



Piloting a Regional Scale Ocean Literacy Survey in Fife

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Ocean Literacy (OL) encapsulates the journey of improved awareness of marine and coastal issues, to the adoption of clear values and attitudes based on that knowledge, and intentional lifestyle and other personal choices at an individual and societal level. Understanding a community or group's position in this transition enables institutions, such as universities, charities or civil society organisations, to target their public engagement efforts to make progress toward a healthier marine environment. To gather a baseline of OL in Fife, Scotland, an online survey was launched to residents of the Local Authority Area, between the 8th May and 30th June 2021. Responses indicated widespread uncertainty about solutions to marine and coastal problems, prompting the promotion of a solutions-based focus for public engagement efforts, particularly regarding local issues. While there was common agreement that the government, businesses and citizens could be doing more to advance the health of the marine environment and climate, only 55% of respondents had already made some changes to their lifestyles with the intention to continue at the point of survey. Some barriers evidently remain. Concern for the marine environment, climate and future generations largely govern the desire to alter behaviour to reap the desired benefits which include the enjoyment of nature, cultural heritage and aids to mental health. Taking a "nested approach" to OL surveying (regional surveys within a national framework) is likely to improve response rates and amplify the voices of rural and coastal communities. Furthermore, the OL surveying platform may opportunistically serve as a useful tool for investigating public priorities in the early stages of marine planning and policy development.

Keywords: Ocean Literacy, public awareness, behavioural change, climate-related behaviours, marine planning tools, Scotland

INTRODUCTION

Protecting and enabling recovery of ocean biodiversity and ecosystem functions has become a theme of global collaborations, epitomised by its inclusion in the United Nations 2030 Agenda for Sustainable Development. Sustainable Development Goal 14 strives for the sustainable use of marine resources and increased protection of coastal and marine spaces, with the UN Decade of Ocean Science for Sustainable Development (2021–2030) in place as a catalyst for progress. The first summary report of the "Ocean Decade" highlighted the need to communicate the benefits of a "Blue Economy," promote science as a tool for decision making and captivate audiences with ocean matters. The latter is cited as an essential component to the success of the ocean decade, which calls for an "Ocean Generation of informed citizens" (IOC-UNESCO, 2019). Indeed, Gelcich et al. (2014) revealed that the level of "informedness" regarding marine threats is closely linked to the level of public concern. This is the basis of Ocean Literacy (OL).

Ocean Literacy has previously been defined as “Understanding the ocean’s influence on you – and your influence on the ocean” (NOAA, 2020). This understanding enables effective communication of marine and coastal issues, while being informed helps to shift values, attitudes and ultimately behaviours and lifestyle choices. Brennan et al. (2019) identified six dimensions for OL consisting not only of knowledge, communication and behaviour, but also attitudes, awareness and activism. OL is inextricably linked with the idea of “Ocean Citizenship,” often a preferred term when engaging the public. This highlights connections between people and the ocean, recognising benefits gained from a healthy ocean and the consequences of our actions (individual and collectively) on marine and coastal spaces (Fletcher and Potts, 2007; Stoll-Kleemann, 2019). In effect, the concepts of OL and behavioural change have much in common, including climate-related behaviours as a priority area for practitioners. The relevance of climate-impacting behaviours that occur on land, in our homes and other places of work must not be overlooked within OL, and provide a valuable basis upon which to emphasise the connectedness of our lives with the ocean. The OL concept first arose in the early 2000s, to increase public support and engagement with ocean conservation through enhanced public awareness and knowledge (Steel et al., 2005). Public awareness and attitudes (or “social licence”), and consequently engagement, are also recognised as a driver for the creation and application of effective environmental policy. Notwithstanding the role of stakeholder consultations, a broader understanding of public perceptions and priorities should help align policy and government funding priorities with public values (Gelcich et al., 2014; Potts et al., 2016). As such, OL can be envisaged as a dichotomous process (**Figure 1**), whereby increased understanding and awareness helps drive (a) positive behavioural changes and (b) informed democratic process, as parallel but also synergistic outcomes that can together provide transformative change in society.

A 2016 European survey found that concern for the marine environment differed between countries, with broader environmental concerns such as pollution and food safety taking precedence (Potts et al., 2016). Earlier studies found substantial interest from the British public regarding marine and coastal threats and charismatic marine species but also highlighted insufficient availability of information and knowledge gaps (Fletcher et al., 2009; Jefferson et al., 2014). Similarly, Potts et al. (2016) identified a gap between public and scientific perceptions surrounding various marine issues. In 2020, the Marine Stewardship Council UK (MSC) published their findings from surveys administered to practising British teachers. Two-thirds reported concern that their pupils lack an understanding of anthropogenic impacts on marine and coastal environments (MSC, 2020). OL now extends beyond education by also recognising the role of science communication and public engagement, and insights from other disciplines, including the social sciences, arts and humanities. The Department for Environment, Food and Rural Affairs (DEFRA) launched their own survey of OL in England and Wales in February 2021, placing a focus on activism, communication and the link between OL and climate-related behaviours (DEFRA, 2021b).

Determining OL baselines will allow the mapping of progress toward more ocean literate populations. When restrictions on movement and research activities were enforced due to the SARS-CoV-2 Coronavirus (COVID-19) pandemic, an opportunity arose to reflect and reposition the University of St Andrews’ influence on the surrounding community in Fife, Scotland. As part of an interdisciplinary “Living lab” project, this OL survey of residents of the council area of Fife creates a snapshot for a localised Scottish demographic. Marrero et al. (2019) highlight the importance of a collaborative approach to OL by marine education networks. Once an understanding is established, as an institution, the university is better situated to engage with, and fill any OL knowledge gaps within Fife communities.

The Fife Local Authority area offers many interesting juxtapositions; for example, coastal versus inland residents and historic university towns contrasted with industrial root towns (Duffy and Stojanovic, 2018). Some livelihoods depend on the sea, namely inshore creel fishers, [$n = 148$ (Marine Scotland, 2019)] and Fife is also part of the wider Edinburgh commuter belt. There is a draw for its natural beauty and wildlife, with large seabird and seal colonies on the Isle of May, together with the golf facilities and attractions of St Andrews. There are many protected areas along its coastline including Sites of Special Scientific Interest (SSSIs), Special Protection Areas (SPAs), Special Areas of Conservation (SACs) and Ramsar sites, while the Fife Local Biodiversity Action Plan lists the raising of awareness and primary education on the sustainable use of marine and coastal resources amongst its priorities (Fife Biodiversity Partnership, 2013). This was the first study of its kind in Fife and provides a broad understanding of the perceptions, attitudes, and behaviours of survey respondents, also providing a platform for locals to voice their priorities and interests regarding the management of marine and coastal spaces around Fife. Like the DEFRA survey it was adapted from, this survey of Fife residents deliberately seeks to make the connection between OL and climate-related behaviours. If repeated, the survey can inform local scientists and policymakers of progress of OL, with potential for methodological refinement and application to other regions.

This survey also attempted a broad understanding of how COVID-19 has impacted personal appreciation of marine and coastal spaces in Fife and to possible changes in patterns of use or visits to the coast. A review by White et al. (2020) suggested a positive connection between human health/wellbeing and proximity to the coast, so it may follow that the enforcement of lockdowns and movement restrictions have played a role in impairing coastal visitations and subsequently mental health and wellbeing. Conversely, a study found that 54% of respondents subjected to lockdown restriction reported feeling solace or respite on account of visiting green or blue spaces (Astell-Burt and Feng, 2021). A separate survey of people for whom COVID-19 disrupted their routine coastal encounters, discovered a “solastalgia” amongst interviewees, defined as “an emotional distress caused by a changing environment” (Jellard and Bell, 2021). Rousseau and Deschacht (2020) also found an increased interest in nature and nature-related topics on account of the pandemic.

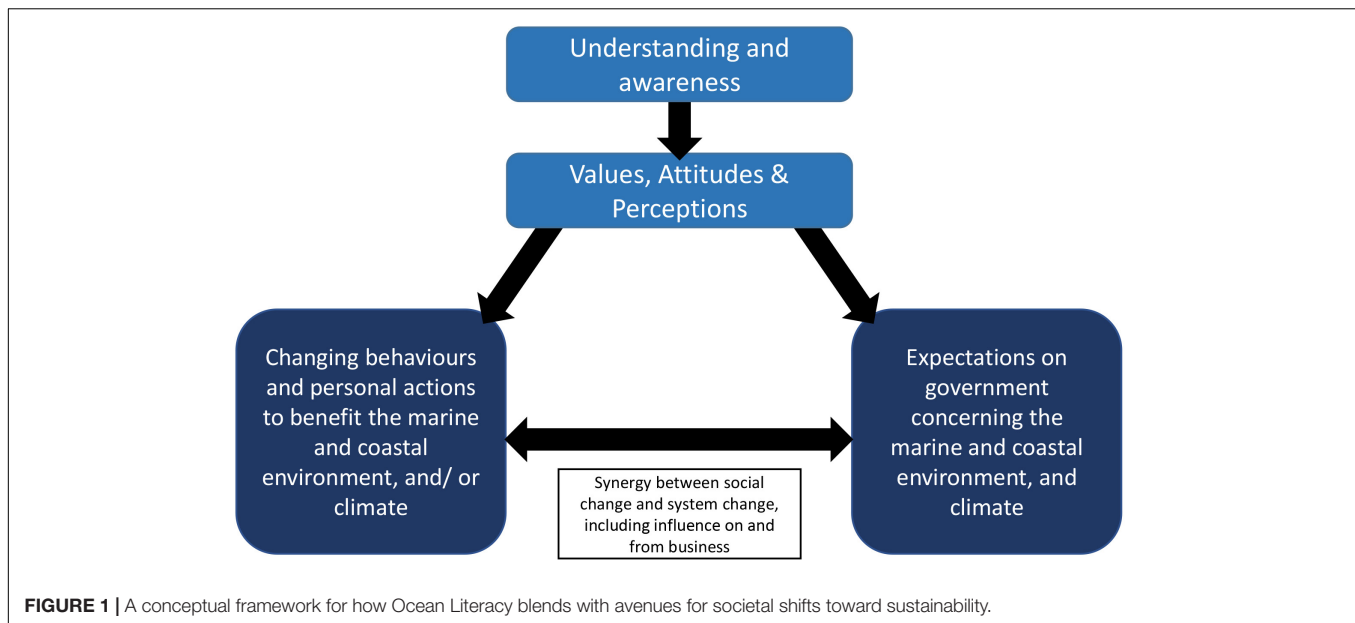


FIGURE 1 | A conceptual framework for how Ocean Literacy blends with avenues for societal shifts toward sustainability.

To evaluate OL in the Fife Local Authority area, a survey was designed and conducted to:

1. Achieve a snapshot of information on Fife residents regarding.
 - i. Perceptions of their own understanding and awareness of basic principles of ocean science and sustainability issues (impacts and solutions) and sources of knowledge.
 - ii. Their attitudes to these issues, including perceptions of responsibility for impacts and solutions.
 - iii. Their behaviours (actual and intended) exhibited to contribute to addressing these issues, including climate-related behaviours.
 - iv. Any emotional or experiential underpinning to awareness, attitudes or actions.
2. Understand what is important to Fife communities regarding a future vision of the Fife marine and coastal environment, its uses and benefits to society.
3. Begin to explore how COVID-19 has impacted Fife communities in terms of their visitations and appreciation of local marine and coastal spaces.

A supplementary objective includes exploring the potential for a regional (council-area) approach to evaluating OL.

MATERIALS AND METHODS

Target Audience

An online survey targeted people in Fife aged 16 years and over, from all electoral wards across the local authority area. Eligibility required either residency or temporary residency (e.g., students) in Fife and/or owning property in the region. The aim was to,

as far as possible with the time and resources available, reach as broad an audience as possible within the council area.

Survey Design

The survey design consisted of 21 topical questions covering OL themes including knowledge and awareness of threats and solutions both locally and globally, and behaviours both toward the marine environment and climate. Also included were questions examining feelings toward marine and coastal spaces, including in light of COVID-19. A further five questions focussed on the demographic of the individual including age bracket, sex at birth, level of qualification, the electoral ward in which they live and whether they or an immediate family member have ever studied or worked in the environment sector. Largely for reasons of data ethics, information on more personal and specific demographic characteristics were not collected, although this presented subsequent limitations in the analysis (see section Biases and Limitations). No prior guidance on wording or terminology was created, so steps were taken to keep language simple and neutral. Consequently, questions were interpreted based on the innate knowledge and perceptions of the respondent at the time of surveying. The question types presented were a mixture of multiple-choice, Likert scale and ordered category items, with the option for elaboration in open-ended text questions and were designed to be completed in 15 min or less. Where possible, statements given within multiple-choice questions were randomised. The online survey platform Qualtrics^{XM} software version 04:07/2021 (Qualtrics, 2005) was used to build the survey. A draft survey was tested and critiqued by academics at the University of St Andrews and several laypersons, with their comments addressed before distribution.

Survey Distribution

The survey was distributed between the 8th May and the 30th June 2021 (54 days) and accessed through a shareable web link

or QR code. All participants were supplied with a Participant Information Sheet and required to give their consent for their data to be recorded. Participation was incentivised with an opt-in prize draw for one of two £50 gift vouchers.

Response rates are typically stronger with a mix of distribution methods, therefore, various distribution techniques were undertaken (Wallen et al., 2016). This included distributing flyers with a QR code in public spaces, posting on social media sites (Twitter, Facebook, and Instagram), emailing various contacts and organisations with access to community groups, advertising in local newsletters and some word of mouth. In total, 201 individuals, community groups and organisations were contacted to enlist their help with distribution. Facebook was the predominant means of social media distribution, allowing targeting of local community groups and pages; investing in “sponsored” posts to boost promotion was ruled out due to budget constraints. The option was also given to complete the survey via a telephone/video call interview, but with only very limited take-up. Paper-based surveys were not included due to budgetary constraints on researcher time, printing and postage. All data was stored confidentially under United Kingdom General Data Protection Regulations (GDPR). Ethical approval was granted by the School of Biology Ethics Committee acting on behalf of the University Teaching and Research Ethics Committee (UTREC) (Approval Code: BL15446).

Survey Analysis

Survey analysis was completed using RStudio Version 3.6.1 (2019-07-05) “Action of the toes” (R Core Team, 2019) and Microsoft Excel Version 2106 (Build 14131.20278). Partially completed surveys (<70% complete) were removed from the analysis. From summary statistics, each question was analysed by selected demographic groupings. For each question by each grouping, a count and percentage were calculated using Microsoft Excel. Chi-squared tests and Fisher’s Exact tests were used to determine if there were any significant associations between statements and responses for Likert scale and ordered-category items. Full methodological details are available from Spoors et al. (2021)¹.

RESULTS

Responses

The online survey was opened 459 times, yielding 331 usable responses (quantified as > = 70% complete). All n-numbers given show the number of respondents that answered that question in full). Survey distribution support was received from 26 different individuals, community groups and organisations. Facebook posts were added to 28 community pages with the potential to have reached approximately 45,000 members of the community. Although with considerable overall variability and very low numbers in some areas, responses came from every electoral ward within the Local Authority area.

TABLE 1 | Demographic characteristics of survey respondents ($n = 331$), showing the characteristic groupings analysed in the survey.

Demographic characteristics	Demographic characteristic groupings	Response count per group	Percentage per group (%)
Age (Years)	16–34	59	17.82
	35–44	57	17.22
	45–54	69	20.85
	55–64	78	23.56
	65+	61	18.43
	NA	7	2.11
Sex	Female	231	69.79
	Male	90	27.19
	NA	9	2.72
	Prefer not to say	1	0.30
Educational attainment	Higher Education	270	81.57
	Secondary Education	46	13.90
	No formals qualifications	5	1.51
	NA	10	3.02
Environment sector background?	Yes	104	31.42
	No	219	66.16
	Prefer not to say	2	0.60
	NA	6	1.81

The demographic characteristics of the respondents were identified; data were subsequently grouped to account for differences in sex, educational attainment, age and whether the participant (or an immediate family member) had studied or worked in the environment sector (Table 1). The decision was made not to observe the inter-electoral ward differences due to the small number of responses from several wards and the variable intra-ward deprivation indices, as indicated by the Scottish Index of Multiple Deprivation².

Survey Outcomes

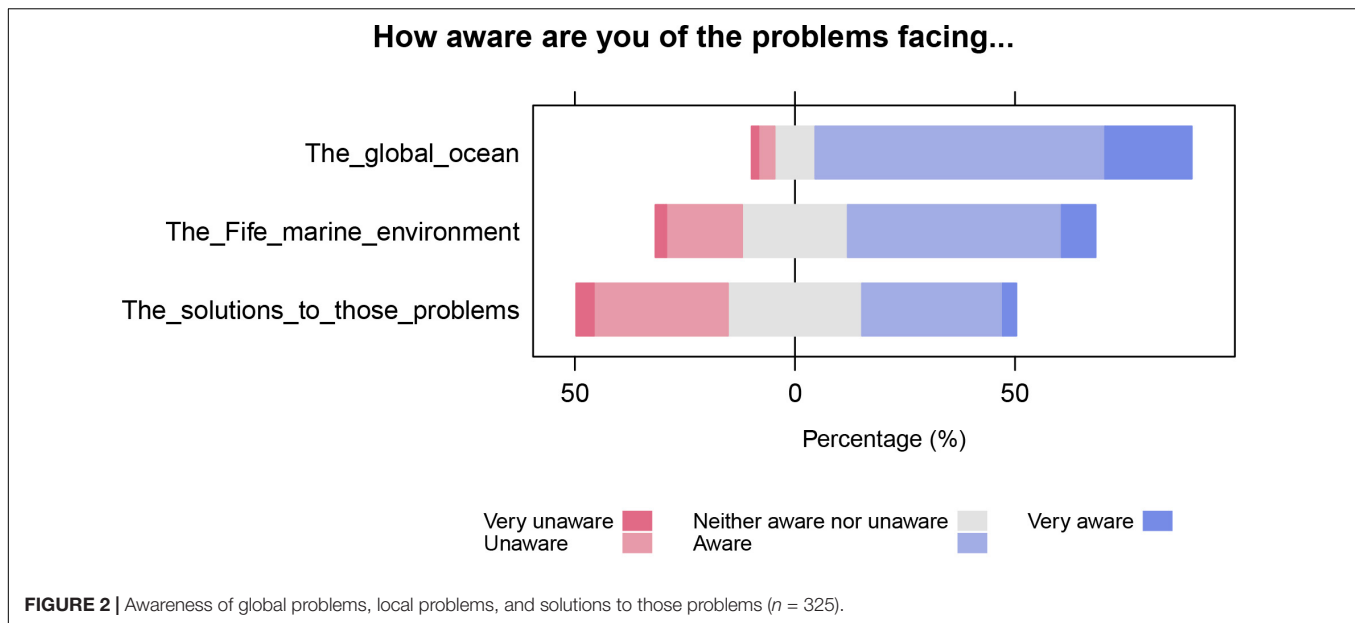
Knowledge and Understanding of Threats and Solutions

The majority (47%) ($n = 329$) believed the health of the marine and coastal environment in Fife to be good, 19% believed that it was neither good nor poor and 12% believed it to be very good. Female respondents showed more uncertainty than male respondents in rating the health of the local marine and coastal environment with 12% of female respondents answering “don’t know” compared to 2% of male respondents. For young people aged 16–34 years, 69% thought the health of the Fife local marine and coastal environment was good or very good compared to 49% of those aged 65 years+.

Chi-squared testing reveals a significant relationship between perceived awareness and the statements relating to issues and solutions (Pearson’s Chi-squared test: $\chi^2 = 193.24$, $df = 8$, $p < 0.001$, $n = 325$) (Figure 2). Respondents felt more awareness for global issues facing the marine and coastal environment than they did for the local environment. Regarding awareness of solutions, as many people perceived themselves as having

¹<https://research-repository.st-andrews.ac.uk/handle/10023/23981>

²<https://simd.scot>



poor awareness as those that perceived themselves as having a good awareness. In total, 85% of respondents felt aware or very aware of the problems facing the global marine and coastal environment, 55% felt aware or very aware of the problems facing the Fife marine and coastal environment and 34% of respondents felt aware or very aware of the solutions. Those of an environmental sector background felt more aware of local issues and solutions. Young people are the most likely to feel very aware of global issues.

Marine litter and plastics were the most commonly identified local threat with 90% of respondents choosing it as one of their top five responses, followed by 60% of respondents selecting climate change ($n = 329$) (Figure 3). For those that selected “other,” threats listed included sewage disposal into the marine environment and urban expansion, with some voicing that they wished they could have ticked all options.

News articles are the primary source of knowledge for Fife residents with 67% of respondents selecting it as one of their top five, followed by wildlife and natural history documentaries, selected by 58% of respondents ($n = 331$). First-hand experience was as important as social media for learning about marine and coastal environments.

In total, 86% of respondents believe scientific knowledge to be very important for guiding us toward healthier seas. Of the 330 respondents, one (0.3%) believed science to be unimportant and a further four (1.21%) believed science to be neither important nor unimportant. There was no clear demographic pattern associated with these beliefs.

In total, 59% ($n = 330$) of respondents believed that “the climate is changing relatively quickly as a result of human activity,” a further 40% believed that “the climate is changing relatively quickly due to a combination of human activity and natural processes.” In terms of sex, 61% of female respondents attributed a rapidly changing climate to human activity and 38% to a combination of human activity and natural processes,

whereas 50% of male respondents attributed a rapidly changing climate to human activity and 48% to a combination of human activity and natural processes. For those with an environment sector background, 69% attributed the relatively quick changes in climate to human activity and 31% attributed it to human activity and natural processes, compared to those that have not, for whom 54% believed that a rapidly changing climate is attributed to human activity and 44% to a combination of human activity and natural processes.

Attitudes and Perceptions of Responsibility

Survey results revealed significant interest in learning more about the global ocean and local marine and coastal environments (Fisher’s Exact test: $p < 0.001$, $n = 326$). There was more interest in learning about the local marine and coastal environment in Fife than there was for the global environment. Young people are more interested in learning more about the global marine and coastal environment with 41% of those aged 16–34 selecting “5” (very interested) compared to 25% of those aged 65 years+.

There was a significant consensus that individuals, governments and businesses all have responsibility for delivering solutions and should be doing more to that end (Fisher’s exact test with simulated p -value based on 2000 replicates: $p < 0.001$, $n = 251$). Whilst the majority selected “agree” or “strongly agree” for all statements provided, the emphasis, however, was for government and business rather than the individual to do more. There was a relatively high number of non-responses (blanks), increasing in proportion as age increases. This may have been a result of the question wording or format. This question and others that encountered a similar issue were formatted as a “carousel” of auto-advancing statements with a multiple-choice style Likert scale beneath. It appears that some respondents may not have noticed the statements auto-advancing and scrolled onto the next question prematurely (see section “Biases and Limitations”).

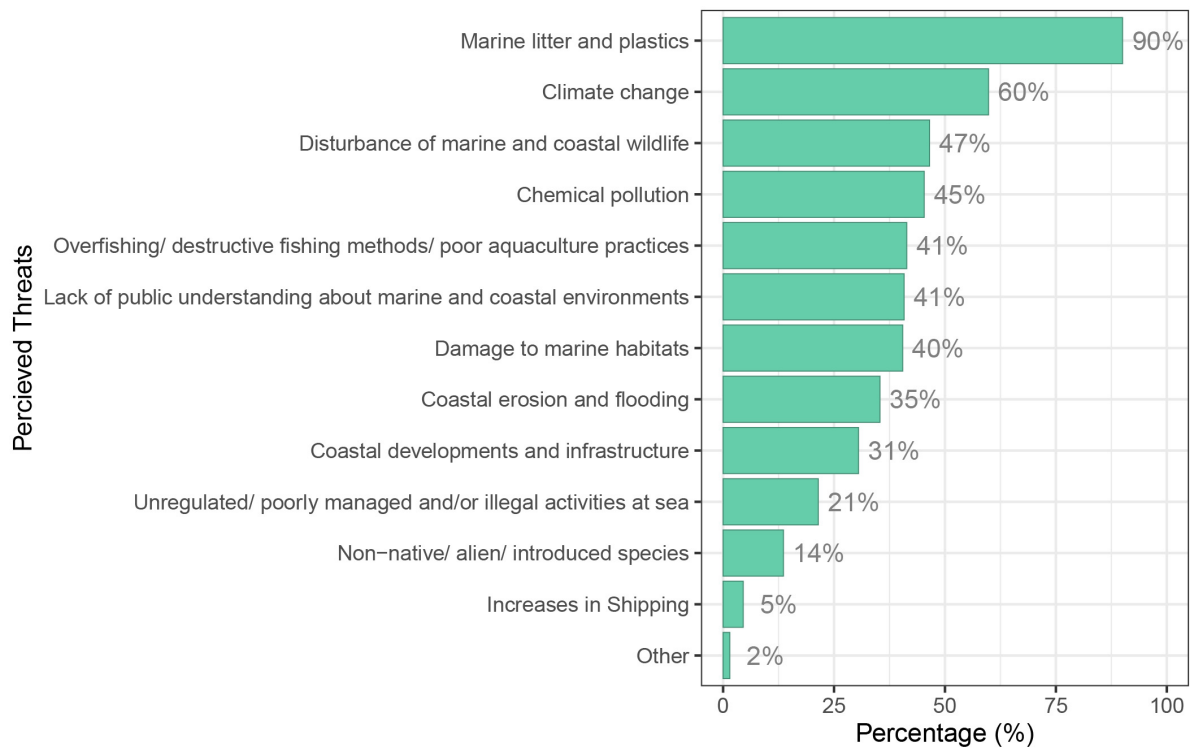


FIGURE 3 | Commonly perceived threats to the Fife marine and coastal environment ($n = 329$).

There was a significant consensus over business-based solutions and their perceived importance (Fisher's Exact test with simulated p -value based on 2,000 replicates: $p < 0.001$, $n = 281$). Respondents found all actions proposed for businesses to be important, including investing in sustainable technologies, investing in nature and conservation, transparency of supply chains and commitment to being carbon neutral. Of these business-based actions, 86% of respondents believed that it was very important for businesses to act responsibly when working in the marine environment to minimise their impacts and 86% also believed it very important to increase the efficiency of resource use and reduce waste.

There was a significant consensus over government-based solutions and perceived importance (Fisher's exact test with simulated p -value based on 2,000 replicates: $p < 0.001$, $n = 289$). All proposed government actions were deemed important including the transformation of the food, energy, transport and finance systems, educating society, the creation of marine protected areas (MPAs) and adopting and enforcing regulations. The latter was deemed the highest priority with 85% of respondents selecting "very important."

Behavioural Responses

Chi-squared testing revealed a significant association between the possible actions and whether respondents had taken (or wanted to take) those actions (Pearson's Chi-squared test: $\chi^2 = 676.68$, $df = 16$, $p < 0.001$, $n = 273$) (Figure 4). The most commonly taken actions included avoiding wildlife disturbance,

reducing consumerism and waste, and broader lifestyle changes to reduce their carbon footprint (78, 70, and 67%, respectively). In total, 62% of respondents would like to vote for strong marine environmental protection policies, 40% would like to contact their local politician or sign petitions concerning the marine and coastal environment and 40% would like to make ethical investments and savings. However, 23% are uninterested in talking to others or sharing online, 21% are uninterested in ethical investments and savings, and 19% are uninterested in contacting local politicians or signing petitions. Of those with an environment sector background, 48% have spoken to others or shared online about supporting the marine and coastal environment, compared to 31% of those who have not. The percentages of respondents that have actively engaged in these actions are consistently greater amongst those with higher education qualifications. There was a relatively high percentage of blanks, possibly a legacy of the question format or wording.

Concern primarily governed the intention to make personal lifestyle changes with 74% ($n = 330$) feeling concerned about the marine environment, 71% feeling concerned by climate change and 62% feeling worried about future generations. Wanting to contribute more (selected by 63%) was also a driver for changing lifestyles. The main inhibition to behavioural change was a lack of knowledge concerning the extent of solutions (selected by 23% of respondents) (Figure 5). For those that selected "other," the reasons that might prompt lifestyle change were "making a difference through togetherness" and "limited time to act." For those that selected "other," the reasons that might hinder

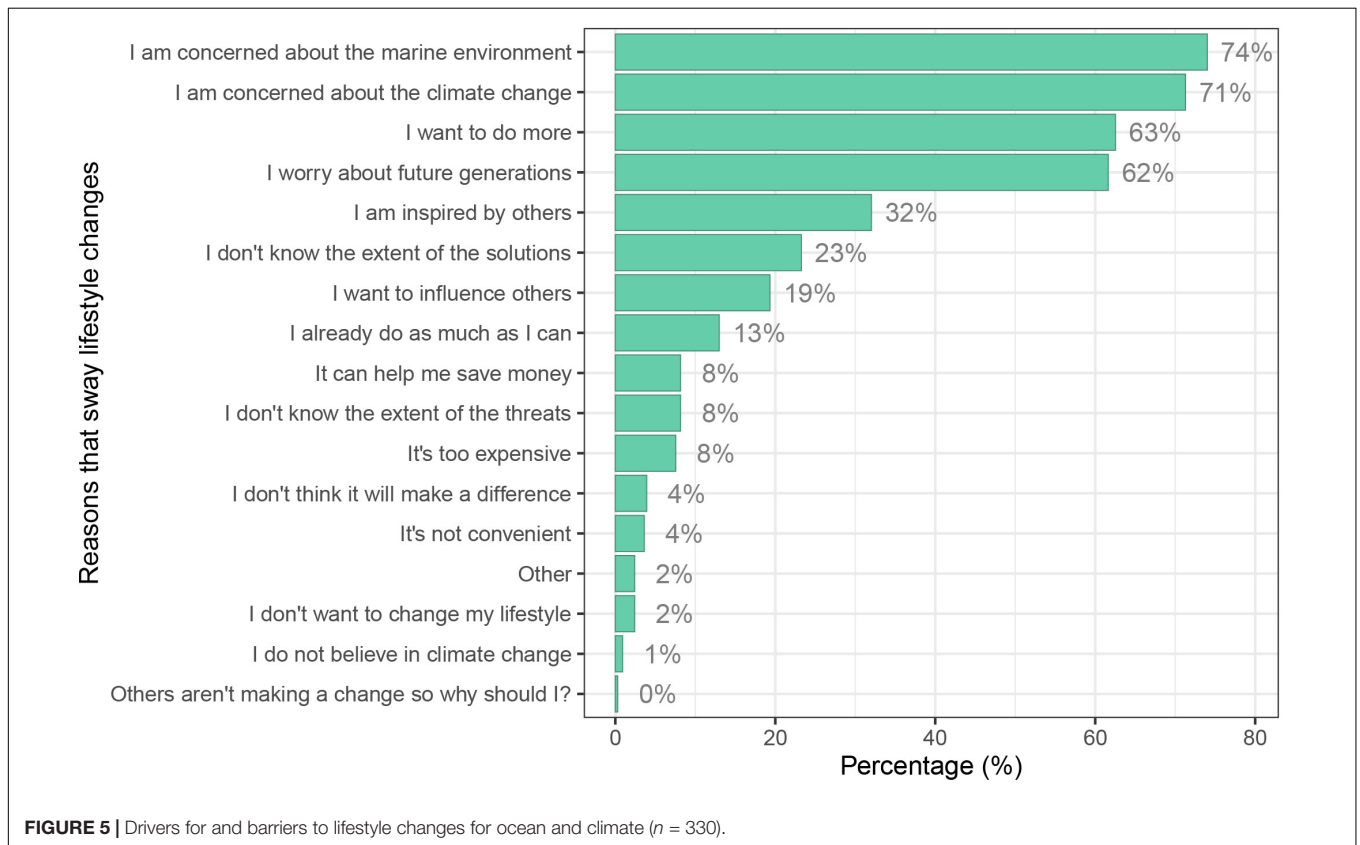
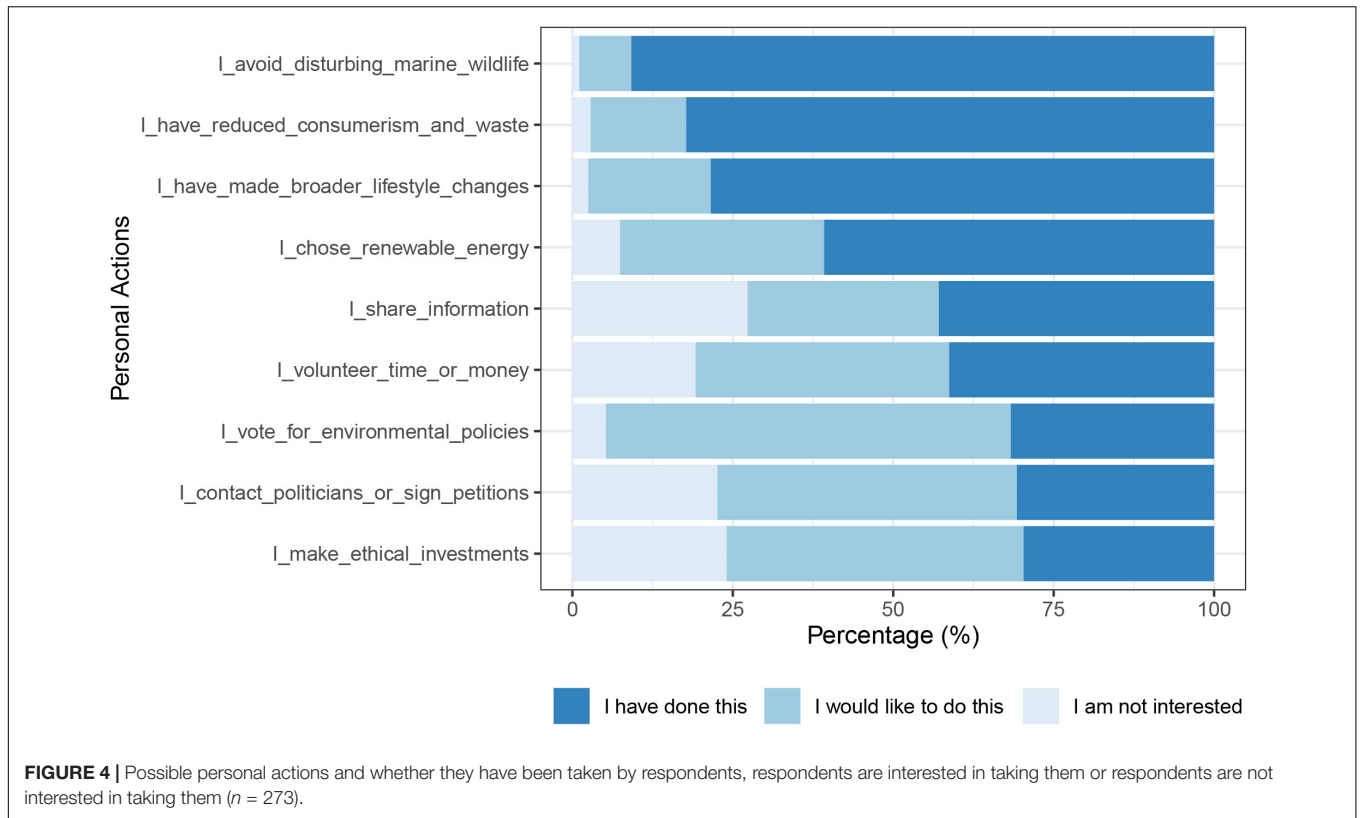


TABLE 2 | Counts and percentages ($n = 330$) of how likely respondents are to make changes to their lifestyles within the next 12 months to benefit the sea, coast and climate, due to the reasons given in **Figure 5**.

Possible response	Count	Percentage
I've already made changes, but plan to make more	183	55.29
I've already made changes and don't plan on making any more	26	7.85
It is very likely	42	12.69
It is quite likely	57	17.22
I don't think I will make any changes to my current lifestyle	22	6.65
I definitely will not make changes to my current lifestyle	0	0.00

lifestyle change were “it's too big a problem,” “lack of support from the government,” “issues of social justice and poverty are more pressing,” and “a lack of clear and direct guidance.”

In total, 55% of respondents have made changes to their lifestyles and intend to make more (**Table 2**). This option was most frequently selected by young people (64% of those aged 16–34). The percentage of respondents that had “already made changes but plan to make more” decreases with age with 46% of 65 years+ selecting this option. “I don't think I will make any changes to my current lifestyle” was selected more frequently as age increases, with 4% of 16–34 s, compared with 10% of those who are 65 years+.

It was estimated that approximately 14% of respondents do not purchase seafood, though this cannot be separated from those that chose not to answer this question for other reasons. Chi-squared testing identified a significant relationship between the factors that may influence seafood purchase and the degree to which they influence purchase (Pearson's Chi-squared test: $\chi^2 = 135.87$, $df = 20$, $p < 0.001$, $n = 274$). All the factors presented influenced the purchase of seafood, including labels of sustainability and animal welfare, whether it was caught locally, the fishing method, carbon footprint and price. The price of seafood had the largest percentages of “neutral” to “no influence,” although 24% of 16–34-year-olds were strongly influenced by the price of seafood. This decreased as age increased with 10% of 65 years+ strongly influenced by the price of seafood. However, sustainability and welfare standards are more important to respondents, particularly regarding labels denoting locally caught fish and sustainability, which strongly influence 35% and 33% of respondents, respectively. The carbon footprint of seafood was also an influential factor, albeit less so than other aspects of sustainability.

Emotional Underpinning

The dominant feelings of respondents ($n = 329$) to the marine and coastal environment are positive with 64% feeling peaceful/calm, 59% feeling awe/wonder and 47% feeling happiness. Conversely, 45% of respondents expressed concern when thinking about the marine and coastal environment (**Figure 6**). The majority of respondents (54%) expressed a mixture of positive and negative feelings, and 40% feel only positive emotions. Less than 5% of respondents feel solely negative emotions and less than 2% have no emotional connection with the marine and coastal environment (**Table 3**).

Visioning – Public Attitudes on the Future Use of and Benefits From the Sea

Chi-squared testing revealed a significant relationship between the benefits of marine and coastal spaces and their perceived importance (Pearson's Chi-squared test: $\chi^2 = 255.69$, $df = 20$, $p < 0.001$, $n = 290$). Respondents generally placed importance on all benefits. The three most important benefits were deemed to be the enjoyment of marine nature and wildlife, preserving cultural heritage, and supporting mental health with 60, 48, and 47% of respondents selecting “very important,” respectively. The inspiration of the arts was the most divisive benefit, with 33% of respondents selecting “neither important nor unimportant” to “not important.” More female respondents felt that supporting mental health was “very important” (54% compared to 32% of male respondents). Of those with an environment sector background, 71% thought “enjoying marine nature and wildlife” to be “very important” compared to 56% for those that do not. A relatively high number of blanks, particularly amongst older respondents, suggests issues with the question wording or format.

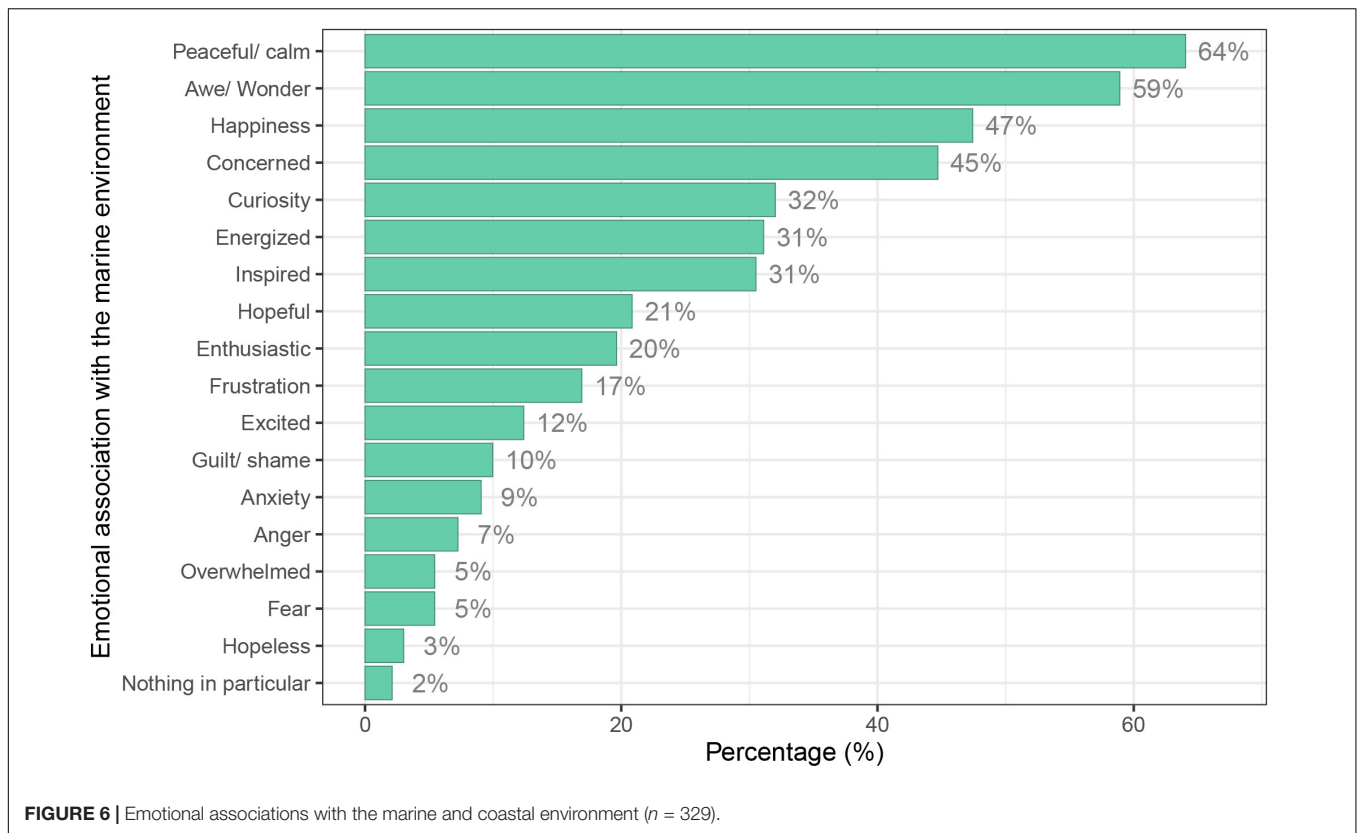
Chi-squared testing revealed a significant relationship between potential actions toward the vision of Fife and their importance (Pearson's Chi-squared test: $\chi^2 = 306.86$, $df = 16$, $p < 0.001$, $n = 288$) (see **Figure 7**). Of the actions presented, the majority found all to be important; the preference was for increased environmental protection at sea with 61% of respondents answering “very important.” Attracting tourists was the most divisive of the actions with 18% of respondents selecting either “somewhat unimportant” or “not important.” Respondents with an environment sector background selected “very important” more frequently than those who have not for supporting the growth of offshore renewable energies (44 and 34%, respectively) and increased environmental protection at sea (67 and 59%, respectively). There was a relatively high number of blanks, increasing in proportion as age increases likely as a result of the question wording or format.

Impacts of COVID-19

Of all the respondents, 23% ($n = 323$) live on the coastline. Those that live on the coast were removed from the subsequent question analysis (therefore $n = 249$). In total, 71% of respondents intend to continue visiting the Fife coast at the same frequency post-COVID-19. Respondents intending to increase their visits to the Fife coast post-COVID-19 (22%), outnumbered those who plan to decrease their visits (7%). There was one respondent that intends to decrease their coastal visits to “never” post-COVID-19.

For the majority (58%, $n = 329$) their views on the importance of the Fife marine and coastal environment have not changed due to COVID-19. Overall, 21% believed it to be somewhat more important and 20% believed it to be much more important. In terms of sex, 24% of female respondents find the marine and coastal environment “much more important” compared to 11% of male respondents.

Fisher's Exact testing found no significant relationship between the anticipated frequency of visits and the perceived importance of marine and coastal areas around Fife in relation to COVID-19 (Fisher's Exact Test with simulated p -values based



on 2000 replicates: $p = 0.12$ | $n = 248$). The perceived importance of the local coastline was not related to the frequency with which someone intends to visit. For those that anticipate resuming the same frequency of coastal visits post-COVID-19, 40% intend to visit more than once a week, 30% intend to visit about once a week, 24% intend to visit about once a month. It was found that 6% intend to visit less than once a month.

Other Findings

This survey also sought to determine the predominant motivation for visiting local marine and coastal spaces, along with any memberships to environmental organisations that advocate for marine and coastal protection. In total, 75% of respondents ($n = 311$) visit coastal spaces solely for the natural coastal features, 1% solely for facilities and attractions and 15% visit both equally. Overall, 16% of respondents ($n = 330$) claimed to be members of an environmental organisation and all of those respondents had

obtained higher education qualifications. Not all organisations listed, however, were strictly membership organisations. The question was potentially interpreted as non-financial support or awareness of organisations that advocated for marine and coastal protection. The complete listing of OL survey results in Fife can be viewed in Spooks et al. (2021) and accessed at: <https://research-repository.st-andrews.ac.uk/handle/10023/23981>.

DISCUSSION

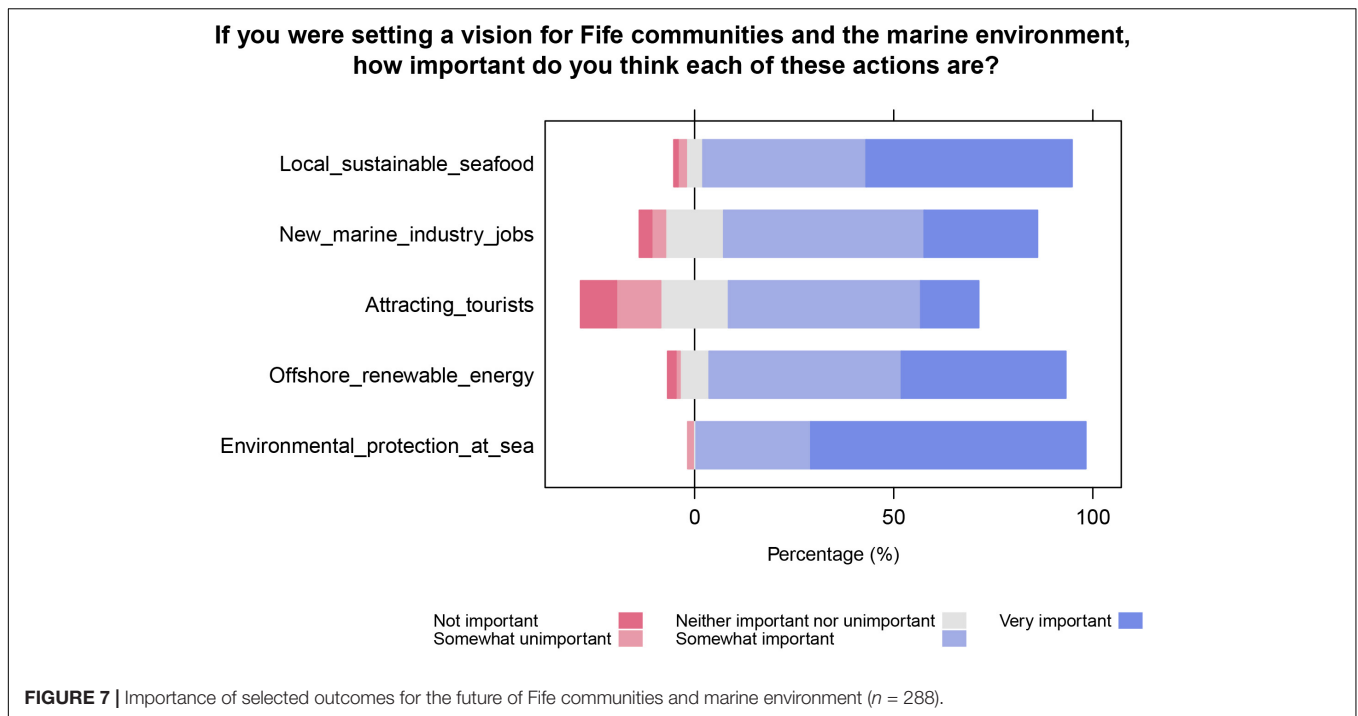
Summary

A publicly distributed survey was used to assess Ocean Literacy (OL) within the Fife Local Authority area. The focus was placed on perceived understanding, attitudes toward issues and solutions, behaviours and intentions, along with any emotional response toward the marine and coastal environment. This survey also sought to reveal visioning priorities for the future of the Fife marine and coastal environment as well as the impact that COVID-19 may have had on the appreciation of marine and coastal spaces. A total of 331 usable surveys were obtained, representing all wards within the Local Authority. In some wards, however, responses were too low to incorporate place of residence as a demographic variable. Demographic variables, therefore, consisted of age, sex, environment sector background, and educational attainment.

Notably, young people felt more aware of global issues than local issues and female respondents showed more interest in

TABLE 3 | Counts and percentages (n = 329) of the types of emotional responses given by respondents when asked to think about the marine and coastal environment.

Possible response	Count	Percentage
Positive only	133	40.43
Neutral	5	1.52
Negative only	14	4.26
Mixed emotional response	177	53.80



learning about local marine and coastal areas. Those with an environment sector background showed more awareness of local issues and solutions, were more likely to have shared information with others and placed more importance on offshore renewables and at-sea environmental protection. Those with higher education qualifications also perceived themselves to be more aware of issues and solutions than those with secondary education qualifications and were more likely to have already made behaviour changes or become members of organisations that promote healthier seas.

Key Messages

Understanding and Awareness

Results indicated that respondents were more aware of global issues than they are of local issues and solutions. In some respects, this was not surprising as most press coverage reports marine environmental issues as a generic concern, such as plastic pollution and sea-level rise with only occasional reference to issues at regional or local scales. This trend was particularly marked in younger age groups suggesting that they may be more connected to global media than older generations due to ease of access to global information through technology and social media. There was a higher perceived awareness of problems over solutions suggesting that greater focus for public engagement and education ought to be placed on a solutions-based approach. An analysis of Canadian school curricula found similar issues for climate literacy whereby the educational focus was placed on mechanisms of climate change and links with human activity. The study reported a lack of emphasis on impacts, scientific consensus and solutions (Wynes and Nicholas, 2019). This lack of emphasis, particularly on solutions in education, is a remediable

lost opportunity with the potential for challenging social norms and instilling better environmental practice from an early age, by empowering actions through practical guidance.

Marine litter and plastics were the most frequently cited issue for the local coastline. Both media coverage of this issue and its visibility at a local level are likely to reinforce perceptions that litter and plastic are threats. This highlights the success of various campaigns against plastics in infiltrating public awareness and provides a welcome entry point for OL efforts. Firsthand experiences of plastics on the coastline are also likely to have contributed to a perceived higher awareness. Respondents hold travelling/firsthand experiences as equally important to social media in creating knowledge and awareness. The challenge remains to elicit a similar response toward threats that are less tangible or “out of sight, out of mind,” such as that of overfishing, damage to marine habitats and some manifestations of climate change in the ocean. This “out of sight, out of mind” mentality, possibly related to coastal proximity, has been previously identified as a barrier to OL and positive behavioural change (Wild Labs, 2018; McKinley and Burdon, 2020).

Attitudes

The majority of respondents value the role of science in the push toward healthier seas, are interested in learning more, particularly about the local marine environment, and recognise the role of human activity in the rapidly changing climate. These attitudes are positive and helpful starting points for OL public engagement initiatives, showing a widely held acceptance of responsibility for rapid environmental change and a willingness to engage with scientific findings. Whilst the survey indicates a collective responsibility for finding solutions to the challenges facing the coastal and marine environment, generically, there does appear

to be an expectation on government and businesses to lead this process. The recognition of personal responsibility is welcome, though a top-down approach is critical to spearhead positive change in areas where respondents feel they have little influence. Individual action may also become more effective if there is an expectation that challenges current social norms coming from higher powers. As such, this suggests that there is a legislative gap for tools, infrastructure and simple advice that enables people to make informed decisions.

Behaviours

Many respondents have already made lifestyle changes; this positive uptake appears to be largely driven by concern for the environment and future generations. Further work should be undertaken to better understand the interpretation of “lifestyle changes” and their subsequent longevity. Those aged 65 years+ had the highest percentage of “I don’t think I will make any changes to my current lifestyle,” suggesting that age instils some rigidity in thinking and habits. Many would like to instigate more change using their votes, lobbying, ethical investments, switching energy providers and volunteering or donating money. Certain lifestyle changes proved to be more divisive than others; the sharing of information, volunteering time or money, ethical investments and contacting politicians/signing petitions attracted higher percentages of disinterest. This suggests that these particular lifestyle changes may prove to be too difficult, time-consuming or expensive for some. This implies that at present, there are barriers to their implementation; these barriers, be it technical, financial or mental need to be tackled via fiscal, legal and educational tools. “The action perspective” was proposed as a means of promoting positive behavioural change by identifying the barriers toward change within the social context and how those barriers have been successfully breached (Lokhorst and van Woerkum, 2011). This empowers interested parties to implement their good intentions and share their successes with others.

The labelling of seafood, particularly regarding fishery sustainability, was the most widely regarded influencing factor to purchase. There is an opportunity here to include the carbon-labelling of seafood and other food products as a method of swaying consumeristic tendencies. Carbon labelling provides a means by which consumers can hold industries accountable with their purchases. Literature suggests that there is potential when combined with reduced prices on lower-carbon goods, to be influential in reducing carbon emissions (Vanclay et al., 2011).

Emotional and Experiential Underpinning

The results suggested that the sea instils an emotional connection in its visitors. A sense of peace and awe were the most frequently experienced emotions. This has implications for the marine and coastal environment as a source of emotional well-being and highlights the importance of blue spaces in Fife. The majority expressed mixed feelings; any feelings of concern, frustration, guilt or anxiety related to its health further illustrates the value placed on the marine and coastal environment. The 2017–2018 Scotland’s People and Nature Survey helps to substantiate the benefits of the outdoors, (blue spaces included). Their findings indicated that a quarter of outdoor visits were solely

for relaxation and enjoyment of the weather or fresh air, bringing improvements to physical health or feeling energised and unwinding (Wilson and Seddon, 2018).

Recognising Diverse Benefits

Most place high value in marine nature and wildlife, cultural heritage and the use of coastal spaces to support mental health. The arts along with space to exercise and meet people were also recognised as important benefits by most, though to a lesser extent. Respondents were most interested in increasing at-sea environmental protection and supporting local sustainable seafood. There was also strong support for new industries including renewable energy and tourism, though tourism appears to be the most divisive of these, and ought to be broached sensitively.

An issue raised was that of the lack of accessibility along much of the Fife coast. A respondent voiced their frustrations:

“That is my only disappointment with our stunning coast, that people in wheelchairs are cut off from so much of it. It’s one of those things that if you don’t live it, you don’t realise how bad it is.”

(Gill White, email correspondence with author, 18 May, 2021).

The survey highlighted the importance of the Fife coastline to the local community for well-being. To have limited access to the coastline is to restrict the benefits that the marine and coastal environment can provide and serves as an injustice of inequality to those for whom access is limited. It is proposed that this be taken up with coastal planning authorities and voluntary coastal management bodies for Fife.

Consequences of COVID-19

Over a fifth of respondents lived within close proximity to the Fife coast at the time of surveying. This may indicate a higher interest in coastal matters amongst residents at closer proximity and potentially created a bias in the data, though proximity was not defined and is prone to subjectivity. For the majority, the frequency of visits to the coast will resume post-COVID-19, with a fifth increasing the visit frequency. We can only speculate upon the reasons why 7% of respondents intend to decrease the frequency of visits. These could include easing of restrictions relating to COVID-19 and associated anxiety, particularly for those who are shielding.

Whilst 41% of respondents believed the local marine and coastal environment was more important following the easing of COVID-19 restrictions, there was no apparent connection between the perceived importance of the local marine and coastal environment and the frequency at which respondents intend to visit post-COVID-19. The majority reported that their views remained unchanged throughout the pandemic. This could be related to limited sample size and bias in respondents toward those that are already interested in coastal matters and hence would not necessarily have changed their views due to COVID-19. Though it remains speculation, this may be an indication that many respondents value local blue spaces highly. This also suggests that the frequency of visits to the coast may not be a major contributing factor to the broadly held importance of the sea. This suggests that OL

engagements may have a positive impact on the sea amongst landlocked communities that are unable to visit the coast with any regularity. It should be noted, however, that this survey was not specifically designed to answer these questions regarding the impact of COVID-19 on coastal visitations and perceived importance. This would require a specific and in-depth investigation.

Biases and Limitations

Survey distribution techniques, question design and question-wording may have unintentionally contributed to bias within the survey responses. The most notable demographic biases observed within the data were female: male (70 and 27%, respectively), and educational attainment (“Higher education qualification” account for 82%, “Secondary education qualification” for 14% and “No formal qualifications” for 2%). There was also an inter-ward bias, with electoral wards closer to the University of St Andrews showing higher response rates, and lower response rates from wards that include more deprived communities. To address the differences in sex and qualification biases, data were grouped and analysed separately to allow a direct comparison of percentages. Within the limits of time and resources available, every effort was taken to improve the survey response from wards at a greater distance from the university. Of the ~310,000 eligible community members (as calculated from the 2019 National Records of Scotland statistics) the 331 useable survey responses represent a response rate of 0.11%. To further improve the response rates, surveys could be further customised to specific areas within a region to encourage fine-scale participation that can be later aggregated.

Facebook was used to target specific community groups and flyers were distributed to public spaces in areas of low uptake. Although the data were not rich enough to allow an inter-ward analysis, having responses from each ward was taken as an indication of a reasonable geographic spread in data-collection efforts. The higher response rates within proximity to the university suggest, however, that this might be a more appropriate scale for such a survey and its outputs.

For the Likert questions, the number of unanswered statements (blanks) present in the data increased with age. This was likely due to the question wording and/or format. Likert questions were presented in a “carousel” format with statements auto-advancing once an answer had been selected. It appears that as age (and perhaps technological uncertainty) increases, fewer respondents noticed the statements auto-advancing and prematurely moved onto the next question. The percentage of blanks does not exceed 22% and reduces throughout the survey, presumably as respondents became accustomed to the question style. The varying percentage of blanks across ages will obscure inter-age differences for the Likert questions, however, the patterns across any single age group should bear scrutiny.

In Context

When these results were compared with DEFRA’s (2021a) OL survey of England and Wales, stark differences were observed

on some key themes. For example, when asked about climate change and its causes, 40% of respondents to DEFRA’s survey were not clear on whether the climate is changing due to human activity (DEFRA, 2021a), compared to just 0.3% of Fife respondents. Approximately 40% of Fife respondents recognised that the climate was changing relatively quickly due to both human activity and natural processes, compared to 4% of DEFRA respondents, indicating a greater awareness about the relevance of rate of change, as opposed to change *per se*. Fife respondents also perceived themselves as more aware of ocean challenges than DEFRA respondents and collectively felt less concerned and more peaceful when thinking about the marine environment. In terms of behaviour, more Fife respondents had already made lifestyle changes to benefit the sea, coast, and climate, with the intention of doing more compared to DEFRA respondents (55 and 25%, respectively).

The differences may indicate contrasting ideologies regarding marine and coastal issues between England, Wales, and Scotland, or at least this region of Scotland, but they may also be reflective of the approach to survey distribution. The nationwide stance taken by DEFRA may be less sensitive to the views held by small rural and coastal communities, instead skewed toward the views maintained in populous, urbanised areas; however, this is speculation without full knowledge of the distribution methods of the DEFRA survey. Whilst care had been taken within the analysis of the DEFRA survey to ensure the weighted representation of coastal communities, the overarching results are not sensitive to the differences in OL and how this may change with distance from the coast. This presents a likely limitation, considering key stakeholders for marine planning and governance will be likely more numerous with increasing coastal proximity.

Marine planning provides an important opportunity for collaboration between “top-down” arrangements of governance from the national government, including policy insights and legal legitimacy, and devolved powers including regional organisations and local stakeholders (Greenhill et al., 2020). As underlined in Scotland’s National Marine Plan, The Scottish Government intends to support Marine Planning partnerships to forward the development of regional marine plans and have set out several legislative requirements to this end (Marine Scotland, 2015). A regional approach to OL surveys can be used to illuminate local opinions and priorities to feed into the early “visioning” phase of the marine planning process. Furthermore, public engagement in OL will enrich the local public understanding of marine issues raised in marine planning and could contribute an additional voice to those devolved powers with the necessary objectivity to planning and governance proposals concerning local coastlines. An educated local population is required for a sensible debate in public consultations and for reaching decisions on regional resource allocation.

Recommendations for Advancing Ocean Literacy

- Shifting science communication, public engagement activities and formal education toward a solutions-based

approach for widely accepted problems and toward local issues. Marine plastics can be used as an entry point for OL engagement, yet greater efforts are recommended to develop awareness for other key issues.

- Young people may be a key target for engagement with local issues, which could be broached in formal education, encouraging young people to be actively involved in environmental campaigns, marine citizenship initiatives (e.g., beach cleans) and citizen science projects (e.g., Citizen Fins). Opportunities should be sought to connect wider society with the marine and coastal environment through firsthand experiences such as wildlife watching and citizen science.
- Provision of simple advice, tools and opportunities from government, academy, third sector and businesses that enable people to take personal action, e.g., promotion and fostered understanding of seafood certification labels and movement toward the carbon-labelling of goods either as a distinct certification process or integrated with other eco-labels.
- Make use of social science interventions to promote behavioural changes. This includes “the action perspective,” challenging social norms, making pledges, labelling oneself as “the kind of people who do such things” (social identity) and instilling an emotional response (albeit still rooted in robust evidence) such as collective guilt or local pride (Lokhorst and van Woerkum, 2011). Further work should also be undertaken to identify whether behaviour changes are merely short-lived “tokens” or meaningful and lasting. Older generations may be a key target group for behavioural change efforts.
- Some technical, financial and mental barriers will remain, which need to be identified and tackled through fiscal, legal and educational tools.

Recommendations for Added-Value Outcomes for Ocean Literacy Surveys

- Utilise OL surveys to examine public priorities for the future of marine and coastal areas, as a contribution to the early stages of the planning and policy development process.
- Evaluation of the role of universities to include research on climate, sustainability and marine and coastal research, plus engagement with local communities on these outputs.
- Share findings through regional conferences, such as those held by organisations like the Tay Estuary Forum, and through open days like the University of St Andrews “Science Discovery Day.”
- Improve the accessibility of marine and coastal spaces, including publicly available facilities such as public restrooms.
- Natural capital and ecosystem services framing for policy and management are likely to be welcomed yet there is a need to ensure that coastal tourism is done responsibly and any negative impacts managed.

- Understand motivations for the different uses of the local coastline and any barriers, including investigating reasons for any changes post-COVID-19. Also, the investigation of factors that influence the perceived importance of marine and coastal spaces, including coastal proximity.

Recommendations for Survey Design and Distribution

The survey was limited by resources, time, and COVID-19 restrictions. For similar surveys with adequate time and budgeting, the following is recommended:

- Advertising the survey online and in print through local news broadcasters.
- The use of funding to boost social media outputs.
- Accessibility for those who may not be technologically savvy, by distributing survey hardcopies with Freepost envelopes.
- If using a “carousel” format with auto-advancing statements, ensure the question layout is well explained.
- Bring in public-facing/community-based organisations as partners early on to support survey promotion, enhance response rates and provide opportunities for collaboration with potential public engagement.
- A comprehensive series of interviews with a sample of respondents to understand the reasoning behind their responses.
- Including more demographic data in line with GDPR guidelines and ethical data standards, to enable a deeper analysis of demographic differences in OL and subsequent targetting of public engagement initiatives.
- Consideration of a nested approach with a suite of surveys, identical in substance, but tailored to small geographic areas (e.g., ward level). The finer granularity of data may provide insight into regional differences in OL and may help steer the direction of public engagement activities locally and nationally.
- Repeating the survey process in the future to document shifts in perceived OL across demographics as a response to public engagement activities.

CONCLUSION

This survey has provided a snapshot of perceived OL in the Fife Local Authority area. This includes how the respondents perceived their awareness of marine and coastal issues and climate change, their attitudes toward solutions and the parties responsible for delivering them, as well as their willingness to alter their lifestyles and priorities for the future. This project has demonstrated what is achievable on a limited budget and timeframe. Its critique and adaptation regionally across Scotland could provide a nested national snapshot of OL and, in due course, a time series with the potential to serve as a tool to inform marine and coastal planning and policy processes. Follow up with the appropriate public engagement is an essential next step and opportunities for collaboration in this should be sought.

DATA AVAILABILITY STATEMENT

The datasets presented in this article are not readily available because ethical requirements stipulate that data may only be shared in an anonymised, aggregated format. Data will not be given to a research data repository or included with reports, displays or publications. Requests to access the datasets should be directed to FS, fjs8@st-andrews.ac.uk.

ETHICS STATEMENT

The studies involving human participants were reviewed and approved by the School of Biology Ethics Committee on behalf of the University Teaching and Research Ethics Committee at the University of St Andrews. The patients/participants provided their written informed consent to participate in this study. Written informed consent was obtained from the individual(s) for the publication of any potentially identifiable images or data included in this article.

AUTHOR CONTRIBUTIONS

MJ and CL conceived and supervised the project and its administration, proposed the methodology, and were responsible for reviewing and editing the survey and manuscript. FS designed and distributed the survey, undertook the data analysis, and

wrote the original draft. All authors contributed to the article and approved the submitted version.

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