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**Scottish Marine and Freshwater Science Vol 13 No 1**

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# Fisheries and Climate Change: Opinions from Key Stakeholders in Scotland's Wild Capture Fishing Sector

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## 1 Executive summary

Human activities are causing unprecedented rates of change to our climate, and the impacts of these changes are already apparent in Scottish waters. During the COP26 climate change summit in Glasgow, Marine Scotland launched a questionnaire to engage key stakeholders in the wild capture fishing sector on the subject of climate change. In total, 66 respondents participated, from a range of backgrounds although fishing industry representatives made up the majority of responses (59.1%). Results show strong engagement and recognition of the issues on the topic of climate change across all stakeholder groups. This included both topics relating to the emissions of greenhouse gases from the industry's activities and the need to adapt to the impacts of climate change. Key themes emerging relate to innovation in fuels, propulsion and gears to reduce greenhouse gas emissions, the shared responsibility across industry, government and research communities to support the sector, and the interaction between bottom-contacting fishing gears and natural carbon stores.

## 2 Introduction

Human activities are causing unprecedented rates of change to our climate (IPCC, 2021). The increased concentration of greenhouse gases (carbon dioxide, methane, nitrous oxide and others) in the atmosphere are also impacting the marine environment: the ocean has absorbed almost 90% of the additional heat since 1971 (von Schuckman et al., 2020), and takes up at least a quarter of the carbon dioxide emissions released to the atmosphere each year (Friedlingstein et al., 2022). This has caused ocean warming and ocean acidification (a reduction in the ocean's pH). Scotland's Marine Assessment, published in 2020, summarises the latest evidence

of the currently observed changes to the marine environment and how these may likely develop in future.

Scotland has recognised that there is currently a Climate Emergency, and it is now committed by law to reduce the country's greenhouse gas emissions to net zero by 2045. Wild capture fisheries are an important component of Scotland's marine economy. Fishing generated £329 million Gross Value Added in 2019 (0.22% of the overall Scottish economy, and 6.5% of the marine economy; Scottish Government, 2022). The fishing industry has an important part to play, alongside all sectors of our society, in reducing emissions and helping to create a low carbon economy with clean, green jobs. The transition to net zero will no doubt be challenging for the fishing sector, but also presents an opportunity to make a positive impact by adjusting practices, and growing Scottish businesses and supply chains in a sustainable way to create good, sustainable jobs.

Scotland's Fisheries Management Strategy 2020-2030 (FFM Strategy) sets out a vision for Scotland to be a world class fishing nation delivering responsible and sustainable fisheries management which provides access to a high protein, low carbon food. The FFM Strategy includes some proposed actions relating to climate change and commits to the development of an action plan in partnership with stakeholders specifically intended to help the sea fishing industry to deliver towards net zero targets. In November 2021, Marine Scotland launched a questionnaire to engage with key stakeholders in the wild capture fishing sector on the subject of climate change. This engagement included aspects of climate change mitigation (i.e., reducing the emissions of greenhouse gases to address climate change) and adaptation (i.e., living with the risks and opportunities due to climate change).

This document summarises the responses received which came from across the wild capture fishing industry, public sector, academia and Non-Government Organisations (NGOs).

## 3 Methods and data

Questions were designed to address the climate change actions listed in Scotland's Fisheries Management Strategy. Question topics included the estimation of greenhouse gas emissions, changes to behaviour, gear and deck machinery to reduce emissions, and the climate impacts on the sector.

The survey launched on 1 November 2021 to coincide with the 26$^{th}$ UNFCCC Conference of the Parties (COP26), and concluded at the end of December 2021.

The questionnaire was shared with key stakeholders through established email distribution lists, as well as through social media and other channels (e.g., Fishing News). Those key stakeholders who had not engaged throughout the period received further targeted emails to encourage participation.

In total, 66 responses were received. Respondents came from a range of backgrounds (e.g., skippers, producer organisations, fishing associations, processors, consultancy, NGO and research/academia; Figure 1a and Table 1). Most responses from outside the fishing industry did not identify with a specific fleet segment. Therefore, the fleet segmentation shown in Figure 1b and Table 2 is based only on respondents from the industry. Twelve respondents didn't identify with a particular fleet segment (i.e., selected 'Other'). These include a coalition (1), federations or membership bodies (7), fishers whose main gear was not listed (2), and fishers with interest in more than one of the listed gears (3).

For this analysis, the 12 categories in the original survey were grouped to six categories: fishing industry (i.e., vessel owner/skipper, producer's organisation, processor, fishing association, coalition), public sector (i.e., Scottish Government and non-departmental public bodies), research (i.e., academia and independent research organisation), NGO, consultancy and other (Table 1). The public sector view summarises the personal views of respondents (4) working in the public sector.

Responses have been calculated as a percentage of the total number of participants (i.e., a percentage of 66). Particular focus is also given to responses by those active in the fishing industry, and, therefore, for some questions, the responses of the industry representatives are shown as a percentage of the respondents in these categories (i.e., a percentage of 39).

Analysis of free text answers was semi-quantitative: the authors reviewed answers and created a summary of the main points per question, and for some questions a quantitative analysis of certain themes in the responses was conducted.

Given the relatively small total sample size (66 respondents) and due to the skew in respondent backgrounds (39 industry representatives, nine research, ten NGO, four public sector, two consultancy and two other; Figure 1 and Table 1) due care should be taken in the interpretation of the responses as they may not be representative to the wide range of stakeholders who make up the fishing sector or have an interest in the fishing sector.

# 4 Results

## 4.1 Links between climate change and Scotland's fishing sector (questions 1-3)

Survey results show widespread recognition of the linkages between the wild capture fisheries sector and the global climate emergency (Figure 2 and Table 3). This is both through the lens of climate change mitigation (i.e., the contribution of fishing activities to Scotland's greenhouse gas emissions; Figure 2 a & b) and of climate change adaptation (i.e., the impact of climate change on Scotland's fisheries; Figure 2c).

When considering the overarching questions on reducing greenhouse gas emissions in Scotland, and the potential role of the wild capture fishing sector in aiding this reduction, 74.2% of respondents chose "agree" or "strongly agree", 19.7% were undecided and the remaining 6.0% disagreed or strongly disagreed with the statement. There was a larger spread of opinion in the responses of public sector and fishing industry representatives (Figure 2a). When considering the urgent reduction of greenhouse gas emissions from fishing activity, agreement across all categories reduced to 66.7% and disagreement increased to 16.6% (i.e., shift in distribution between Figure 2a and b). This shift was most noticeable in the industry representatives.

While the impacts of climate change on fish and fisheries are becoming increasingly apparent, the opinion of respondents to the urgency was not unequivocal (Figure 2c). 69.7% of respondents agreed that urgent adaptation action is needed, while 16.7% disagreed and 13.6% were undecided.

## 4.2 Roles and responsibilities for action (questions 4-5)

Across all respondent categories, there is recognition of the shared responsibility of climate action between public sector and fishing industry (Figure 3 and Table 4). The share of responsibility in terms of greenhouse gas reductions (Figure 3a and Table 4) and resilience to climate change (Figure 3b and Table 4) were broadly the same. Respondents also identified a clear role for the retail sector. NGO and research representatives generally shared responsibility across societal actors (e.g., wider distribution across public sector, industry, consumer, and retail; Figure 3a and b). For reducing greenhouse gas emissions, suggestions of others that should be considered in sharing responsibility included processors, maritime industries (propulsion, engines, technology), catering companies, local authorities and

accreditation schemes. For building resilience in light of climate change, the suggestions included catering companies, local authorities and an adaptive loop between science and management. Given the small sample sizes across all sectors, it is difficult to give a confident assessment of whether any differences in views on responsibility are significant.

### 4.3 Estimation of greenhouse gas emissions (questions 6-8)

The majority of industry respondents (71.2%) do not currently estimate greenhouse gas emissions from their activity (Figure 4a and Table 5). This is not surprising given the complexity of such a calculation, and lack of knowledge on methodology and boundaries were highlighted as key barriers. Based on the free text responses, there is a general awareness of the emissions sources in the wild capture fishing sector.

When reviewing the free text responses, there was an obvious range in how respondents interpreted the “calculation of greenhouse gas emissions”. For example, some of the pelagic fleet responses refer to the recent study by Sandison et al. (2021) as their calculation method. Other responses included noting that their vessel is electric (implying no emissions calculation is needed) or that the estimate could be made from the fuel use if required.

There is a strong desire across all respondent categories (66.7% answered “yes”; Figure 4b and Table 5) to be given tools to calculate greenhouse gas emissions from the sector. The response from the industry alone is similar (61.5% answered “yes”; Figure 4b). Free text answers mention the need for consistent methodology and boundary setting, and the application of certain detailed methodologies to provide insight and advice (e.g., life cycle analysis). Those in academia, consultancy and public sector with expert knowledge expressed their willingness to advise and support the industry in the quantification of greenhouse gasses emissions.

Based on survey responses, there is no clear “pull” from retail or consumers for the sector to provide detail of the greenhouse gas emissions (74.2% answered “no”; Figure 4c and Table 5). Eight respondents thought that such information would soon be requested. A lack of knowledge, the lack of requirement for accreditation and the increased interest due to COP26 in Glasgow were highlighted by respondents.

### 4.4 Engagement (questions 9-10)

Stakeholders across the wild capture fishing sector in Scotland are willing to participate in workshops and projects to help support climate action (Questions 9

and 10; Figure 5 and Table 5). There appears a wider spread in engagement in certain fleet segments in the industry (under 10 m and demersal trawl and seine show an almost 50-50 split, not shown). However, respondent numbers are relatively low, so care should be taken to not generalise this to the entire fleet.

### 4.5 Alternative fuels and other innovation to reduce greenhouse gas emissions (questions 11-13)

Respondents give a clear indication that a shift across the wild capture fishing sector to lower greenhouse gas emission fuels would help the sector to reduce its emissions. There is strong support to consider the use of alternative fuels (other than marine diesel) with 77.3% agreement, although a fairly significant percentage don't know (19.7%; Question 11, Figure 6a and Table 6). Currently, just over half of the fishing industry representatives report that they have considered changing fuel, gear or behaviour to reduce greenhouse gas emissions (53.8%, Figure 6b), while one third reported having not made any changes to their practice (33.3%, Figure 6b).

When comparing responses to questions on changing fuel, fishing behaviour or gear to reduce greenhouse gas emissions, industry representatives show strong agreement on changing fuel (74.4% yes, 2.6% no and 23.1% don't know) and gear (79.5% yes, 7.7% no and 12.8% don't know), and lower agreement to behaviour change (56.4% yes, 28.2% no, 15.4% don't know). This pattern is also seen more generally when considering all respondent categories (Questions 11, 13 and 14, Table 6, Figures 6 and 7). Elaboration in free text suggests that changes in behaviour were considered misplaced as the industry already is efficient, or that this focus is generated from conflict over use of marine space, particularly between static and mobile gears.

48.5% of respondents mentioned hydrogen in their free text answer on which alternative fuels should be considered (Table 7). Other fuels which were mentioned by a large number of respondents were electric engines (19.7%), hybrid engines (16.7%) and biofuels (16.7%).

One of the greatest perceived barriers to adopting low carbon fuels is cost: 19.7% of respondents mentioned cost in general, while the cost of retrofitting was raised by a further 9.1% (Table 8). Other costs highlighted were the cost of fuels and the cost of replacement. Other significant barriers were the unproven nature of the technology (15.2%), the availability of alternative fuels in ports (15.2%), port infrastructure (12.1%) and safety (10.6%).

### 4.6 Gear innovation (questions 14-16)

Gear innovation was recognised by all respondents as one possible way to reduce greenhouse gas emissions from wild capture fishing, with 86.4% responding “yes” (Table 6 and Figure 7). Industry representatives showed lower agreement with the statement (79.5% “yes”). Innovation to reduce the impact on naturally occurring seabed carbon stores was also perceived as important (71.2% in agreement; Table 6), although again the responses from industry representatives is more distributed (61.6% yes, 15.4% no and 23.1% don’t know; Figure 7b). More details on interactions between fisheries and natural carbon stores will be presented in Section 5.2.

There is no clear response as to whether gear innovation is sufficiently accessible, and respondents appear to lean more towards “don’t know” (24.2% yes, 33.3% no, 42.4% don’t know; Table 6 and Figure 7c). In the industry representatives sector, there is also no clear agreement, although this sector appears to lean more towards “yes” (38.5% yes, 30.8% no, and 30.8% don’t know). Perceived barriers to gear innovation included a lack of coordination of innovation and trials, concern over the balance between innovation and viability of the business, and translation of trials into industry applications. Responses did suggest that gear innovation could have benefits for other drivers for change (e.g., environmental impact and bycatch reduction), and several respondents proposed a change from mobile to static gears.

### 4.7 Deck machinery and refrigeration (questions 17-18)

The role of modifications to deck machinery and refrigeration appear less of a priority in addressing greenhouse gas emissions (generally an equal spread across the three answers; Questions 17 and 18, Table 6 and Figure 8). Free text responses mentioned a need for improved understanding of refrigeration (six responses), a lack of knowledge (four responses), and that it is thought not significant (four responses) or not urgent (two responses). Solutions mentioned by respondents included the possibility of electrifying deck machinery and regenerating electricity from winches.

Almost half of industry representatives mention they have already made changes to reduce energy use (48.7% yes). The main changes were to the refrigerants in use, which could be due to changes in legislation to ban F gas in 2020 (The Ozone-Depleting Substances and Fluorinated Greenhouse Gases (Amendment etc.) (EU Exit) Regulations 2019).

### 4.8 Impacts of climate change and resilience (question 19)

Nearly half of respondents (48.5% yes; Question 19, Table 6 and Figure 9) mentioned that they are already observing changes due to climate change. These changes include increased storminess, migration of species, growth rate of species, seasonality of species, algal blooms, and increased lice in salmon farms. One diver noticed an increase in marine life after lockdown. One respondent also mentioned the need to move operations due to increased presence of cod. Although climate change may have played a role in changes to cod stocks, other factors such as fishing pressure and interspecies competition are also important. Recent increases in biomass have occurred despite a continued warming trend, and are more likely to be due to improved stock assessments, enhanced management measures, and better fishery compliance with these measures.

### 4.9 Other suggested climate action

In free text answers, respondents were asked to highlight other actions (for government, the fishing industry or others) that should be included in government considerations. Common themes in the responses were the consideration of Remote Electronic Monitoring (REM) or similar vessel monitoring (seven mentions), the provision of preferential access to marine space for low impact gears (six mentions), the consideration of blue carbon habitat impact (six mentions), the consideration of a three mile limit (five responses) and, related to this, a shift from mobile gears to static ones (two responses), and a ban of inshore trawling/dredging (two responses). Improved communication and collaboration across all parties (public sector, industry and science) were both mentioned in four responses.

## 5 Discussion

### 5.1 Recognition of the importance of climate change to Scottish fisheries

The survey results show a strong engagement of stakeholders in the wild capture fishing sector on the subject of climate change. There is a recognition of an imminent need to reduce greenhouse gas emissions from activities in the sector, but a view that costs and access to innovation could be major barriers. While there is a general view of the activities that are sources of greenhouse gas emissions, coherent quantification is lacking, and often based on approximation through effort, rather than from more specific measurements.

Respondents identified the adoption of alternative fuels or propulsion systems and changes to gears as those innovations which would (in their opinion) provide the clearest mechanisms to reducing greenhouse gas emissions from the sector.

### 5.2 Interaction between fisheries and blue carbon

Throughout the survey, there was repeated mention of the interaction between fisheries (esp. bottom contact gear) and disturbance of sedimentary and blue carbon, a clear “hot topic” for the sector. These mentions were not restricted to the specific question on the interaction of gear with natural carbon stores (Question 15; Table 6 and Figure 7b), and in the free text responses some view the interaction between fisheries and blue carbon as an opportunity for preferential access for low impact gears in such areas.

Opinions expressed in some responses suggest that the emissions due to disturbance of natural carbon stores were more significant than emissions of greenhouse gases due to fuel use. However, there was also general recognition that the amount of greenhouse gas emissions due to interaction with carbon stored in sediments and habitats was a significant knowledge gap. One response raised concern that the profile of fishing and disturbance of natural carbon stores is a response to headlines, and several others raised the need for measures to be founded on rigorous science.

The role of fish in sequestering carbon, and therefore disturbance to natural carbon stores by extraction of fish was also mentioned and recognised as an unknown in the debate.

### 5.3 Supporting innovation

Innovation, through changes in fuel, propulsion and gears, was seen as enabling greenhouse gas reductions from the wild capture sector. Respondents also raised some critical barriers to adopting such innovation in the industry, mainly over concerns of impacts on the business’s viability and the risk of backing the wrong solutions. Some suggestions to support the adoption of innovation by industry included suitable funding mechanisms (incl. indirectly through preferential access to quota or marine space), decommissioning programmes and trials or pilot schemes.

## 6 Conclusions

This document summarises the responses of wild capture fisheries stakeholders in Scotland to a survey conducted during COP26. In total, 66 respondents participated, from a range of backgrounds although industry representatives made up the majority of responses (59.1%).

There is strong engagement and recognition of the issues on the topic of climate change, including the emissions of greenhouse gases from the industry's activities and the need to adapt to the impacts of climate change.

Key themes emerging relate to innovation in fuels, propulsion and gears to reduce greenhouse gas emissions, the shared responsibility across industry, government and research communities to support the sector, and the interaction between bottom-contacting fishing gears and natural carbon stores.

## 7 Acknowledgements

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## 8 Author Contributions

BB: Conceptualisation, Data Curation, Formal Analysis, Investigation, Methodology, Visualisation, Writing – Original Draft Preparation; GB: Conceptualisation, Formal Analysis, Methodology, Writing – review & editing; OR: Conceptualisation, Formal Analysis, Methodology, Writing – review & editing; AA: Conceptualisation, Writing – review & editing; WRT: Conceptualisation, Writing – review & editing.

## 9 References

Friedlingstein, P., Jones, M. W., O'Sullivan, M., Andrew, R. M., Bakker, D. C. E., Hauck, J., Le Quéré, C., Peters, G. P., Peters, W., Pongratz, J., Sitch, S., Canadell, J. G., Ciais, P., Jackson, R. B., Alin, S. R., Anthoni, P., Bates, N. R., Becker, M., Bellouin, N., Bopp, L., Chau, T. T. T., Chevallier, F., Chini, L. P., Cronin, M., Currie, K. I., Decharme, B., Djeutchouang, L. M., Dou, X., Evans, W., Feely, R. A., Feng, L., Gasser, T., Gilfillan, D., Gkritzalis, T., Grassi, G., Gregor, L., Gruber, N., Gürses, Ö., Harris, I., Houghton, R. A., Hurtt, G. C., Iida, Y., Ilyina, T., Luijkx, I. T., Jain, A., Jones, S. D., Kato, E., Kennedy, D., Klein Goldewijk, K., Knauer, J., Korsbakken, J. I., Körtzinger, A., Landschützer, P., Lauvset, S. K., Lefèvre, N., Lienert, S., Liu, J., Marland, G., McGuire, P. C., Melton, J. R., Munro, D. R., Nabel, J. E. M. S., Nakaoka, S.-I., Niwa, Y., Ono, T., Pierrot, D., Poulter, B., Rehder, G., Resplandy, L., Robertson, E., Rödenbeck, C., Rosan, T. M., Schwinger, J., Schwingshackl, C., Séférian, R., Sutton, A. J., Sweeney, C., Tanhua, T., Tans, P. P., Tian, H., Tilbrook, B., Tubiello, F., van der Werf, G. R., Vuichard, N., Wada, C., Wanninkhof, R., Watson, A. J., Willis, D., Wiltshire, A. J., Yuan, W., Yue, C., Yue, X., Zaehle, S., and Zeng, J. (2022) Global Carbon Budget 2021, Earth Syst. Sci. Data, 14, 1917–2005, https://doi.org/10.5194/essd-14-1917-2022.

IPCC (2021) Summary for Policymakers. In: Climate Change 2021: The Physical Science Basis. Contribution of Working Group I to the Sixth Assessment Report of the Intergovernmental Panel on Climate Change [Masson-Delmotte, V., P. Zhai, A. Pirani, S.L. Connors, C. Péan, S. Berger, N. Caud, Y. Chen, L. Goldfarb, M.I. Gomis, M. Huang, K. Leitzell, E. Lonnoy, J.B.R. Matthews, T.K. Maycock, T. Waterfield, O. Yelekçi, R. Yu, and B. Zhou (eds.)]. Cambridge University Press, Cambridge, United Kingdom and New York, NY, USA, pp. 3−32, doi:10.1017/9781009157896.001

Sandison, Frances, Hillier, Jon, Hastings, Astley, Macdonald, Paul, Mouat, Beth, and Marshall, C. Tara (2021) The environmental impacts of pelagic fish caught by Scottish vessels, Fisheries Research, 236, 105850, https://doi.org/10.1016/j.fishres.2020.105850.

Scottish Government (2022) Scotland’s Marine Economic Statistics, https://www.gov.scot/publications/scotlands-marine-economic-statistics-2019/

von Schuckmann, K., Cheng, L., Palmer, M. D., Hansen, J., Tassone, C., Aich, V., Adusumilli, S., Beltrami, H., Boyer, T., Cuesta-Valero, F. J., Desbruyères, D., Domingues, C., García-García, A., Gentine, P., Gilson, J., Gorfer, M., Haimberger, L., Ishii, M., Johnson, G. C., Killick, R., King, B. A., Kirchengast, G., Kolodziejczyk,

N., Lyman, J., Marzeion, B., Mayer, M., Monier, M., Monselesan, D. P., Purkey, S., Roemmich, D., Schweiger, A., Seneviratne, S. I., Shepherd, A., Slater, D. A., Steiner, A. K., Straneo, F., Timmermans, M.-L., and Wijffels, S. E. (2020) Heat stored in the Earth system: where does the energy go?, Earth Syst. Sci. Data, 12, 2013–2041, https://doi.org/10.5194/essd-12-2013-2020.

## Table 1

Total number of respondents by categories as asked in the survey (i.e., original sector) and total number and percentage of their aggregation into sectors for this analysis (i.e., sector). See also Figure 1.

| Original Sector | N | Sector | N | % |
|---|---|---|---|---|
| Fishing association | 8 | Fishing Industry | 39 | 59.1 |
| Coalition | 1 | | | |
| Processor | 2 | | | |
| Producer's organisation | 2 | | | |
| Vessel owner/Skipper | 26 | | | |
| Government | 3 | Public sector | 4 | 6.1 |
| Non-Departmental Public Body | 1 | | | |
| Academia | 8 | Research | 9 | 13.6 |
| Independent Research Organisation | 1 | | | |
| Non-Governmental Organisation | 10 | Non-Governmental Organisation | 10 | 15.2 |
| Consultancy | 2 | Consultancy | 2 | 3.0 |
| Other | 2 | Other | 2 | 3.0 |
| Total | 66 | Total | 66 | 100.0 |

## Table 2

Total number and percentage of respondents from the fishing industry by fleet segment. See also Figure 1. More details on the choice of 'Other' are given in text.

| Fleet Segments | N | % |
|---|---|---|
| Pelagic | 3 | 4.6 |
| Demersal trawl & sein | 4 | 6.1 |
| Beam trawlers | 0 | 0.0 |
| Passive gears | 5 | 12.8 |
| Scallop dredgers | 2 | 5.1 |
| Nephrops | 7 | 17.9 |
| Under 10 m | 6 | 15.4 |
| Other | 12 | 30.8 |
| Total | 39 | 100.0 |

## Table 3

Summary of respondent answers to Questions 1 to 3 for all respondents See also Figure 2.

| Question Number | Question | Strongly disagree | Disagree | Undecided | Agree | Strongly agree |
|---|---|---|---|---|---|---|
| 1 | The Scottish fishing industry can help Scotland reduce its greenhouse gas emissions to net zero by 2045. | 3.0%‡ | 3.0%‡ | 19.7%‡ | 40.9%‡ | 33.3%‡ |
| 2 | The Scottish fishing industry must urgently work to reduce its greenhouse gas emissions. | 4.5% | 12.1% | 46.7% | 27.3% | 39.4% |
| 3 | The Scottish fishing industry must urgently work to adapt to changes in the sea (warming seas, reduced oxygen, ocean acidification and sea-level rise) caused by climate change. | 1.5% | 15.2% | 13.6% | 27.3% | 42.4% |

‡ due to rounding, the total is 99.9%

## Table 4

Summary of respondent answers to Questions 4 and 5 for all respondents See also Figure 3.

| Question Number | Question | Government | Fishing industry/ producer | Consumer | Retail Organisation | No opinion | Other |
|---|---|---|---|---|---|---|---|
| 4 | With whom or where should responsibility lie to ensure the Scottish fishing industry is reducing its contribution to greenhouse gas emissions? | 89.4% | 75.8% | 22.7% | 34.8% | 3.0% | 13.6% |
| 5 | With whom or where should responsibility lie to ensure the Scottish fishing industry is resilient to the impacts of climate change? | 93.9% | 81.8% | 24.2% | 36.4% | 4.5% | 4.5% |

## Table 5

Summary of respondent answers to Questions 6 to 10 for all respondents (ALL; sample size = 66), and for industry representatives (i.e., vessel owner/skipper, producer's organisation, processor, fishing association, coalition; FISH; sample size = 39). See also Figures 4 and 5.

| Question Number | Question | ALL Yes | ALL No | FISH Yes | FISH No |
|---|---|---|---|---|---|
| 6 | Do you estimate your greenhouse gas emissions from your fishing activity? This includes emissions from vessel operations, such as fuel usage and refrigeration. This could be your own fishing vessel, or could be in support of others (for example, if you are an academic researcher). | 28.8% | 71.2% | 25.6% | 74.4% |
| 7 | Would you like to be given methods/tools to measure your greenhouse gas emissions? | 66.7% | 33.3% | 61.5% | 38.5% |
| 8 | Have you been asked by customers / buyers / suppliers about your greenhouse gas emissions? | 25.8% | 74.2% | 17.9% | 82.1% |
| 9 | Would you be willing to participate in projects in collaboration with Marine Scotland, and others, designed to measure / reduce greenhouse gas emissions and to inform climate adaptation for the fishing sector? | 83.3% | 16.7% | 76.9% | 23.1% |
| 10 | Would you be interested in joining the stakeholder workshop led by Marine Scotland in early 2022 where the aim will be to establish a working group and a programme of work to inform climate change mitigation and adaptation in Scottish fishing? | 77.3% | 22.7% | 71.8% | 28.2% |

## Table 6

Summary of respondent answers to Questions 11 to 19 for all respondents, and for industry representatives (i.e., vessel owner/skipper, producer's organisation, processor, fishing association, coalition). See also Figures 7, 8 and 9.

| Question Number | Question | ALL Yes | ALL No | ALL I don't know | FISH Yes | FISH No | FISH I don't know |
|---|---|---|---|---|---|---|---|
| 11 | Should alternative fuels, other than marine diesel, be explored for Scottish fishing vessels? | 77.3% | 3.0% | 19.7% | 74.4%† | 2.6%† | 23.1%† |
| 12 | If you own/operate a fishing vessel, have you considered using alternative fuels / modifying your fishing method / modifying your fishing gear in order to reduce emissions? | 34.8%‡ | 30.3%‡ | 34.8%‡ | 53.8%‡ | 33.3%‡ | 12.8%‡ |
| 13 | Should Scottish fishing vessels consider alternative behaviours for fishing to reduce fuel use? Examples could include more seasonal effort, effort reductions or different spatial distribution of activity. | 68.2% | 21.2% | 10.6% | 56.4% | 28.2% | 15.4% |
| 14 | Should Scottish fishing vessels explore new fishing gear to reduce fuel use? Examples could be changes to doors, nets, and weights. | 86.4% | 4.5% | 9.1% | 79.5% | 7.7% | 12.8% |
| 15 | Should Scottish fishing vessels explore innovative fishing gear to reduce impacts on seabed habitats, especially those recognised for carbon uptake and storage (i.e. Blue Carbon)? | 71.2% | 9.1% | 19.7% | 61.5% | 15.4% | 23.1% |
| 16 | Is gear innovation sufficiently accessible to the fishing sector to enable uptake of these in their activity? | 24.2%‡ | 33.3%‡ | 42.4%‡ | 38.5%† | 30.8%† | 30.8%† |
| 17 | Is tackling inefficient deck machinery / ancillary machinery urgent in order to reduce emissions? | 36.4% | 28.8% | 34.8% | 38.5%† | 38.5%† | 23.1%† |
| 18 | Have you taken any measures already to reduce your energy use during fishing operations (for example, using refrigerants | 30.3% | 39.4% | 30.3% | 48.7% | 35.9% | 15.4% |

| Question Number | Question | ALL Yes | ALL No | ALL I don't know | FISH Yes | FISH No | FISH I don't know |
|---|---|---|---|---|---|---|---|
| | which have a lower environmental impact, or any other measures)? | | | | | | |
| 19 | Are you aware of any changes in the sea caused by climate change which the Scottish fishing industry has already had to adapt to (i.e. make changes to reduce the negative impact, or to benefit from emerging opportunities)? | 48.5% | 28.8% | 22.7% | 41.0% | 34.9% | 23.1% |

‡ due to rounding, the total is 99.9%

† due to rounding, the total is 100.1%

## Table 7

Summary of alternative fuels and propulsion systems mentioned by respondents in answer to the question “What alternative fuels should be considered?”

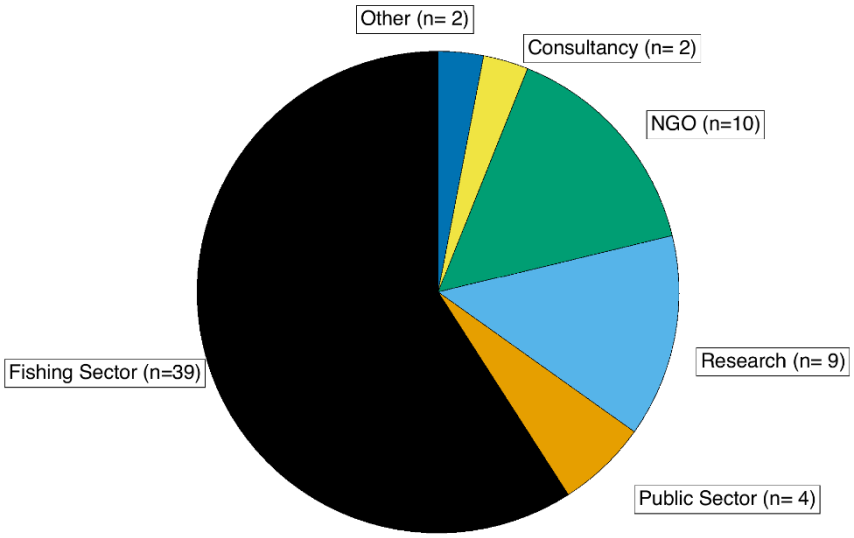
| Alternative Fuel/Engine | Response Number | Response Percentage |
|---|---|---|
| Hydrogen | 32 | 48.5% |
| Electric | 13 | 19.7% |
| Hybrid | 11 | 16.7% |
| Biofuels (including biodiesel, bio-alcohol) | 11 | 16.7% |
| Renewable | 3 | 4.5% |
| LNG (including hybrid) | 3 | 4.5% |
| Diesel Electric | 2 | 3.0% |
| Hybrid Diesel | 1 | 1.5% |
| Sail | 1 | 1.5% |
| Solar | 1 | 1.5% |
| Provided a response | 39 | 59.1% |
| No response | 27 | 40.9% |

## Table 8

Summary themes of perceived barriers mentioned by respondents in answer to the question “What are the main barriers to using alternative fuels?”

| Perceived Barrier | Response Number | Response Percentage |
|---|---|---|
| cost | 13 | 19.7% |
| bunkering | 10 | 15.2% |
| unproven technology | 10 | 15.2% |
| infrastructure | 8 | 12.1% |
| safety | 7 | 10.6% |
| cost of retrofit | 6 | 9.1% |
| change in attitude/behaviour | 5 | 7.6% |
| lack of viable alternatives | 5 | 7.6% |
| funding | 4 | 6.1% |
| lack of space | 3 | 4.5% |
| lack of expertise | 2 | 3.0% |
| Remoteness | 2 | 3.0% |
| incentive | 1 | 1.5% |
| compatibility with current | 1 | 1.5% |
| concern of viability | 1 | 1.5% |
| concerns on data collection | 1 | 1.5% |
| cost of fuel | 1 | 1.5% |
| cost of replacement | 1 | 1.5% |
| duty cycle impact | 1 | 1.5% |
| efficiency | 1 | 1.5% |
| finance | 1 | 1.5% |
| holistic view across supply chain | 1 | 1.5% |
| impact on profitability | 1 | 1.5% |
| just transition principles | 1 | 1.5% |
| lack of information | 1 | 1.5% |
| lack of investment | 1 | 1.5% |
| need to retrofit | 1 | 1.5% |
| practicality | 1 | 1.5% |
| vessel capacity | 1 | 1.5% |
| will be driven by engine manufacturers | 1 | 1.5% |
| Provided a response | 45 | 68.1% |
| No response | 21 | 31.8% |

(a) Survey respondents by category for all participants (n=66)




(b) Survey respondents fleet representation for fishing industry (n=39)

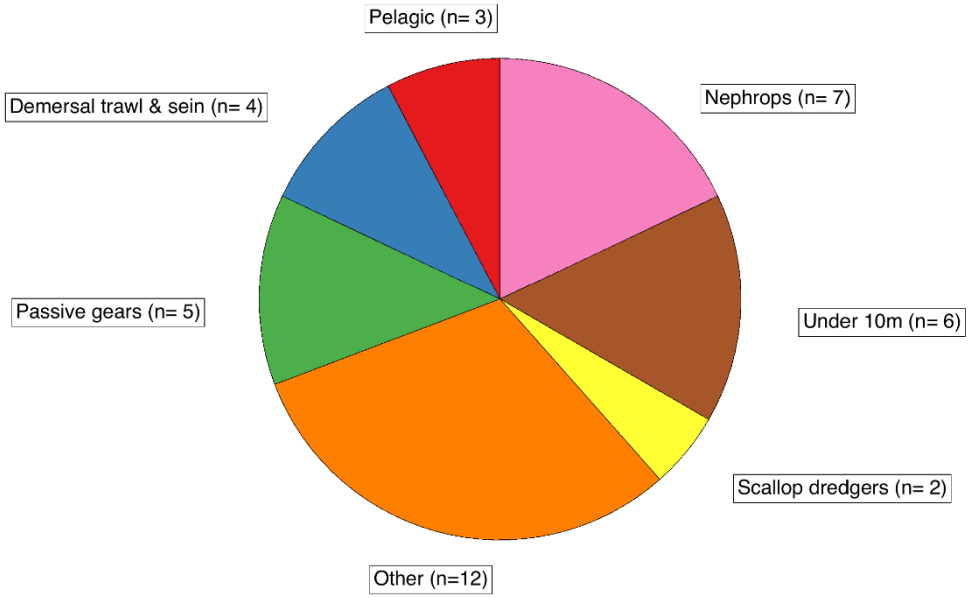



**Figure 1:** Overview of survey respondents (a) by category (all respondents), (b) by high-level fleet representation (fishing industry only). NGO = Non-Governmental Organisation; IRO = Independent Research Organisation; NDPB = non-departmental public body. Fleet representation is only shown for the fishing industry representatives. Further details on the respondents who chose 'Other' are given in text. See also Tables 1 and 2.

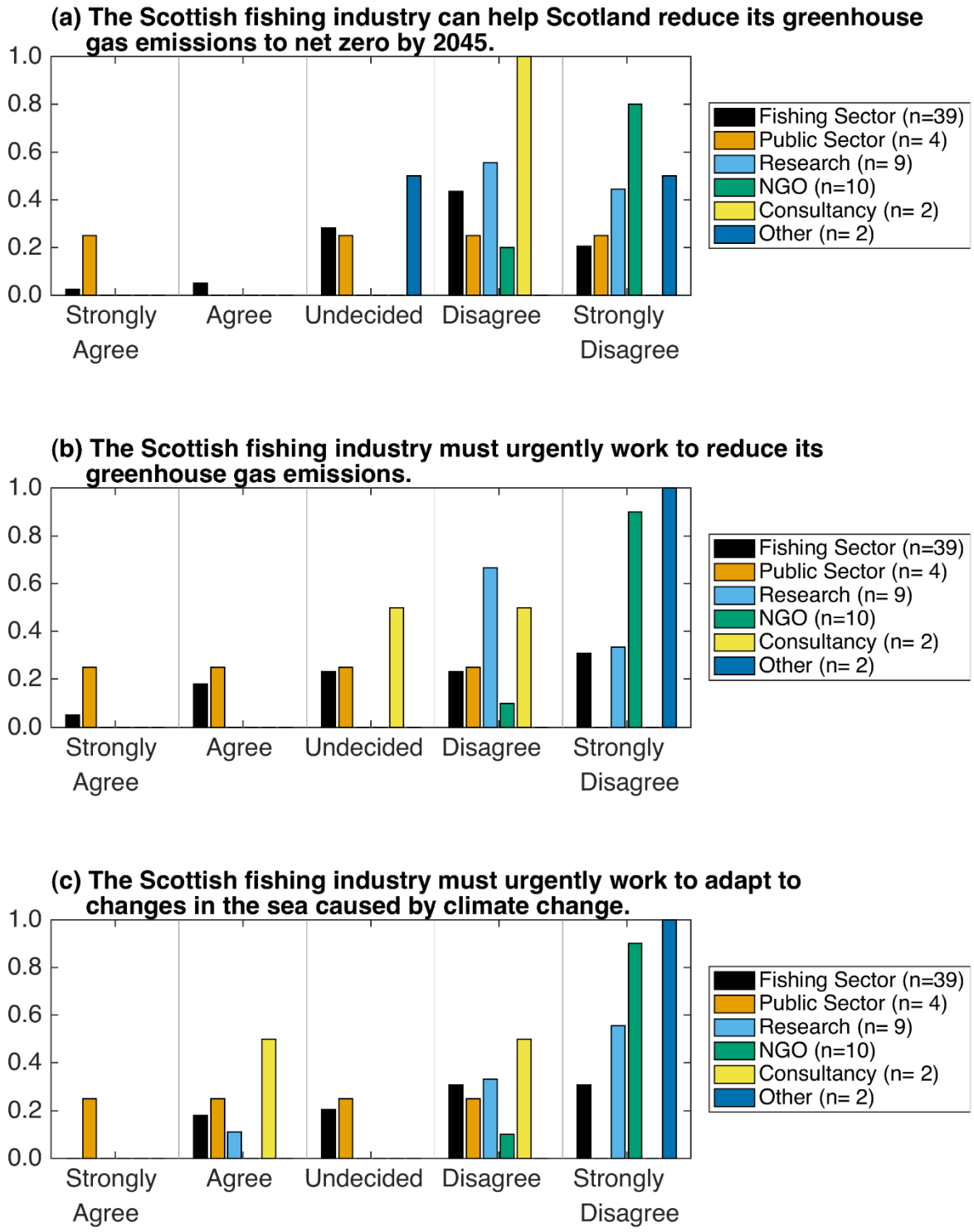



**Figure 2:** Bar chart of survey responses to Questions 1 to 3. See also Table 3. Answers are expressed as percentage of respondents in each sector. Number of respondents in each sector are shown in the legend (note these are not equal across sectors).

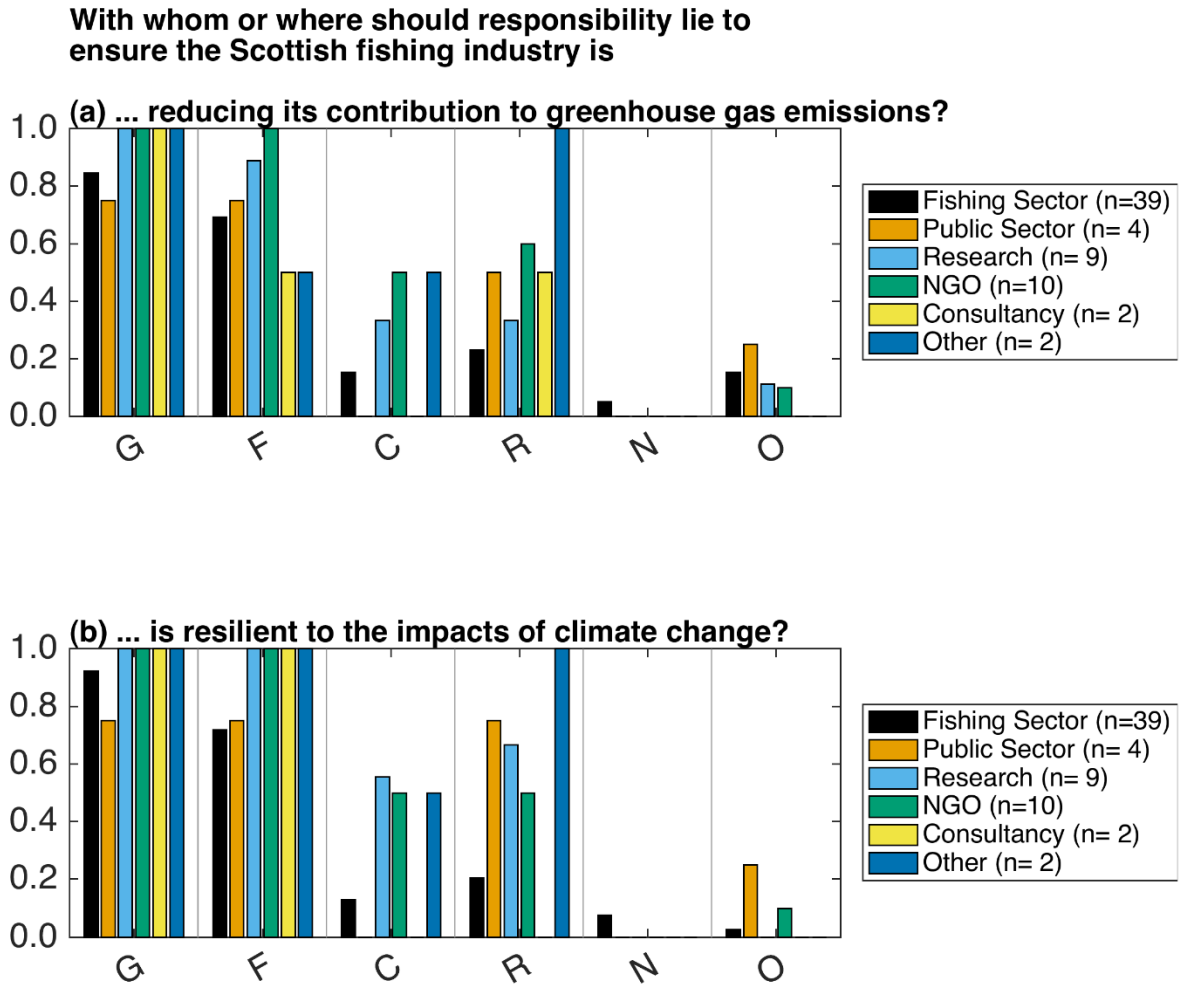



**Figure 3:** Bar chart of survey responses to Questions 4 to 5. See also Table 4. Answers are expressed as percentage of respondents in each sector. Number of respondents in each sector are shown in the legend (note these are not equal across sectors). G = Government; F = Fishing industry/producer; C = Consumer; R = Retail Organisation; N = No opinion; O = Other.

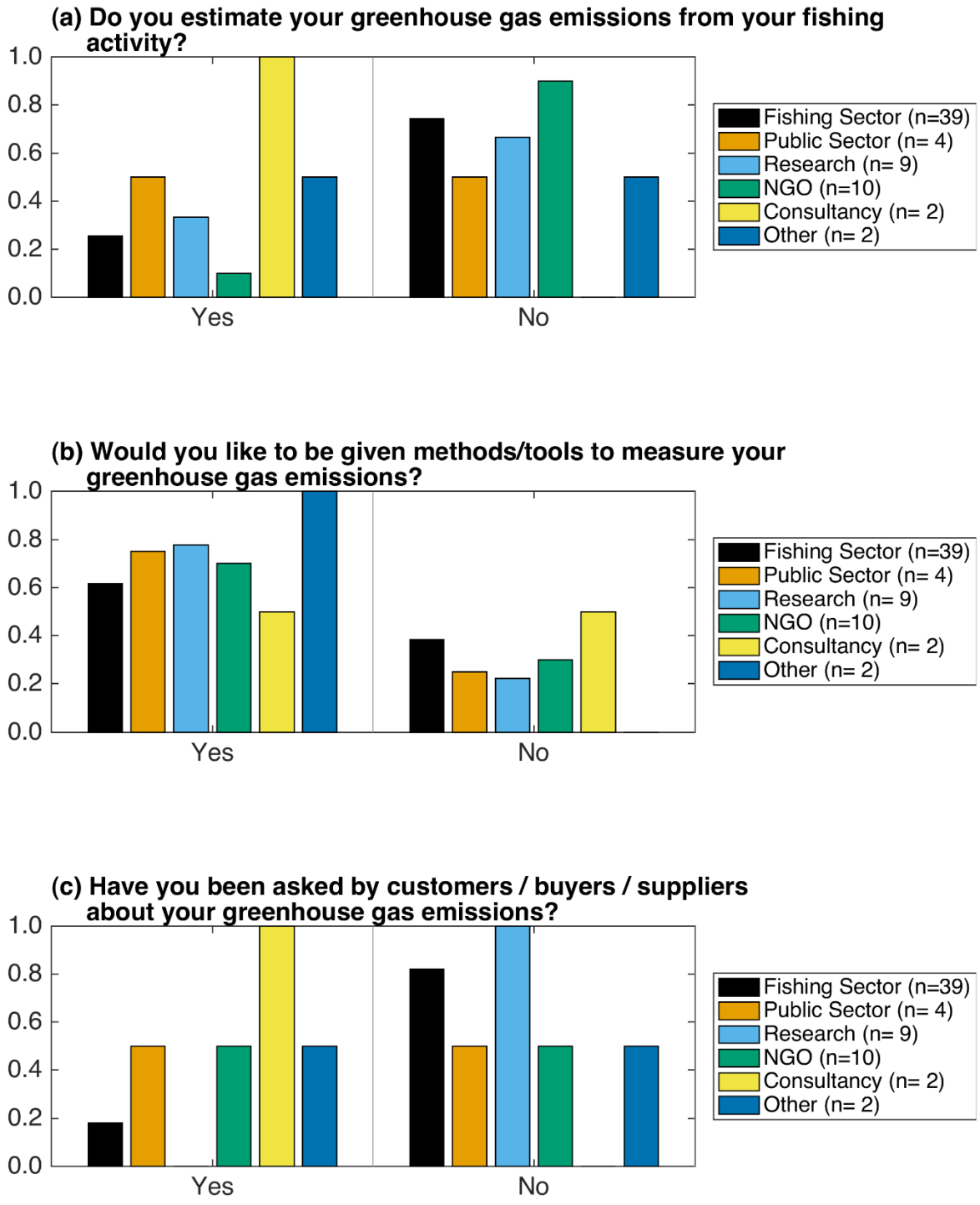



**Figure 4:** Bar chart of survey responses to Questions 6 to 8. See also Table 5. Answers are expressed as percentage of respondents in each sector. Number of respondents in each sector are shown in the legend (note these are not equal across sectors).

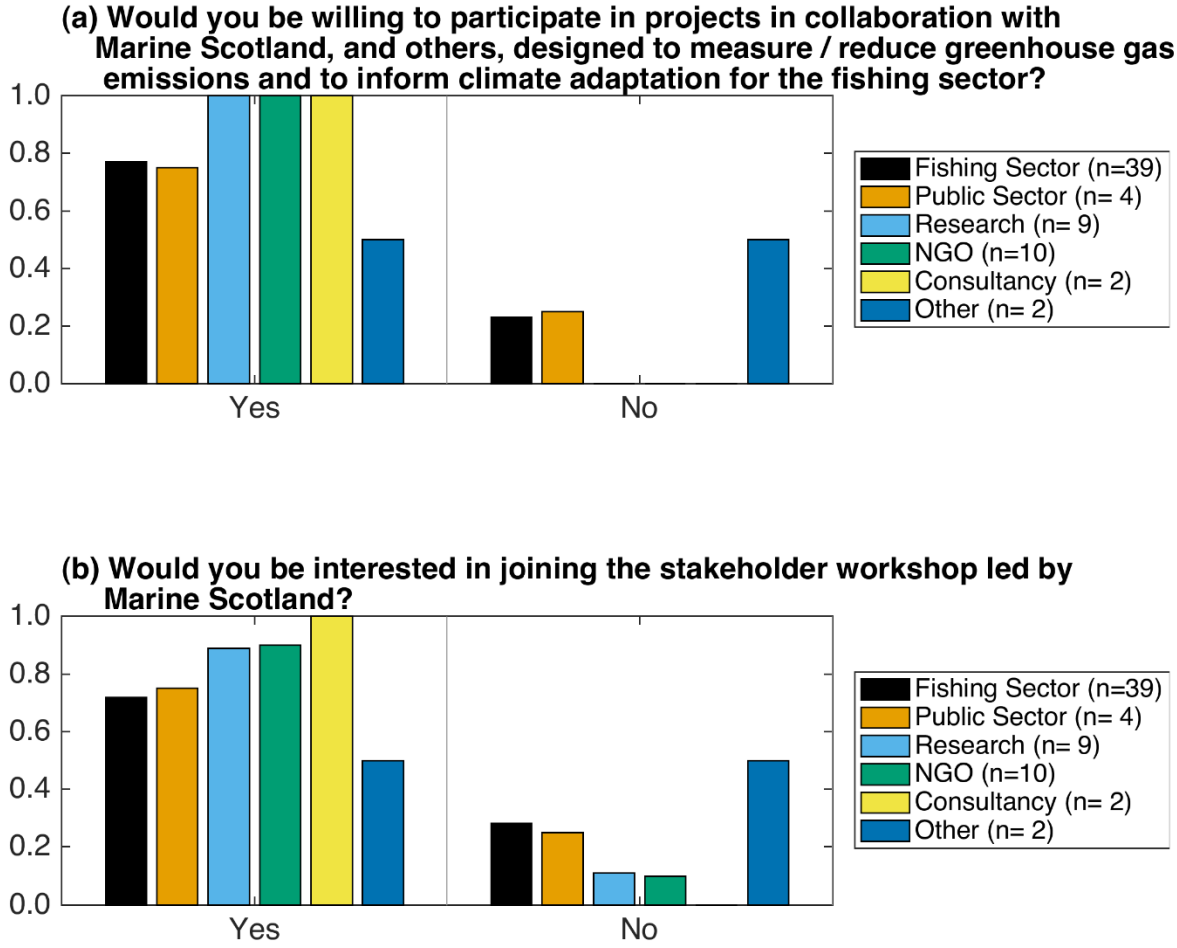



**Figure 5:** Bar chart of survey responses to Questions 9 and 10. See also Table 5. Answers are expressed as percentage of respondents in each sector. Number of respondents in each sector are shown in the legend (note these are not equal across sectors).

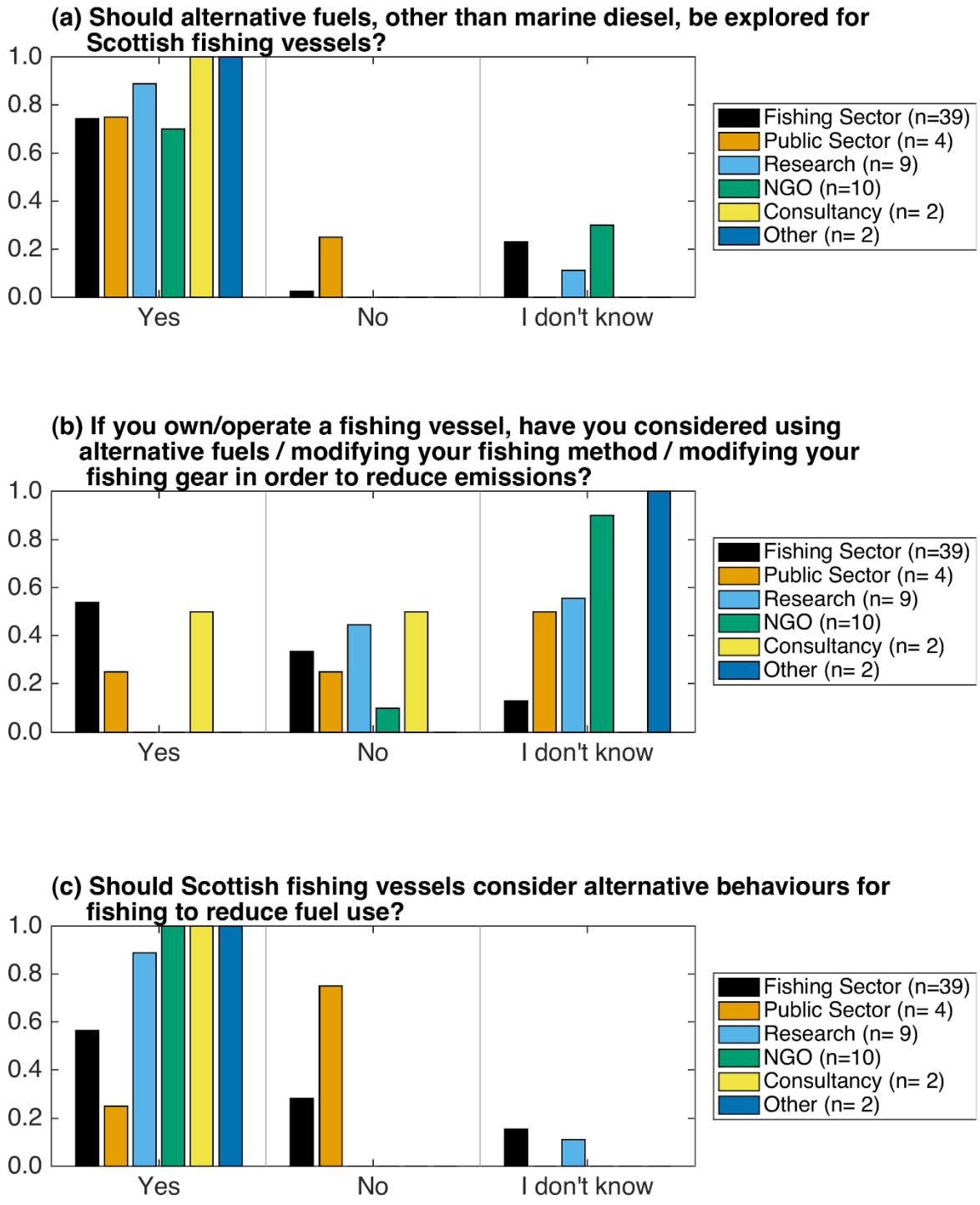



**Figure 6:** Bar chart of survey responses to Questions 11 to 13. See also Table 6. Answers are expressed as percentage of respondents in each sector. Number of respondents in each sector are shown in the legend (note these are not equal across sectors).

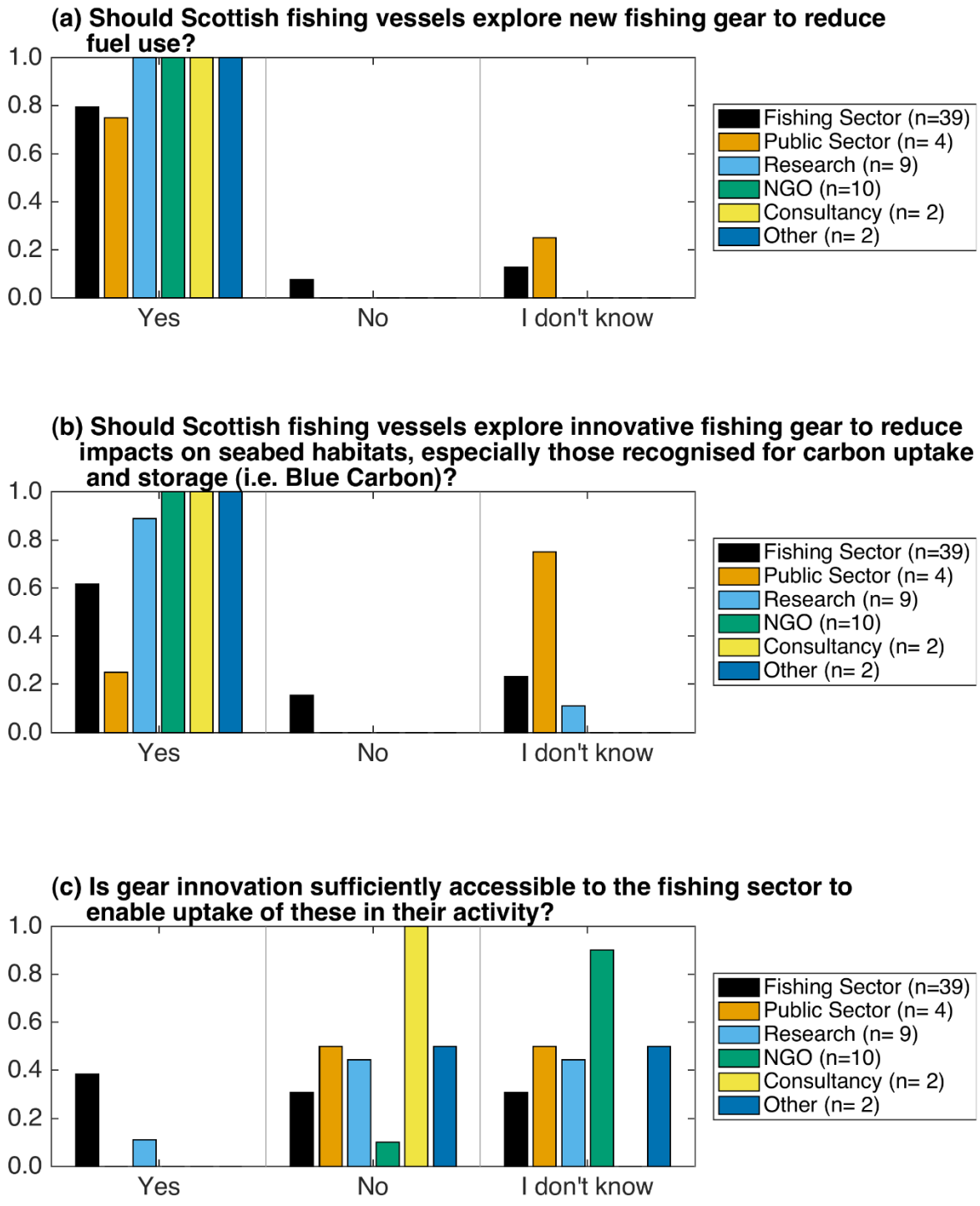



**Figure 7:** Bar chart of survey responses to Questions 14 to 16. See also Table 6. Answers are expressed as percentage of respondents in each sector. Number of respondents in each sector are shown in the legend (note these are not equal across sectors).

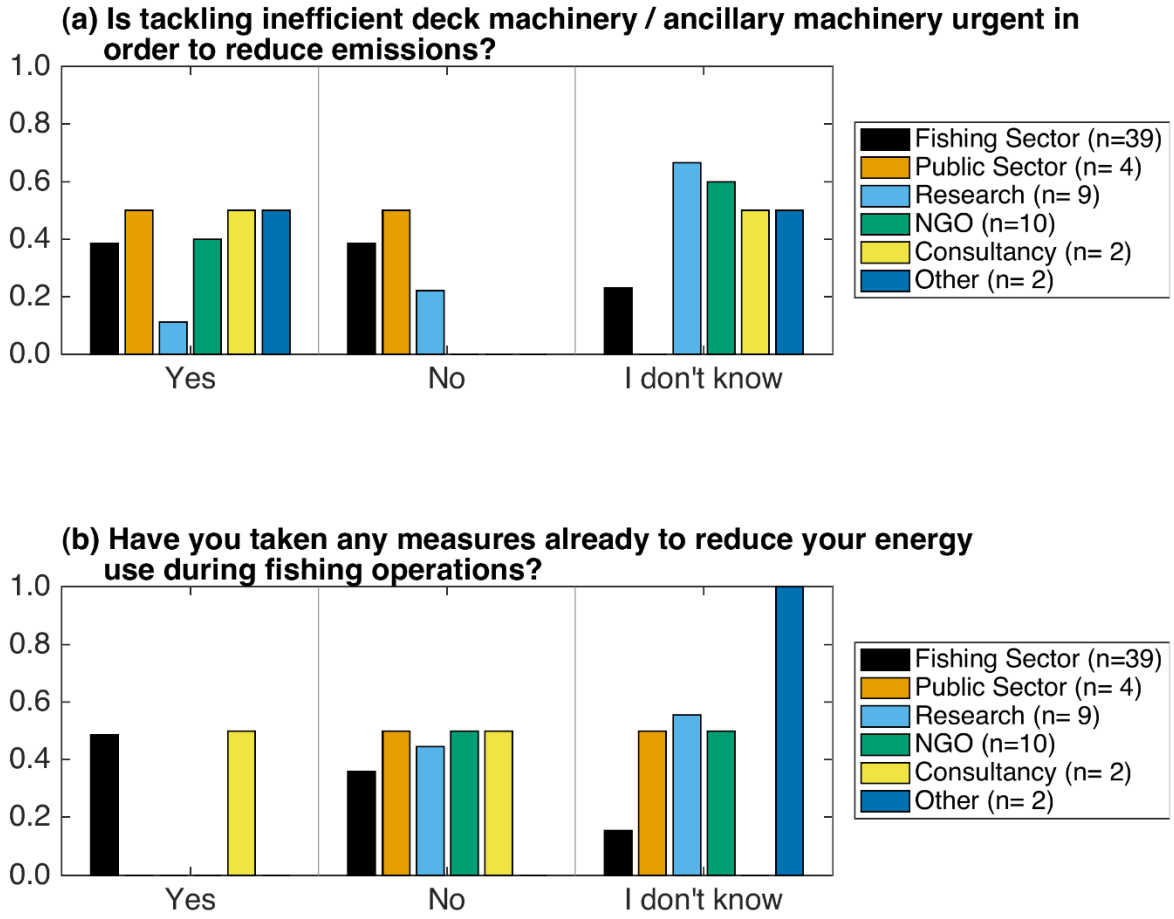



**Figure 8:** Bar chart of survey responses to Questions 17 and 18. See also Table 6. Answers are expressed as percentage of respondents in each sector. Number of respondents in each sector are shown in the legend (note these are not equal across sectors).

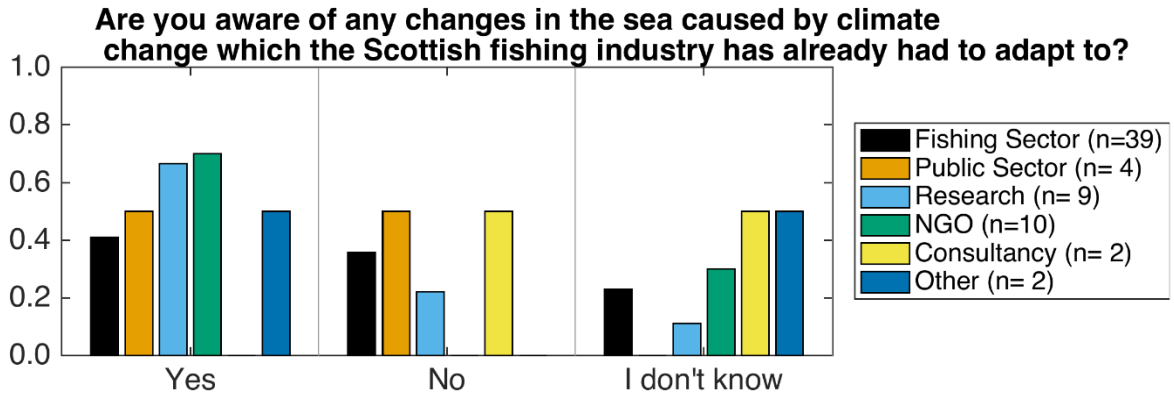



**Figure 9:** Bar chart of survey responses to Questions 19. See also Table 6. Answers are expressed as percentage of respondents in each sector. Number of respondents in each sector are shown in the legend (note these are not equal across sectors).

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