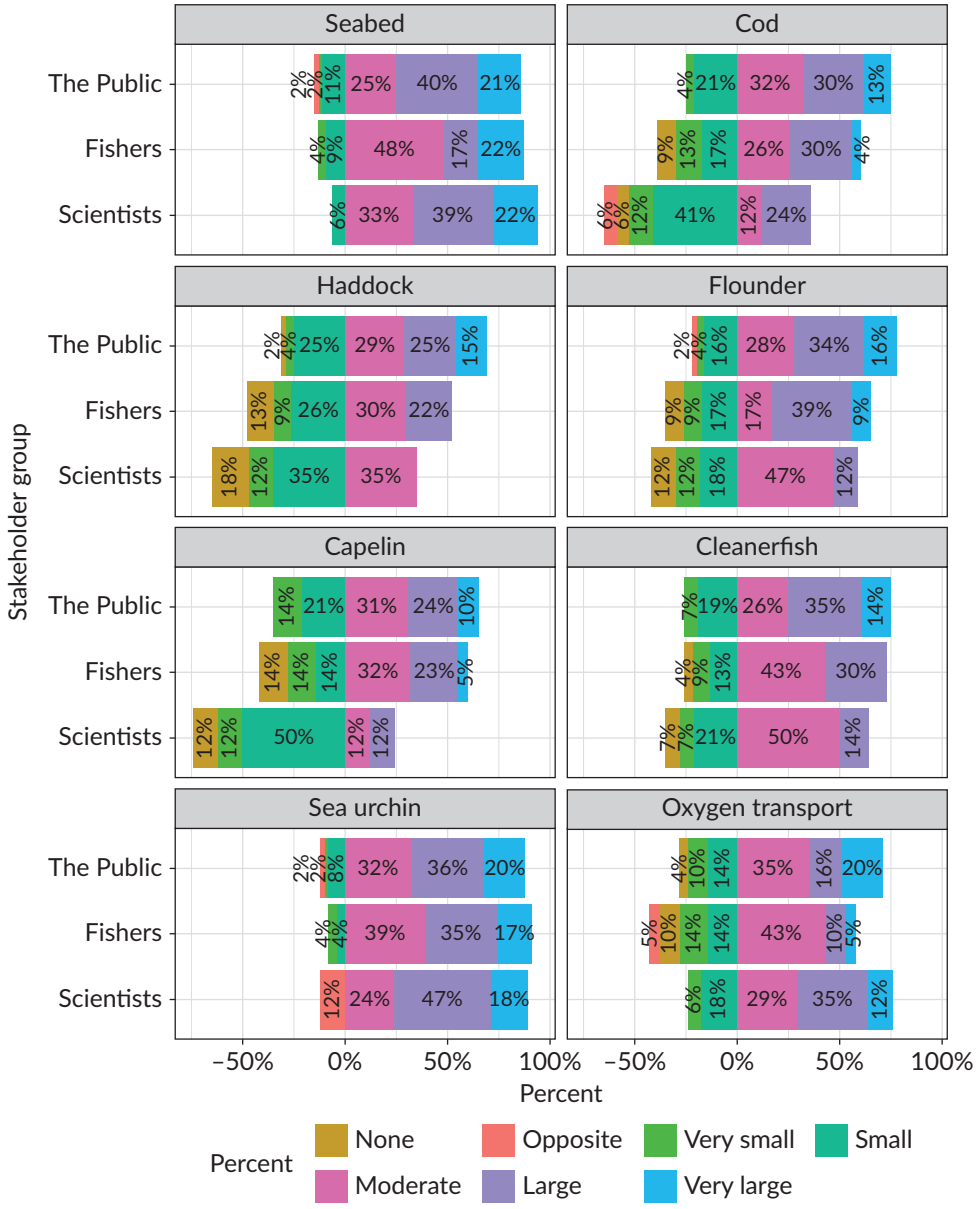

Figure 4. Frequency (share) of respondents choosing one of the seven answer categories for each of the threats. To the right of "0%" are those assessing the threat to be modest, large, or very large, and to the left are those assessing the threat to be small, very small, non-existent, or the opposite of a threat (a benefit). The following "Don't know" answers are excluded: Fishers: 2 (oxygen), and Scientists: 1 (capelin). In addition, the following NA answers are excluded: Fishers: 1 (capelin), Scientists: 1 (cod, haddock, flounder, sea urchin, oxygen) and 4 (lumpsucker). For the public, we could not distinguish between "Don't know" and NA, and the following are missing from the distribution: Public: 3 (seabed, cod), 6 (flounder, sea urchin), 7 (oxygen), 8 (haddock), 13 (lumpsucker), 14 (capelin).

4.3.2. Benefits

Figure 5 displays the distribution of answers across answer categories for the three stakeholder groups for the suggested benefits. The figure shows that among all stakeholder groups, there is substantial reluctance to accept that RKC is beneficial for other marine species and organisms. This is shown by the very large share of respondents to the left of 0% in each diagram. For both commercial fishers and the public, more than 2/3

of the respondents assess such benefits to be small, non-existent, or the reverse. Somewhat surprisingly, the scientists share this assessment when it comes to wolffish, but not for kelp. Note, for kelp and wolffish, almost 30% of the public has answered "Don't know" or not responded, and for kelp almost 27% of the scientists have not responded.

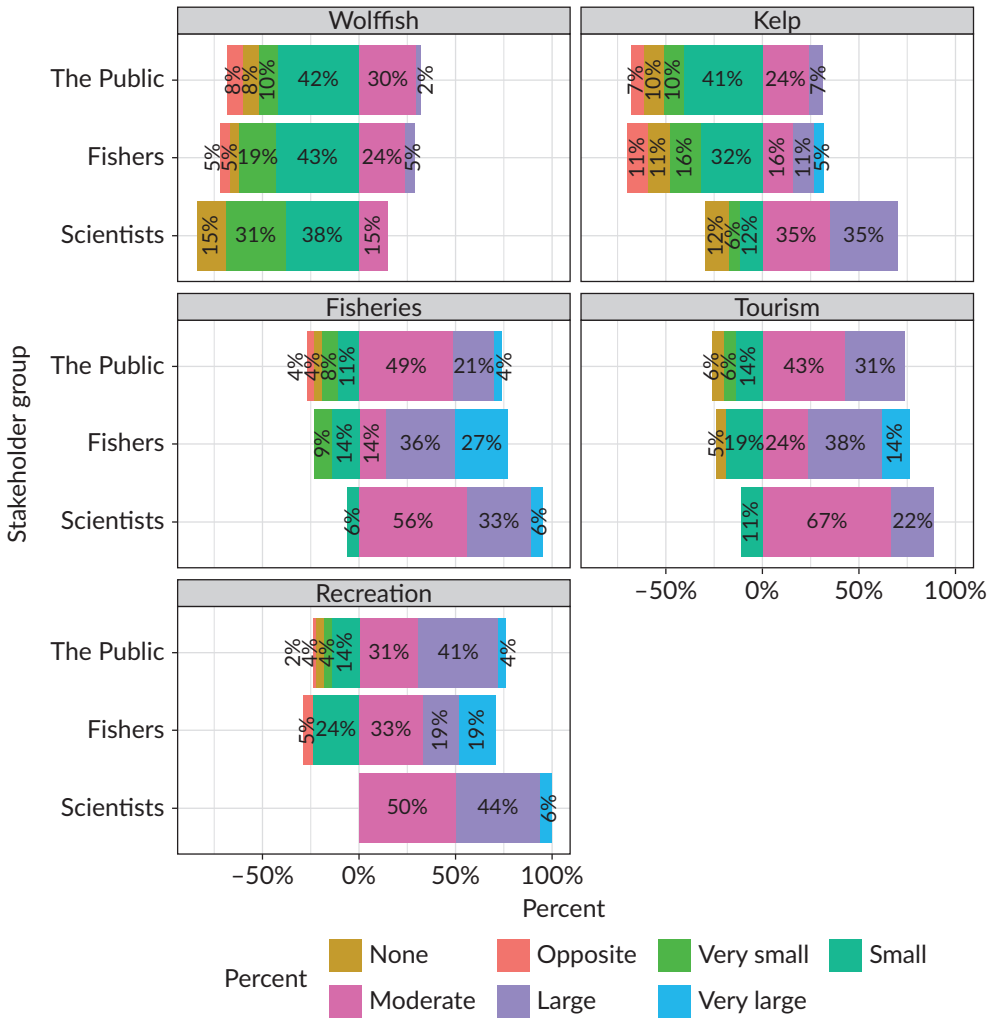

Figure 5. Frequency (share) of respondents choosing one of the seven answer categories for each of the benefits. To the right of "0%" are those assessing the benefit to be modest, large, or very large, and to the left are those assessing the benefit to be small, very small, non-existent, or the opposite of a benefit (a threat). The following "Don't know" answers are excluded: Fishers: 1 (wolffish, kelp, tourism, recreation) and 2 (fisheries). In addition, the following NA are excluded: Fishers: 1 (wolffish, tourism, recreation) and 2 (kelp), Scientists: 1 (kelp) and 5 (wolffish). For the public, we could not distinguish between "Don't know" and NA, and the following are missing from the distribution: Public: 3 (fisheries), 5 (recreation), 7 (tourism), 15 (kelp), 16 (wolffish).

When it comes to economic and social benefits, the picture changes. Relatively few assess these as small, non-existent, or the reverse, and interestingly, it is the scientists who are more on the "positive" side, i.e., the right-hand side of the diagrams. On the other hand, it is mainly fishers that assess benefits to the economic sectors as "very large." It is worth noting that the public is the only group to include respondents who see the RKC as a threat to commercial fisheries. Tests show that there are no general distinctions between the three groups. The main difference is in the impacts on commercial fisheries, where fishers regard such benefits to be

larger compared to scientists and the public. This difference is significant both in the pairwise tests and when using FWER to correct for multiple comparisons (Holm-adjusted). The result also holds when "Don't know" and NA are included in the distribution of answers. There is also a significant difference between scientists and the fishers when it comes to tourism and recreation, and between scientists and the public regarding kelp, but these differences disappear when correcting for multiple comparisons using the FWER. Cramer's *V* indicates larger associations between fishers and scientists than the other groups, with values equal to or above 0.5 for all benefits except wolffish. Table S5 in the Supplementary Material provides the test results and Cramer's *V*.

5. Discussion

Many marine species pose both a benefit and a threat at the same time, which makes the establishment of a management regime more complicated. This challenge is more prevalent for invasive alien species, for which benefits and threats are uncertain. At early stages, economic opportunities may not be obvious, and managers regard the species mainly as a threat to native ecosystems. If the species establishes and becomes more numerous, this perception may change if commercial agents catch interest in using it. Changes in the management regime will often have distributional consequences, but to verify such consequences we need information about how relevant stakeholders assess various threats and benefits from the species. While the stake that fishers and scientists have in the RKC management is obvious, one could question why the public's assessments are of interest. The fact that the public regards themselves as less knowledgeable in all topics compared to scientists and fishers begs the question of what their answers may be worth. The answer lies in recognizing that Norwegian coastal and ocean waters, and the resources we find there, are common resources of the Norwegian population, managed by the Norwegian government (Norwegian Ministry of Industries and Fisheries, 2023–2024). Thus, when various stakeholder groups hold different interests in a common resource, information about such multiplicity of interests across groups with a stake in the management contributes to increased societal equity and welfare based on the managed resource.

There are some robust results from the survey. Local inhabitants in the survey assess it as more likely that the RKC will establish in new areas during the next 15 years as compared to surveyed small-scale local fishers, and they assess threats to commercial fish species from the RKC to be significantly larger as compared to the surveyed scientists. On the other hand, small-scale commercial fishers in the survey assess benefits to commercial fisheries from the RKC to be significantly larger compared to surveyed scientists and local inhabitants. Taken together, this indicates a picture of local inhabitants being more concerned about the expansion of RKC into new areas and the threats this may pose to existing marine species than local fishers and scientists, and local fishers that are more optimistic about the benefits such expansion may provide for commercial fisheries. Hence, based on the survey results, if the current management regime fails in preventing the RKC from establishing in areas to the west of the North Cape, this will benefit commercial fishers at the cost of local people. However, such a conclusion is conditional on a relatively small sample of respondents with some biases, particularly for the local inhabitants.

According to the self-rated knowledge level, local residents are generally less informed than local fishers and scientists. Lack of knowledge has been demonstrated to be a reason for concern and for supporting a precautionary approach (Hom et al., 2009). Furthermore, the local resident sample is not fully representative, as the participants are older and more highly educated than the population in the area.

The potential impact of these biases is ambiguous. Previous studies on environmental conservation in Norway demonstrate that younger and more educated people are more likely to choose environmental protection rather than development scenarios when assessing economic activity with potential negative environmental impacts (Aanesen et al., 2018, 2023). Hence, the biases in our sample draw in opposite directions. Higher education levels in the sample may indicate a greater tendency to perceive the risks from the RKC to the marine environment as high, requiring protection measures. Conversely, being older may imply perceptions of risks to the environment being smaller. Moreover, there is the issue of self-selection, as the words "red king crab" were mentioned in the invitation letter to the survey. If those more interested in the RKC are also those more concerned about its spread and threats, our sample will give biased results, overestimating inhabitants' concern.

Finally, the public sample includes more respondents living to the west of North Cape, where the aim is to drive the crab to extinction, than to the east, where it is regulated. According to Falk-Petersen (2014), stakeholders living west of North Cape were more inclined to regard the RKC as a threat compared to those living east of North Cape. Distinguishing between local residents in the survey living east and west of North Cape, however, does not show any differences in assessments of expansion, threats, and benefits. Moreover, research shows that media coverage actively shapes public perceptions by amplifying certain risks while omitting or downplaying others (Allan et al., 2000). Such selective reporting and framing can shape understandings of environmental risks, influencing which threats are perceived as pressing and which are ignored. In the Norwegian aquaculture context, for instance, Olsen and Osmundsen (2017) found that environmental challenges are often emphasized disproportionately in the public debate. There are, however, highly rational reasons for local inhabitants to be more concerned about further spread of the RKC. They see smaller benefits for commercial activities from the RKC compared to fishers. Previous research shows that when people recognize that the expansion of nature-based commercial activities has positive effects in their local society, even if they don't profit directly from it, they often accept such expansion (Aanesen et al., 2023). But when people are exposed to the impacts of nature-based commercial activities without recognizing positive impacts on the larger society, they tend to be more negative towards such expansion (Dugstad et al., 2020, 2024). Hence, while sample characteristics are reasons to interpret the results for local residents cautiously, these results can also be understood and rationalized in the light of existing research.

The samples of scientists and fishers are convenience samples, as we lack information about the exact size of these populations or their socio-demographic distributions. However, these populations are either limited in number (scientists) or assumed to be relatively homogeneous regarding the activity they represent (fishers). The fishers we accessed are all in the smallest vessel group (below 11 meters total length), and their self-rated knowledge level on the various RKC-related topics is more homogeneous as compared to the public and the scientists. A study comparing responses to 59 non-dichotomous questions from a convenience sample of 30 on-farm recruited farmers and 187 randomly recruited farmers from the same population showed no difference across the two groups for 80% of the questions (Luschei et al., 2009). Thus, we argue that although the sample of fishers is small, it may still represent a large share of small-scale, local fishers' assessments of the RKC. We don't see the fact that "red king crab" was mentioned in the invitation to the survey, while potentially representing a self-selection problem in the public sample, as problematic for the samples of scientists and fishers. We intentionally recruited scientists knowledgeable about the RKC, and if fishers more interested in the RKC are the ones who respond to the survey, this means the results from the survey are based on answers from those more knowledgeable about RKC issues than the average for the two groups.

6. Conclusion

Now largely established in the Norwegian EEZ, the invasive RKC is in practice a common property resource, with the government responsible for managing it in the best interest of society. Following the precautionary principle, management has so far emphasized limiting the spread of the RKC west and south of North Cape. Yet, what constitutes management in the "best interest of society" is not necessarily clear. This article illustrates how conflicting interests may emerge when an invasive species generates both threats and benefits.

Our results indicate some significant differences across three relevant stakeholder groups. Based on survey responses, local inhabitants expect the RKC to expand further west and south, compared to local fishers, and they seem to be more concerned about negative impacts on other fish species than the scientists. Surveyed local fishers perceive larger benefits to the fishery sector from the RKC compared to the local population and scientists in the survey.

The reason for these differences is not clear-cut. They may reflect different knowledge levels, as the local inhabitants report lower knowledge of all aspects of the RKC relative to the fishers and scientists. This, in turn, may make them more concerned about potential, but unknown, impacts. Alternatively, these differences may reflect rational assessments: While the public may see few direct benefits from a spread of the crab, they face potential losses through reduced access to other marine species from which they currently benefit. Thus, our findings give some evidence that stakeholder concern and perceived trade-offs should be considered alongside ecological and economic factors when establishing management regimes for common resources or evaluating changes to current management regimes.

These results hold broader implications for invasive alien species management. Similar tensions are currently being experienced in the case of the Pacific pink salmon (*Oncorhynchus gorbuscha*), which has invaded Norwegian rivers, mainly in the Arctic. While management authorities largely view eradication as the preferred strategy, some members of the public welcome the species as a readily available and beneficial resource ("Fiske etter pukkellaks," 2025; Martinsen & Bye, 2025), and some processing plants have already incorporated it into their production. Like the RKC, the Pacific pink salmon raises questions about how to balance conflicting stakeholder interests and underscores the importance of research into how different groups perceive both risks and benefits.

Acknowledgments

We wish to thank the survey respondents for taking the time to fill in the questionnaire. We also thank Øystein Hermansen, Directorate of Fisheries, for extensive and very useful assistance in understanding the current management regulations and for reference to relevant reports. Finally, we thank Ingvild Skumlien Furuset and Paulina Ramirez-Monsalve, NIVA, for useful input to the survey and the manuscript. The authors take full responsibility for all conclusions and viewpoints in the manuscript.

Funding

This manuscript is based on a study implemented as part of the project Participatory Modelling of Integrated Ecosystem-Based Management Regime for Invasive Crabs (PICO), funded by the Norwegian Research Council, grant no. 302114. It has also received support from the project Winners and Losers in the Climate Casino: Arctic and Marine Resources Under Climate Change (CASINO), funded by the Norwegian Research Council, grant no. 325665.

Conflict of Interests

The authors declare no conflict of interests.

Data Availability

The anonymized dataset and R-codes to run tests and make Figures 3–5 are available in GitHub: https://github.com/maanesen/RKC_invasion

LLMs Disclosure

During the preparation of this work, the corresponding author used Grammarly to proofread the manuscript. After using this tool/service, the authors have reviewed and edited the content as needed and take full responsibility for the content of the published article.

Supplementary Material

Supplementary material for this article is available online in the format provided by the authors (unedited).

References

Aanesen, M., Czajkowski, M., Lindhjem, H., & Navrud, S. (2023). Trade-offs in the transition to a blue economy—Mapping social acceptance of aquaculture expansion in Norway. *Science of the Total Environment*, *859*, Article 160199. https://doi.org/10.1016/j.scitotenv.2022.160199

Aanesen, M., Falk-Andersson, J., Vondolia, G. K., Borch, T., Navrud, S., & Tinch, D. (2018). Valuing coastal recreation and the visual intrusion from commercial activities in Arctic Norway. *Ocean & Coastal Management*, *153*, 157–167. https://doi.org/10.1016/j.ocecoaman.2017.12.017

Allan, S., Adam, B., & Carter, C. (2000). The media politics of environmental risk. In B. Adam, S. Allan, & C. Carter (Eds.) *Environmental risks and the media* (1st ed., pp. 1–26), Taylor & Francis.

Avemegah, E., Gu,W., Abulbasher, A., Koci, K., Ogunyiola, A., Eduful, J., Li, S., Barington, K., Wang, T., Kolady, D., Perkins, L., Leffler, A. J., Kovacs, P., Clark, J. D., Clay, D. E. & Ulrich-Schad, J. D. (2020). An examination of best practices for survey research with agricultural producers. *Society & Natural Resources*, *34*(4), 538–549. https://doi.org/10.1080/08941920.2020.1804651

Crawly, M. J. (2007). *The R book*. Wiley.

Directorate of Fisheries. (2018). *Lokasjoner (f.o.m. 2018)* [Data set]. https://portal.fiskeridir.no/nedlasting

Directorate of Fisheries. (2024). *Kongekrabbe - regulering* [Data set]. https://portal.fiskeridir.no/nedlasting

Directorate of Fisheries. (2024). *Høringsnotat—Forslag til regulering av fangst av kongekrabbe i 2024*. https://www.fiskeridir.no/hoeringer/horing-forslag-til-regulering-av-fangst-av-kongekrabbe-i-2024

Directorate of Fisheries. (2025a). *Fisketillatelser med fartøytilknytning* [Data set]. https://www.fiskeridir.no/statistikk-tall-og-analyse/data-og-statistikk-om-yrkesfiske/apne-data-fiskere-fartoy-og-fisketillatelser

Directorate of Fisheries. (2025b). *Fangstdata seddel koblet med fartøydata* [Data set]. https://www.fiskeridir.no/statistikk-tall-og-analyse/data-og-statistikk-om-yrkesfiske/apne-data-fangstdata-seddel-koblet-med-fartoydata

Dugstad, A., Brouwer, R., Grimsrud, K., Kipperberg, G., Lindhjem, H., & Navrud, S. (2024). Nature is ours!—Psychological ownership and preferences for wind energy. *Energy Economics*, *129*, Article 107239. https://doi.org/10.1016/j.eneco.2023.107239

Dugstad, A., Grimsrud, K., Kipperberg, G., Lindhjem, H., & Navrud, S. (2020). Acceptance of wind power development and exposure—Not-in-anybody's-backyard. *Energy Policy*, *147*, Article 111780. https://doi.org/10.1016/j.enpol.2020.111780

Dunlap, R. E., & Van Liere, K. D. (1978). The "new environmental paradigm." *The Journal of Environmental Education*, *9*(4), 10–19. https://doi.org/10.1080/00958964.1978.10801875

Falk-Petersen, J. (2014). Alien invasive species management: Stakeholder perceptions of the Barents Sea king crab. *Environmental Values*, *23*(6), 701–725. https://doi.org/10.3197/096327114X13947900181356

Falk-Petersen, J., Bøhn, T., & Sandlund, O. T. (2006). On the numerous concepts in invasion biology. *Biological Invasions*, *8*, 1409–1424. https://doi.org/10.1007/s10530-005-0710-6

Fiske etter pukkellaks kan bli ny næring for kystflåten. (2025, November 13). *fisk.no*. https://fisk.no/fiskeri/7881-fiske-etter-pukkellaks-kan-bli-ny-naering-for-kystflaten

Gederaas, L., Salvesen, I. & Viken, Å. (2007). *Norsk svarteliste 2007—Økologiske risikovurderinger av fremmede arter*. Artsdatabanken. https://artsdatabanken.no/Files/13975/Norsk_Svarteliste_2007_(PDF)

Hom, A. G., Plaza, R. M., Feijóo, S. F., & Palmén, R. (2009). From precautionary inadequacy to participatory risk management. *Futures*, *41*(5), 260–268. https://doi.org/10.1016/j.futures.2008.11.006

Hvingel, C., Hjelset, A. M., Danielsen, H. E. H., & Jenssen, M. (2022). *Kongekrabbe i norsk sone. Bestandstaksering og rådgivning for 2023*. Institute of Marine Research. https://www.hi.no/resources/Bestandsvurderinge-av-kongekrabbe-2022-og-rad-for-2023.pdf

Jansen, P. A., Mackenzie, K., & Hemmingsen, W. (1998). Some parasites and commensals of red king crabs, *Paralithodes camtschaticus* (Tilesius) in the Barents Sea. *Bulletin of the European Association of Fish Pathologists*, *18*(2), 46–49.

Jørgensen, L. L., & Primicerio, R. (2007). Impact scenario for the invasive red king crab *Paralithodes camtschaticus* (Tilesius, 1815) (Reptantia, Lithodidae) on Norwegian, native, epibenthic prey. *Hydrobiologia*, *590*(1), 47–54. https://doi.org/10.1007/s10750-007-0756-9

Kourantidou, M., Haubrock, P. J., Cuthbert, R. N., Bodey, T. W., Lenzner, B., Gozlan, R. E., Nuñez, M. A., Salles, J.-M., Diagne, C., & Courchamp, F. (2022). Invasive alien species as simultaneous benefits and burdens: Trends, stakeholder perceptions and management. *Biological Invasions*, *24*(7), 1905–1926. https://doi.org/10.1007/s10530-021-02727-w

Kraemer, R. A. (2017). *A sustainable ocean economy, innovation and growth: A G20 initiative* (Policy Brief No. 113). Centre for International Governance Innovation.

Kvile, K. Ø., Andersen, G. S., Baden, S. P., Bekkby, T., Bruhn, A., Geertz-Hansen, O., Hancke, K., Hansen, J. L. S., Krause-Jensen, D., Rinde, E., Steen, H., Wegeberg, S., & Gundersen, H. (2022). Kelp forest distribution in the Nordic region. *Frontiers in Marine Science*, *9*, Article 850359. https://www.frontiersin.org/articles/10.3389/fmars.2022.850359

Luschei, E. C., Hammond, C. M., Boerboom, C. M., & Nowak, P. J. (2009). Convenience sample of on-farm research cooperators representative of Wisconsin farmers. *Weed Technology*, *23*(2), 300–307. https://doi.org/10.1614/WT-08-083.1

Mailu, S., Adem, A., Mbugua, D., Gathuka, P., & Mwogoi, T. (2021). Response rate, incentives and timing of online surveys: A study of agriculture researchers in Kenya. *Tanzania Journal of Agricultural Sciences*, *20*(1), 82–93. https://www.ajol.info/index.php/tjags/article/view/217207

Martinsen, A. H., & Bye, K. S. (2025, June 18). Mange søker fiskelykken etter uønsket art—Den er liksom ikke så kresen. *NRK*. https://www.nrk.no/tromsogfinnmark/ventes-storinnrykk-av-pukkellaks_-slik-lykkes-du-med-fisket-1.17457820

Mikkelsen, N. (2013). Predation on the demersal fish eggs of capelin *Mallotus villosus* and lumpsucker *Cyclopterus lumpus* in relation to recruitment [Unpublished doctoral dissertation]. University of Tromsø. https://munin.uit.no/handle/10037/5428

Mikkelsen, N., & Pedersen, T. (2012). Invasive red king crab affects lumpsucker recruitment by egg consumption. *Marine Ecology Progress Series*, *469*, 87–99. https://doi.org/10.3354/meps09917

Norwegian Ministry of Industries and Fisheries. (2006–2007). *Forvaltning av kongekrabbe* (St.meld. nr. 40).

Norwegian Ministry of Industries and Fisheries. (2014–2015). *Evaluering av forvaltningen av kongekrabbe* (Meld. St. 17).

Norwegian Ministry of Industries and Fisheries. (2023–2024). *Folk, fisk og fellesskap—En kvotemelding for forutsigbarhet og rettferdig fordeling* (Meld. St. 7).

Olsen, M. S., & Osmundsen, T. C. (2017). Media framing of aquaculture. *Marine Policy*, *76*, 19–27. https://doi.org/10.1016/j.marpol.2016.11.013

Oug, E., Cochrane, S. K., Sundet, J. H., Norling, K., & Nilsson, H. C. (2011). Effects of the invasive red king crab (*Paralithodes camtschaticus*) on soft-bottom fauna in Varangerfjorden, northern Norway. *Marine Biodiversity*, *41*, 467–479. https://doi.org/10.1007/s12526-010-0068-6

Oug, E., Sundet, J. H., & Cochrane, S. K. (2018). Structural and functional changes of soft-bottom ecosystems in northern fjords invaded by the red king crab (*Paralithodes camtschaticus*). *Journal of Marine Systems*, *180*, 255–264. https://doi.org/10.1016/j.jmarsys.2017.07.005

Pedersen, T., Fuhrmann, M. M., Lindstrøm, U., Nilssen, E. M., Ivarjord, T., Ramasco, V., Jørgensen, L. L., Sundet, J. H., Sivertsen, K., Källgren, E., Hjelset, A. M., Michaelsen, C., Systad, G., Norrbin, F., Svenning, M. A., Bjørge, A., Steen, H., & Nilssen, K. T. (2018). Effects of the invasive red king crab on food web structure and ecosystem properties in an Atlantic fjord. *Marine Ecology Progress Series*, *596*, 13–31. https://doi.org/10.3354/meps12548

Sandorf, E. D., Aanesen, M., Falk-Andersson, J., Furuseth, I. S., Hanley, N., Kaiser, B. A., Kourantidou, M., Navrud, S., Vondolia, G. K., & Xuan, B. B. (2025). Exploring information and embedding effects on willingness-to-pay to control the invasive red king crab in Norway. *Environmental and Resource Economics*, *88*, 2529–2556. https://doi.org/10.1007/s10640-025-01022-9

Steinsbø, S., Isaksen, J. R., & Svorken, M. (2024). *Kongekrabbe og omsetningskrav—Ulike modeller for fordeling i den kvoteregulerte fangsten* (Nofima report 28/2024). Nofima.

Sundet, J., & Hjelmset, A. M. (2019). *Red king crab*. Institute of Marine Science. https://www.hi.no/resources/klimastatus-pa-bestander/20211214_Kingcrab_red_narrative.pdf

Sundet, J., & Hoel, A. H. (2016). The Norwegian management of an introduced species: The Arctic red king crab fishery. *Marine Policy*, *72*, 278–284. https://doi.org/10.1016/j.marpol.2016.04.041

Sundet, J., Hvingel, C., & Hjelmset, A. M. (2019). *Kongekrabbe i norsk sone. Bestandstaksering og rådgivning for 2020*. Institute of Marine Research. https://www.hi.no/resources/Bestandsvurderinger-av-kongekrabbe-for-2020-2.pdf

Woodford, D. J., Ivey, P., Novoa, A., Shackleton, R., Richardson, D., Weyl, O., Van Wilgen, B., & Zengeya, T. (2017). Managing conflict-generating invasive species in South Africa: Challenges and trade-offs. *Bothalia – African Biodiversity & Conservation*, *47*(2). https://hdl.handle.net/10520/EJC-727738f3d

About the Authors



Margrethe Aanesen is a professor of environmental and resource economics and works broadly on the management of marine resources. This includes large-scale quantitative surveys on stated preferences for use or protection of marine resources, along with smaller deliberative studies focusing on the motivations for such stated preferences.



Jannike Falk-Andersson is a research professor in ocean governance at UiT – The Arctic University of Norway. She is an interdisciplinary researcher integrating ecological and social sciences and innovation methodologies in the context of marine resource management.



Brooks Kaiser holds positions at the University of Southern Denmark and St. Lawrence University (PhD, Northwestern). Her research agenda connects how economic and ecological transformations of natural capital from systems disruptions affect resource harvest, use, conservation, and investment. She is also a fellow of the Polar Research and Policy Initiative.



Melina Kourantidou is an environmental and resource economist whose research focuses on marine biological invasions, fisheries economics, and biodiversity conservation. Her work explores the socioeconomic impacts of invasive species, the trade-offs between ecological and economic objectives, and the design and evaluation of management strategies in marine and coastal systems.



Ståle Navrud is a professor of environmental and resource economics at the School of Economics and Business at the Norwegian University of Life Sciences. He has worked extensively in the economic valuation of biodiversity and ecosystem services, applying revealed and stated preference methods, benefit transfer, and Delphi techniques.



Erlend Dancke Sandorf is an associate professor of economics with more than 10 years of experience in valuing nature and ecosystem services. He is involved in several large projects on invasive species and nature-based solutions.



Xiurou Wu is an assistant professor in the Department of Natural Resources and Environmental Management at the University of Hawai'i at Mānoa. Her research examines how human activities affect aquatic ecosystems and resource-dependent communities under climate change, combining econometrics, optimization, and spatial analysis to guide sustainable resource use.