Public perceptions of marine environmental issues: A case study of coastal recreational users in Italy

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Abstract

Marine environments provide ecosystem services jeopardised by human activities, resulting in impacts requiring urgent attention. In Europe and southern Mediterranean countries like Italy, marine environmental problems of note include marine litter, overfishing and climate change, among others. Public engagement is essential in mitigating these problems. In this context, investigating public perceptions and what influences these perceptions is necessary to design the right public engagement strategies. This study evaluated perceptions of marine environmental issues among coastal recreational users along the Conero Riviera in the Adriatic Sea. This is a location used for many coastal activities, affected by several human impacts and considered to become a marine protected area. A total of 202 coastal recreational users were interviewed regarding their perceptions of marine environmental issues including awareness, concern, observed changes in the local coast, and pro-environmental behaviours to combat marine environmental issues. Regression analysis was used to determine influential variables in perceptions. The participants were mainly aware of and concerned about issues including pollution, litter and overfishing. They had observed changes in the local coast primarily encompassing wildlife reduction, toxic algal growth and mucilage. They engaged in pro-environmental behaviours principally including recycling, litter collection and pollution reduction. Awareness of marine environmental issues influenced concern, while the observation of coastal changes and pro-environmental behaviours were mainly influenced by demographic variables like water use and gender. The results of this study were used to make recommendations concerning the design of communication and education campaigns and strategies to stimulate pro-environmental behaviours to support marine conservation.

Keywords Environmental concern · Pro-environmental behaviour · Conero Riviera · Water use · Public engagement · Communication campaigns

Introduction

Marine and coastal ecosystems globally are at risk due to anthropogenic impacts which can have repercussions on ecological, social and economic levels (Chilvers et al. 2014; Gkargkavouzi et al. 2020). The degradation of the marine environment is in part due to the collective daily impact of the behavioural and lifestyle choices made by individuals (McKinley and Fletcher 2010). There is an increasing recognition that societies should be engaged in efforts to address marine conservation challenges. This is echoed in the Global Ocean Commission’s report “From Decline to Recovery: A Rescue Package for the Global Oceans” (Gelcich et al. 2014), Sustainable Development Goals (specifically SDG14), and the United Nations Decade of Ocean Science for Sustainable Development (2021–2031) (Gkargkavouzi et al. 2020; Jefferson et al. 2021).

Public engagement represents an important opportunity to create transformation in the relationship between people and the ocean and for people to be part of marine ecosystem management and restoration (Gkargkavouzi et al. 2020; Jefferson et al. 2021; Lotze et al. 2018; McKinley and Fletcher 2010; Tonin and Lucaroni 2017; Yoon et al. 2021). In this context, public perceptions of and responses to marine issues represent one of the foundations of management actions at the individual, collective and governance levels (Engel et al. 2021; Gkargkavouzi et al. 2020; Jefferson et al. 2015, 2021; Lotze et al. 2018; Tonin and Lucaroni 2017). Research on

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the public perceptions of marine environmental issues is still limited (Buckley et al. 2017; Engel et al. 2021; Gelcich et al. 2014; Gkargkavouzi et al. 2020; Jefferson et al. 2015, 2021; Potts et al. 2016; Tonin and Lucaroni 2017; Veiga et al. 2016; Yoon et al. 2021). Additionally, there is poor consideration of how everyday public behaviour could be investigated and engaged to support marine conservation and management (McKinley and Fletcher 2010).

In Europe, there are several marine issues of note. The European Union is one of the largest consumers of seafood in the world (FAO 2012). Climate change has received news media focus to inform the public about scientific findings on the impact of human-induced global warming (Buckley et al. 2017). Marine litter has also received attention as one of the Descriptors of the Marine Strategy Framework Directive and has been extensively covered in the media through documentaries like Blue Planet II, as well as EU-funded projects such as MARLISCO aimed at societal engagement (Hartley et al. 2018; Veiga et al. 2016). European surveys have highlighted increasing public concern regarding environmental issues since 1992, with southern European countries like Italy displaying higher levels of concern compared with others (Lorenzoni and Pidgeon 2006; Potts et al. 2016). Additional research has shown that in different European countries, awareness of and concern about marine issues can vary due to the complex interplay of environmental, historical, institutional and cultural factors (Jefferson et al. 2015, 2021; Potts et al. 2016). Based on the geographical differences in attitudes and perspectives towards the marine environment, studies conducted in individual nations, as well as multi-national studies, are relevant to capture societal perceptions at fine to broad scales.

Research shows that the public may be most aware of and concerned about certain marine issues over others, which reflects, on the one hand, realistic situations, and on the other underestimations of important issues which may not be readily visible, immediate and tangible (Chilvers et al. 2014; Lotze et al. 2018; Potts et al. 2016). Additionally, various authors suggested that while people may be reacting to different threats to the marine environment, they may not associate their actions with formal or institutional definitions of adaptation and resilience, also due to a perceived lack of responsibility or self-efficacy, passivity, a perceived lack of information, and limited trust in institutions in mediating responses to various threats (Curnock et al. 2019; Gelcich et al. 2014; Hofman et al. 2020; Hogg et al. 2018; Liu et al. 2021; McKinley and Fletcher 2010; Soares et al. 2021; Tonin and Lucaroni 2017; Yoon et al. 2021).

Researchers have discussed how perceptions and behaviour regarding marine issues can be determined by various factors, such as demographic profile, personal experience, the visibility and proximity of impacts, perceived risk, local identity, and a sense of morality (Chilvers et al. 2014; Gelcich et al. 2014; Gkargkavouzi et al. 2020; Hartley et al. 2018; Jefferson et al. 2014, 2021; Lotze et al. 2018; McKinley and Fletcher 2010; Potts et al. 2016; Soares et al. 2021). It is expected that public concern about marine issues is preceded by knowledge about their effects (Engel et al. 2021; Yoon et al. 2021). Similarly, authors have suggested that awareness and concern, as well as experiences of marine issues in local contexts, could shape behavioural intentions to mitigate issues in the marine environment (Gkargkavouzi et al. 2020; Hofman et al. 2020; Liu et al. 2021; Yoon et al. 2021). People can display several behaviours to combat marine issues, such as recycling, reducing plastic, reducing energy use at home, water saving, and participating in litter clean-ups (Chilvers et al. 2014; Engel et al. 2021; Soares et al. 2021). These behaviours encompass private-sphere environmentalism (Stern 2000) with direct (e.g. marine plastic pollution) and indirect impacts on the ocean (e.g. energy consumption contributing to climate change) (Engel et al. 2021; Hofman et al. 2020). They suggest substantial public interest to engage with marine environmental issues and are important to explore to shape future actions and develop a vision of a ‘sea interest’ (Ritchie and Ellis 2010). Additionally, the adoption of pro-environmental behaviours like recycling could lead to other, similar behaviours such as environmental activism (Hofman et al. 2020; Jefferson et al. 2015). However, it remains unclear whether public concern for marine issues would translate into personal actions or demands to solve these issues on a political level (Buckley et al. 2017; Chilvers et al. 2014; Hogg et al. 2018). Therefore, since behaviour is central to contributing to the mitigation of marine environmental problems, it is important to understand it and its determinants (Hartley et al. 2018).

A review by Jefferson et al. (2021) identified residents and tourists in coastal areas, including different types of recreational groups, as important targets of research on the public perceptions of ocean issues. Coastal ecosystems are important economic assets and areas of tourism and leisure, which makes it critical to address marine conservation from the socio-behavioural perspective including groups that access these ecosystems (Portman and Camporesi 2020). Knowledge and interest in marine protection among those who use and depend on the sea and coast can be used to produce the political will necessary to improve the ocean environment, and understanding the heterogeneity of various coastal user groups can be fundamental in the exploration of public perceptions (Lotze et al. 2018; McKinley and Fletcher 2010; Portman and Camporesi 2020).

This research focuses on perceptions of marine issues from a social and human perspective, examining how perceptions vary among coastal visitors in association with specific parameters. Specifically, this study aimed to assess perceptions of marine environmental issues among coastal recreational users in Italy. Perceptions included awareness...
of and concern for problems affecting the global oceans and marine life; observation of environmental changes in the local coastal area; and pro-environmental behaviour to mitigate marine environmental issues. The study also investigated whether perceptions influenced one another and were influenced by the demographic characteristics of recreational coastal users.

**Background**

**Public perceptions of marine environmental issues**

Perceptions can be considered as including components such as knowledge, attitude (including concern) and behaviour. Environmental attitude can be defined as a “predisposition to respond consistently in a favourable (or unfavourable) manner concerning the environment”, while a pro-environmental behaviour can be defined as a “behaviour that consciously seeks to minimise the negative impact of one’s action on the natural and built world” (Eagly and Chaiken 1993; Kollmuss and Agyeman 2002). Environmental concern can be defined as “how people perceive environmental issues and their willingness to respond rationally to environmental issues” (Franzen and Vogl 2013). UNESCO’s Man and the Biosphere Program adopted environmental perception studies as a useful instrument in 1968 when it declared that these studies represent a basis for environmental management; since then, public perception research has been used to investigate positions on environmental issues (Portman and Camporesi 2020). An example is the Ocean Topic Public Attitude Survey (Wiener et al. 2016).

In Europe, important marine issues have called for public perceptions research revealing a complex interplay of factors. Buckley et al. (2017) found that German, Italian and Spanish respondents were the most informed on the greatest number of marine issues; people living near the Mediterranean Sea were particularly concerned about raising sea temperatures, invasive species and jellyfish blooms, and were able to observe several impacts with the naked eye. Lotze et al. (2018) found that notable marine issues perceived by European citizens included climate change, oil spills, litter, ocean acidification, coastal erosion, aquaculture, and even marine renewable energy. Gelcich et al. (2014) found that the European public was most informed about ocean pollution, melting sea ice, overfishing, sea level rise, coastal flooding, and extreme weather events, and least informed about ocean acidification, invasive species and jellyfish blooms. Another European study by Potts et al. (2016) indicated that although people were generally concerned about ocean health and climate change, they perceived industry pollution and litter as the most severe threats to marine environments. Hartley et al. (2018) showed that European citizens perceived marine litter, especially plastics, as an important and concerning problem. In a survey of 10,000 people in ten European countries (Buckley et al. 2017), the public described pollution as the most serious environmental issue affecting the coast and sea, while only 4% mentioned climate change. Issues including coastal erosion, sea level rise, melting ice caps, raising temperatures, increasing frequency of extreme weather events and flooding, which are related indirectly to climate change, were considered very concerning. In a series of UK-wide studies, various authors showed that the public listed pollution, coastal erosion and marine litter as the most salient matters related to the coastline and the sea (Chilvers et al. 2014; Fletcher et al. 2009). A Greek study by Gkargkavouzi et al. (2020) showed that coastal residents acknowledged that the marine environment and biodiversity are under threat from pollution and litter, shipping, fishing, farming, and habitat alteration, although they tended to underestimate the negative impacts of tourism and recreation as well as climate change. The authors suggested that these perceptions were influenced by a focus on these issues by media and conservation-related campaigns, as well as an easier public understanding of issues like pollution, compared to more complex, less visible and newer ones like climate change.

**Factors determining perceptions of marine environmental issues**

Perceptions of marine issues can be determined by various factors, such as demographic profile, personal experiences, or coastal use. In an Italian study, Gusmerotti et al. (2016) showed that young people were more aware of the marine litter problem and willing to act to raise awareness and engage in pro-environmental behaviours, while Soares et al. (2021) found that in Portugal, older people and women reported having more pro-environmental behaviours. Chilvers et al. (2014) found a connection between public perception and personal experiences in the UK, denoting how these experiences shape an understanding of marine environmental change. Coastal users are likely to have stronger inclinations to protect their recreational environments because marine environmental issues like pollution, litter and alien species are perceived as potential ecological and health dangers jeopardising their activities on the coast (Rangel et al. 2015). For instance, water use can predict recreationists’ perceptions of marine environmental issues and pro-environmental behaviours to combat these issues (Portman and Camporesi 2020; Wiener et al. 2016). Water users like scuba divers are known to develop feelings of connection with marine environments, and contact with water may counteract their tendency to see themselves as separate from nature, raising awareness and resulting in
positive environmental attitudes and behaviours (Portman and Camporesi 2020).

Various European studies found a positive association between public knowledge, concern regarding marine issues, and inclinations to engage in pro-environmental behaviours (Buckley et al. 2017; Gelich et al. 2014; Gusmerotti et al. 2016; Hartley et al. 2018; Soares et al. 2021). In contrast, Chilvers et al. (2014) highlighted that despite their knowledge of some issues, people may display feelings of complacency and lack of personal agency to combat these issues, especially those that are perceived as less tangible, like climate change. Hogg et al. (2018) described behaviours in response to marine environmental threats that include passivity (complacency and fatalism), adaptation (taking positive steps to adapt to a situation) and transformation (embracing the strategy of changing circumstances).

**Materials and methods**

**Study location**

Italy represents a critical area for issues like marine debris due to its centrality in the Mediterranean basin, and research into the public perceptions of and response to marine environmental issues is scant but necessary to effectively engage society and change behaviour (Forleo and Romagnoli 2021). Work by Tonin and Lucaroni (2017) suggested that Italian people tend to visit the coast frequently, both in summer and winter. They consider recreational activities and tourism as the most important activities offered by the sea, followed by education and scientific research to raise public awareness about respecting the sea environment and preserving it for future generations. These people, especially those living on the coast, are mostly aware of the issue of marine biodiversity, and many consider the local marine biodiversity worse than that of other Mediterranean regions. Forleo and Romagnoli (2021) confirmed that Italian people were aware of issues like marine litter and concerned about the effects on marine life and human health. Most declared that they engaged in behaviours like the proper disposal of litter, and some also adopted behaviours like responsible purchase choices. The authors, however, also revealed that the spectrum of people's profiles is more complex than what emerged by investigating the sample in its entirety, highlighting the importance of addressing the differences in people's perspectives in terms of awareness, concern and behaviour also based on socio-demographic variables.

This study was conducted along the Conero Riviera, in the north-western Adriatic Sea, central Italy (Fig. 1). The Conero Riviera encompasses a section of rocky coast approximately 20 km long, stretching from the city of Ancona to the town of Numana, including the Conero promontory and several coastal villages. The Riviera is visited for tourism and recreational activities such as swimming, diving, boating, and fishing (Rindi et al. 2020). The coastal environments of the Riviera are important for larval settlement of marine species, growth of canopy-forming brown algae of the genus *Cystoseira* and the green alga *Ulva* (sea lettuce), which is a habitat to species of value for recreational diving and harvesting (Bulleri and Airoldi 2005; Palmieri and Forleo 2020). The marine area has been subjected to stressors including pollution, toxic blooms of the dinoflagellate *Ostreopsis ovata*, urbanisation, hard and soft engineering, sediment runoff, erosion, seafood harvesting, the presence of non-indigenous species, and tourism (Accoroni et al. 2012; Montanari et al. 2016; Rindi et al. 2020). The Conero Riviera has recently become a region of interest for the establishment of a marine protected area, calling for research evaluating public perceptions of marine environmental issues and potential support for this endeavour (Insieme per AMP Conero 2022).
Research design, data collection and analysis

This study deployed a semi-structured interview for data collection, allowing members of the study group to freely voice their opinions so that they could be later coded. The interview targeted coastal users including scuba divers, beach visitors, and people walking along the promenade at the study location. Face validity of the questions in the interview (i.e., where experts analyse the questions and conclude that these will seemingly measure the concept that the researcher intends to measure) was established by two marine biologists with knowledge of marine algae, two social scientists working on tourism and recreation, and one statistician with expertise in question construction. The interview included seven open-ended questions in three sections covering demographic profile; perceptions, encompassing awareness of and concern for problems affecting the global oceans and marine life, as well as whether the participants had observed any environmental changes in the local coastal area; and pro-environmental behaviour (Table 1). Fieldwork was carried out from August to October 2020, in correspondence with the summer and autumn months, on weekdays and weekends. This approach was adopted to avoid the potential effects of seasonality or the day of the week on the data. Interviews were conducted following COVID-19 safety protocols of social distancing. On a typical sampling day, between 09:00 and 18:00, two trained fieldworkers randomly approached people at dive centres, beaches and promenades along the Conero Riviera, introducing themselves as part of a study on public perceptions of and behaviour towards the marine environment, and asking them to take part in a 20-min verbal interview. People who accepted were asked to give informed consent and to be audio-recorded. Interviews were conducted in Italian, with participants sitting at the dive centres, beach or promenade benches.

The interviews were transcribed verbatim by the fieldworkers in Microsoft Word immediately after data collection, with the author checking the quality of transcriptions, translating them into English, and analysing data to look for saturation (Sandelowski 2010). Data saturation was achieved when approximately 150 participants were interviewed. As an additional confirmation of data saturation, sampling continued until just over 200 participants were included. Questions requiring participants to provide numerical or categorical responses (e.g. age) were transferred to Microsoft Excel. Questions requiring participants to provide descriptions and opinions (e.g. What are the problems affecting the global oceans and marine life if any?) were read carefully to extract meaningful topics, which were kept in a master list, reapplied to similar segments of text, and then grouped into themes which were transformed into dummy variables in Microsoft Excel (for each theme: 0 = not mentioned, 1 = mentioned by the respondent). All variables were transferred to the software TIBCO Statistica (Version 13.3, 2017) for statistical analysis. Basic statistics included frequency tables or averages. Spearman rank-order correlations (r_s) were computed to assess unique relationships between all variables (Field 2009). Finally, regression analysis was performed to evaluate influential relationships. Only variables that displayed significant r_s with the dependent variables were included as independent variables in the regression models. Tolerance was calculated to check for multicollinearity between the

Table 1  Semi-structured interview questions

| Section A: Demographic profile | Category | Value |
|-------------------------------|----------|-------|
| What is your: gender, age, and highest level of education? | Gender | Male 57% |
| Do you live on the coast or inland? | | Female 43% |
| Are you engaged in a water-based activity (e.g. scuba diving, swimming, canoeing, fishing)? | Age | Mean 42.2 |
| | | Min–Max 18–86 |
| | | SD 16.37 |
| | | SE 1.15 |
| | Education | High school 56% |
| | | Tertiary 44% |
| | Living on coast | Yes 71% |
| | | No 29% |
| | Water user | Yes 52% |
| | | No 48% |

SD Standard Deviation  
SE Standard Error

Table 2  Participants’ demographic profile (N = 202)

| Variable Category | Value |
|-------------------|-------|
| Gender Male | 57% |
| | Female | 43% |
| Age Mean | 42.2 |
| | Min–Max | 18–86 |
| | SD | 16.37 |
| | SE | 1.15 |
| Education High school | 56% |
| | Tertiary | 44% |
| Living on coast Yes | 71% |
| | No | 29% |
| Water user Yes | 52% |
| | No | 48% |
independent variables, and if this would affect the results of the regression analysis. The dependent variables were binary dummy variables, thus binary logistic regression analysis was executed (following the equation of the form: \( \log(P/(1-P)) = b_0 + b_1X_1 + b_2X_2 + \ldots + b_pX_p \), where \( P \) is the probability of an event occurring).

### Results

#### Participants’ profile and perceptions

A total of 202 people participated in this study; their demographic profile is represented in Table 2. Participants comprised slightly more males than females and were in their early forties on average. The highest level of education was the equivalent of high school for 56% and tertiary for 44%. Most participants (71%) resided along the coast at the case study location, while the rest resided inland and were visiting the coast at the time of the study. The study captured water users and non-users in similar proportions (52% and 48%, respectively).

The participants identified five main problems affecting the global oceans and marine life (Fig. 2). The most mentioned ones were pollution (air, water, oil) (84%) and litter, in particular, plastics (67%). The remaining three problems, mentioned in similar proportions (23–26%) were overfishing, global warming and climate change, and a mixture of others including alien species, habitat removal, erosion, sea transport, illegal activities, eutrophication, and drilling. Concern for the mentioned problems mirrored awareness (Fig. 2). Regarding pollution and litter (with emphasis on plastic), a primary concern of the participants (Table 3) was that these are rapidly escalating problems too difficult to

![Fig. 2 Themes extracted from participants’ descriptions of problems affecting the global oceans and marine life, including concern for these problems](image)

**Table 3** Main concerns regarding problems affecting the global oceans and marine life (N = 202)

| Concern                                                                 | Pollution (air, water, oil) | Litter (plastics) | Overfishing | Global warming/climate change | Other (e.g. alien species, habitat removal) |
|-------------------------------------------------------------------------|-----------------------------|-------------------|-------------|--------------------------------|--------------------------------------------|
| Difficulties or inefficiency in solving the problem, we reached the point of no return | 23                          | 17                | 8           | 8                              | 5                                          |
| Nobody cares nor is doing anything about it—citizens, leaders and industries | 20                          | 19                | 10          | 5                              | 6                                          |
| Impacts on the future generations                                       | 17                          | 12                | 3           | 3                              | 4                                          |
| Entering the food chain                                                 | 11                          | 24                |             |                                |                                            |
| Affecting people’s lives—lifestyle and health                           | 11                          | 6                 | 1           |                                | 2                                          |
| Causing loss of wildlife and extinction of species                      | 10                          | 10                | 8           | 7                              | 2                                          |
| Changes are too rapid and things are only getting worse                 | 9                           | 15                | 1           | 1                              | 2                                          |
| Habitat destruction and environmental degradation                        | 8                           | 10                | 5           | 3                              | 5                                          |
| Global repercussions                                                    | 8                           | 4                 | 2           | 7                              | 1                                          |
| Alterations of the biochemical cycles and ecological imbalance          | 8                           | 4                 | 2           | 4                              | 3                                          |
| The sea is an important resource                                         | 6                           | 3                 | 2           | 1                              |                                            |
| Reduction in the quality of bathing water                               | 4                           |                    |             |                                |                                            |
| Melting of ice and sea level rise, extreme climatic events              |                             |                    |             |                                | 11                                         |
solve and have reached a point of no return, also due to inefficiency and carelessness on behalf of citizens, leaders and industries. Participants were worried about the future generations that would be affected. These concerns were relevant also when considering overfishing, global warming and climate change, and other problems like habitat removal. The participants were also particularly worried that pollution and litter, especially microplastics, would enter the food chain. Finally, pollution and litter were perceived to potentially affect people’s lifestyles and health, cause the loss of wildlife and the extinction of species, destroy habitats, degrade the environment (some participants mentioned the reduction of bathing water quality), have global repercussions, and alter the biochemical cycles and ecological balance. Regarding overfishing (Table 3), aside from the concerns reported above, the participants mentioned that this problem resulted in the depletion of the ocean through the loss of fish and other species, as well as habitat destruction through practices like bottom trawling. Global warming and climate change (Table 3) were reported to be of concern as they caused the melting of the ice caps, sea-level rise, and extreme weather events like storms and floods, resulting also in erosion. Other problems (Table 3), such as habitat removal and sea transport, were claimed to result in habitat destruction and environmental degradation.

The participants had perceived or experienced as many as 14 environmental changes in the coastal area at the study location, although 8% claimed to have noticed none (Fig. 3). Wildlife reduction including species abundance, number and size, was mentioned by 40% of participants, followed by algal growth (with specific reference to the toxic alga Ostreopsis ovata) and mucilage (32%). Between 18 and 21% described water warming but also improved water quality, jellyfish, and wildlife increase (species abundance and number). Between 14 and 16% mentioned pollution, reduced water quality, erosion and sand dredging, and the presence of alien species. One-tenth of the participants claimed to
have noticed a reduction of red and green algae, while 1.5% to 5% mentioned specific fishing practices (mainly trawling), litter, and crowding.

The participants described seven personal actions they were involved in, to combat threats to oceans and marine life (Fig. 4). The main ones were recycling, mentioned by nearly all (84%), litter collection which was mentioned by about half (43%), and pollution reduction (e.g. reduced emissions) which was listed by 37%. Energy and water-saving, and participation in conservation activities (mainly litter clean-ups), were listed by 29% and 25%, respectively. The remaining actions included raising awareness or donating (15%) and responsible food consumption (10%).

**Influential factors in perceptions of marine environmental issues**

Regressions (Table 4) were performed only for variables of demographic profile, perceptions and pro-environmental behaviour which had significant correlations with one another. Tolerance values were larger than 0.2 in all instances, excluding multicollinearity between multiple independent variables. Awareness of problems affecting the global oceans and marine life including the categories represented in Fig. 2 was not influenced by any variables, except for overfishing which was significantly correlated with \( r_s = 0.26 \) and ultimately influenced by the observation of specific fishing practices. Awareness of the problems mentioned by the participants was significantly positively correlated with concern for these problems \( r_s = 0.41–0.78 \). Concern was also significantly influenced by awareness. In the case of overfishing, the observation of specific fishing practices also influenced concern.

Some observed environmental changes in coastal areas were significantly correlated with and influenced by demographic variables (Table 4). Compared with people living inland, people living on the coast were more likely to have observed reduced water quality and wildlife increase, the presence of jellyfish, and a wildlife increase (\( r_s = 0.15–0.18 \)). Water users were more likely than non-users to have observed wildlife reduction and alien species (\( r_s = 0.24–0.28 \)). People with school education were more likely to have observed a reduction in wildlife compared with people with tertiary education (\( r_s = -0.17 \)). Finally, female participants were more likely to have observed improved water quality compared with male participants (\( r_s = 0.16 \)).

Pro-environmental behaviours were significantly correlated with and influenced by different variables (Table 4). Recycling was influenced by age and education, whereby younger people (\( r_s = 0.16 \)) with school qualifications tended to recycle more than older people with tertiary qualifications (\( r_s = -0.14 \)). Litter collection was positively influenced by water use, concern for global warming and climate change, and responsible food consumption (10%).

### Table 4 Results of binary logistic regressions identifying influential variables on awareness of problems affecting the global oceans and marine life; concern for problems affecting the global oceans and marine life; observed environmental changes in coastal areas; and pro-environmental behaviour. Only variables which displayed significant \( r_s \) with the dependent variables were included as independent variables in the models

| Independent variable | Dependent variable | Estimate | SE | Wald stat |
|----------------------|-------------------|----------|----|-----------|
| GEN                  | IWQ               | 0.39     | 0.17 | 4.94*     |
|                      | POR               | 0.38     | 0.15 | 6.16*     |
| AGE                  | REC               | 0.04     | 0.01 | 8.59**    |
|                      | PAR               | 0.04     | 0.01 | 10.37***  |
| EDU                  | WIR               | -0.34    | 0.16 | 4.90*     |
|                      | REC               | -0.56    | 0.21 | 7.19**    |
| LIV                  | ALG               | 0.39     | 0.18 | 4.54*     |
|                      | WIN               | 0.56     | 0.25 | 4.82*     |
|                      | JEL               | 0.62     | 0.25 | 5.93*     |
| WAT                  | WIR               | 0.59     | 0.15 | 14.76**** |
|                      | ALI               | 0.82     | 0.26 | 10.10**   |
|                      | Lit               | 0.36     | 0.16 | 5.16*     |
|                      | RAI               | 1.19     | 0.31 | 14.43**** |
|                      | PAR               | 0.66     | 0.20 | 10.41**   |
| POLa                 | POLc              | 1.45     | 0.31 | 21.37***  |
| LITa                 | LITc              | 2.13     | 0.31 | 46.51***  |
| OVEa                 | OVEc\(^5\)        | 2.05     | 0.26 | 61.07**** |
| GLOa                 | GLOc              | 1.88     | 0.33 | 33.03**** |
|                      | Lit               | 0.48     | 0.20 | 6.08*     |
| ALG                  | POR               | 0.42     | 0.16 | 6.77**    |
| WIN                  | Lit               | 0.54     | 0.20 | 7.08**    |
|                      | PAR               | 0.66     | 0.23 | 8.20**    |
| ERO                  | ENE               | 0.44     | 0.20 | 4.64*     |
| ALI                  | Lit               | 0.71     | 0.25 | 8.36**    |
|                      | ENE               | 0.55     | 0.21 | 6.70**    |
|                      | PAR               | 0.72     | 0.25 | 8.38**    |
| FIS                  | OVEa              | 0.78     | 0.33 | 5.47*     |
|                      | OVEc              | 1.07     | 0.34 | 9.94**    |
| LIT                  | RES               | 0.92     | 0.39 | 5.61*     |

**GEN** Gender, **AGE** Age, **EDU** Education, **LIV** Living on the coast, **WAT** Water user, **POLa** Pollution awareness, **LITa** Litter awareness, **OVEa** Overfishing awareness, **GLOa** Global warming/climate change awareness, **OTHa** Awareness of other problems, **POLc** Pollution concern, **LITc** Litter concern, **OVEc** Overfishing concern, **GLOc** Global warming/climate change concern, **OTHc** Concern for other problems, **WIR** Wildlife reduction, **ALG** Algal growth and mucilage, **IWQ** Improved water quality, **JEL** Jellyfish, **WIN** Wildlife increase, **ALI** Presence of alien species, **FIS** Changed fishing practices, **LIT** Litter, **REC** Recycling, **Lit** Litter collection, **POR** Pollution reduction, **ENE** Energy/water saving, **PAR** Participation in conservation activities, **RAI** Raising awareness, donating, **RES** Responsible food consumption

\(^* P < 0.05, \ ** P < 0.01, \ *** P < 0.001\)

\(^5\) Awareness of overfishing predicted concern for overfishing almost completely, therefore regression analysis could not be performed.
and having observed an increase in wildlife as well as alien species in coastal areas ($r_s = 0.15–0.26$). Pollution reduction was influenced by gender (with females engaging in it more than males) ($r_s = 0.15$) and having observed algal growth and mucilage in coastal areas ($r_s = 0.16$). Energy and water saving were influenced by having observed erosion and sand dredging ($r_s = 0.15$) as well as alien species ($r_s = 0.18$) in coastal areas. Participation in conservation activities was influenced by age (with younger people participating more than older people) ($r_s = 0.17$), water use (users had participated more than non-users) ($r_s = 0.30$), and having observed an increase in wildlife ($r_s = 0.23$) as well as alien species ($r_s = 0.27$) in coastal areas. Water users were more inclined to raise awareness and donate compared to non-users ($r_s = 0.32$). Finally, responsible food consumption was influenced by having observed litter in coastal areas ($r_s = 0.19$).

**Discussion**

**Coastal recreational users’ perceptions of marine environmental issues**

The participants possessed moderate awareness of marine environmental issues that are relevant both in a global and a European context. Pollution and litter were the problems most mentioned, in line with the findings of other European studies of public perceptions of marine environmental issues (Buckley et al. 2017; Chilvers et al. 2014; Gelcich et al. 2014; Gkargkavouzi et al. 2020; Hartley et al. 2018; Lotze et al. 2018; Potts et al. 2016). While the participants in this study were also aware of issues like overfishing and global warming and climate change, this was in lower proportion compared to pollution and litter. This result is also reflected in other research in Europe, where the public tended to be less informed about issues like climate change (Buckley et al. 2017; Chilvers et al. 2014; Gelcich et al. 2014; Gkargkavouzi et al. 2020; Potts et al. 2016). According to Gkargkavouzi et al. (2020), the comprehension of phenomena like climate change may still be limited due to these phenomena being less visible and too complex to understand in media and conservation-related campaigns, compared to other problems like marine litter.

Notably, few participants were aware of various other marine environmental issues like erosion and alien species, both in contrast and in line with other research conducted in Europe (Buckley et al. 2017; Gelcich et al. 2014). Additionally, the participants (who were recreational coastal users) did not mention tourism and recreation as a form of pressure on the marine environment. Gkargkavouzi et al. (2020) demonstrated that coastal users are likely to underestimate the negative impacts of tourism, which is a factor deserving particular management attention.

The participants were concerned about the marine environmental issues they were aware of. This finding supports work by various authors (Buckley et al. 2017; Hartley et al. 2018; Lorenzoni and Pidgeon 2006; Potts et al. 2016) who highlighted increasing public concern regarding environmental issues since 1992, particularly in southern European countries like Italy. The participants were worried about the irreversibility of marine environmental problems, the carelessness of stakeholders, and the future generations being affected. They also correctly associated several issues with their respective consequences on environmental and human health. In reaction to different marine environmental issues, people may be fatalist, especially regarding those issues that are less tangible, like climate change, and have limited trust in institutions in mitigating threats (Curnock et al. 2019; Gelcich et al. 2014; Hofman et al. 2020; Hogg et al. 2018; Liu et al. 2021; McKinley and Fletcher 2010; Soares et al. 2021; Tonin and Lucaroni 2017; Yoon et al. 2021). Additionally, Tonin and Lucaroni (2017) revealed that coastal visitors in Italy are concerned about the integrity of marine ecosystems and biodiversity and marine environmental issues potentially compromising the delivery of ecosystem services to future generations.

The participants claimed to have observed several changes in the local coastal area, most of which were negative (e.g. pollution, alien species). Generally, these changes correspond with both negative and positive phenomena that have been affecting the study location, also during the time of COVID-19 when the improvement of some ecological features was observed in the Adriatic Sea (Accoroni et al. 2012; Braga et al. 2022; Depellegrin et al. 2020; Montanari et al. 2016; Rindi et al. 2020), as well as issues that are generally concerning to experts globally (Halpern et al. 2008; Lotze et al. 2018). However, there was also a gap between public and marine experts’ perceptions, possibly due to the influence of media and personal experiences on public views (Buckley et al. 2017; Potts et al. 2016).

The participants displayed several pro-environmental behaviours to combat marine environmental issues. This finding suggests that, despite the participants being fatalists regarding some marine environmental issues, they still displayed a moderate level of self-efficacy and personal responsibility to contribute to the preservation of marine environments through everyday living. These behaviours have been described in other studies (Chilvers et al. 2014; Engel et al. 2021; Soares et al. 2021; Veiga et al. 2016) and also in this case comprised nonactivist public-sphere environmentalism (e.g. donating) and private-sphere environmentalism (e.g. litter collection) (Stern 2000) aiming to have a direct (e.g. marine plastic pollution) and indirect impact on the ocean (e.g. energy consumption contributing to climate change) (Engel et al. 2021; Hofman et al. 2020). Additionally, the
participants engaged in actions that ascribe to adaptation and transformation as described by Hogg et al. (2018). The results of correlations and regressions demonstrated that the participants’ perceptions of marine environmental issues were influenced by several variables, with some notable relationships. For example, participants’ awareness significantly influenced concern, in line with the findings of other studies in Europe and Italy (Buckley et al. 2017; Chilvers et al. 2014; Forleo and Romagnoli 2021; Gelcich et al. 2014). Regarding the issue of overfishing, the observation of damaging fishing practices like trawling was important in influencing both awareness and concern. This suggests that the participants were particularly susceptible to overfishing, which is recognised as a top environmental concern among the public in some European studies (Gelcich et al. 2014; Gkargkavouzi et al. 2020) and is also identified as a problem in the case study location (Rindi et al. 2020). The observation of specific changes on the local coast (e.g. toxic algal growth and mucilage) was particularly influenced by demographic variables including water use and living on the coast. This suggests that the participants who were in closer contact with the water and the coast were more sensitive to the observation of less known phenomena affecting the marine environment, as indicated in previous studies (Buckley et al. 2017; Gelcich et al. 2014; Portman and Camporesi 2020; Rangel et al. 2015; Wiener et al. 2016).

Pro-environmental behaviours were mainly influenced by demographic parameters and in particular age, water use and gender. Specifically, younger people and water users were more likely to engage in pro-environmental behaviours (e.g. participation in conservation activities, raising awareness). Females were also more inclined to reduce pollution compared to males. Finally, the observation of positive changes on the local coast (e.g. wildlife increase) had a positive influence on some pro-environmental behaviours. These results concur with research by Gusmerotti et al. (2016) showing that younger Italian people are more likely to display pro-environmental behaviours compared to the older generations. They also confirm work by various authors highlighting the role that water use plays in creating a closer connection to the marine environment and willingness to act, shaping pro-environmental behaviour (Portman and Camporesi 2020; Rangel et al. 2015; Wiener et al. 2016).

**Recommendations stemming from the study**

The recommendations that emerge from this research revolve around information and communication campaigns, education, and societal involvement in public and private pro-environmental actions, also facilitated by bottom-up approaches. These recommendations are summarised in Fig. 5.

Creating change at the individual and community level requires significant effort to disseminate correct scientific information; importantly, people not only need but want more information and special education programmes covering marine environmental issues (Tonin and Lucaroni 2017). People may have a high interest in these issues but not necessarily have sufficient knowledge about them (Portman...
This gap calls for increased efforts in the area of science communication regarding underestimated issues, especially those that are less tangible. Communication and public engagement in marine issues should be sensitive to local contexts and how people can approach solutions to various problems on their terms, to increase a sense of self-efficacy (Chilvers et al. 2014). It may be successful when based on the articulation of coherent values for marine ecosystem services, to support decision-making and the pursuit of a blue growth strategy (Potts et al. 2016). Additionally, it should link the health of marine ecosystems to public welfare and promote the central role of the oceans in daily lives (Potts et al. 2016). Communication messages can be framed to encompass coastal biodiversity, changes happening to marine environments, and the potential impact of human activities on these environments (Engel et al. 2021). It is important to properly plan communication campaigns based on the sources of information that the public trusts (e.g. television, internet) (Buckley et al. 2017; Gelcich et al. 2014). Environmental communication should appeal to the protective sentiment of people concerning coastal and marine environments (Curnock et al. 2019). For example, the representation of iconic locations (e.g. in the case of this study, the Conero promontory) and the negative events that they may be subject to could amplify awareness and concern regarding marine environmental issues. Higher levels of interest and empathy can be achieved by using evocative imagery of these locations and impacts. Additionally, environmental messaging should consider socio-cognitive challenges including psychological distance from a problem, poor familiarity with marine environments, and the politicisation of marine environmental issues (Gkargkavouzi et al. 2020).

While the results of this study show that coastal users are willing to commit to various pro-environmental behaviours, more can be done to ensure a greater level of personal responsibility in mitigating marine environmental threats. Campaigns aiming to stimulate pro-environmental behaviours could emphasise the deep connection between various human activities and the marine environment. The organisation of events aimed at raising awareness and actively preserving the marine environment, such as the International Coastal Cleanup Day, can increase knowledge and boost public participation in problem-solving related to marine environmental issues like litter (Yoon et al. 2021). These events can be coordinated by private, community-based and civil groups, which are known to exert a great influence on society, contributing to the promotion of public awareness of marine environmental issues and encouraging pro-environmental behaviours through environmental campaigns, sponsored events, and marine conservation charities (Yoon et al. 2021). Several actions underpinning environmentalism (e.g. private-sphere environmentalism) can be targeted in conservation campaigns and interpretation (in the case of recreational activities like diving) that best contribute to marine environmental protection and the mitigation of marine environmental issues (Hofman et al. 2020).

One of the challenges of convincing people to engage in pro-environmental behaviours is proving that their actions and choices, however small, can affect marine environmental health. In this context, communication messaging on how to engage in such behaviours should include specific, practical suggestions (e.g. taking shorter showers) rather than prohibitions (e.g. saving water) to be persuasive and successful (Hofman et al. 2020). Environmental messages ought to be powerful, be accompanied by tailored support including action strategies, and target multiple behaviours rather than single ones (Hofman et al. 2020). Since there are several real and perceived barriers (e.g. lack of infrastructure and support) preventing people from engaging in pro-environmental behaviours, campaigns should include information on key issues related to marine conservation, current legislation, and resources that could be accessed to become familiar with policies (Hofman et al. 2020). Finally, Curnock et al. (2019) argued that, in environmental communication aimed to foster pro-environmental behaviour, a ‘small changes’ approach with positive affirmation and promotion of incremental success and fostering pride in environmental behaviours, should be used to promote a balance between hope and clear and accessible actions linked to attainable goals.

Projects funded by the European Union can represent an opportunity to achieve several goals of public engagement in marine environmental issues, especially considering that marine environmental issues usually do not have a “one solution fits all” but require a combination of approaches by different actors. These approaches can be cost-effective and effectively enhance awareness, knowledge, individual responsibility, self-efficacy, and commitment to engage in pro-environmental practices (Veiga et al. 2016). Additionally, Hofman et al. (2020) endorsed multi-stakeholder collaboration to effectively promote communication, education and pro-environmental behaviours. For example, encouraging conservation organisations, government and research entities to collaborate in targeting specific educational messages and behaviours could lead to a higher level of public engagement. This is important because the public may trust certain individuals and entities, such as research institutes and NGOs, more than others, such as the government (which paradoxically holds great responsibility for solving environmental problems) to communicate regarding environmental issues (Buckley et al. 2017; Gelcich et al. 2014; Gkargkavouzi et al. 2020). Multi-stakeholder collaboration can promote better trust in different entities.

This study confirms in part that a connection to nature resulting from coastal recreation may contribute towards filling the schism between people and marine environments,
supporting intentions to mitigate marine environmental threats (Portman and Camporesi 2020). Engagement strategies should be tailored to target different types of coastal recreational groups, especially those that are less in contact with water. Targeted environmental education can provide long-term solutions to marine environmental issues by altering human behaviour and community attitude. However, information needs to be accurate and the education process efficient to enhance public concern, personal and societal responsibility and a desire to be involved, even if indirectly, in the solution of marine environmental problems (McKinley and Fletcher 2010). Coastal recreational groups’ values can be stimulated in different ways. Environmental education could be focused on consciously increasing biosphere values, and enhancing perceptions that individual actions will contribute to improving the marine environment, by promoting voluntary activities such as litter collection and providing a material reward for recreational groups that make outstanding contributions to marine environmental conservation (Liu et al. 2021). Local businesses relying on coastal recreation for revenue could adopt sustainability practices to increase recreationists’ environmental concern and pro-environmental behaviour (Liu et al. 2021). Coastal users often aspire to be more actively involved in decision-making, for example, as wardens in marine protected areas, and decision-makers favour more consultation with coastal users (Hogg et al. 2018). These aspirations, coupled with coastal users’ attitudes towards adaptation and transformation, can be exploited to introduce collaborative approaches among different stakeholders to address marine environmental issues, such as participatory research or citizen science.

Finally, considering that the study location is under consideration by various stakeholders to become a marine protected area, it would be critical to continue to probe public perceptions to understand potential support, as this is dependent on beliefs, attitudes, values and concerns towards marine resources and environmental issues, which could ultimately influence the acceptance of conservation and management initiatives (Gkargkavouzi et al. 2020). Local policymakers would need to map public perceptions to design specific communication campaigns to promote societal engagement in discussions of marine protection. While this study focused on coastal recreational groups, it still demonstrated that within this sample perceptions can be heterogeneous and therefore more research should focus on addressing the complex interaction of environmental, social and cultural factors shaping perceptions of marine environmental issues. It is important to consider public consultation and education as a tool to incorporate public perceptions into policy and strengthen marine environmental governance. In this process, different stakeholders should cooperate to design interventions aimed at creating an environmentally literate society and reaching high levels of public support for marine policy.

**Conclusion**

This study aimed to assess perceptions of marine environmental issues among coastal recreational users in Italy, and the eventual influences on these perceptions. The participants were aware of and concerned about a variety of issues, especially pollution and litter which are highly mediatic issues. Engaging in several pro-environmental behaviours demonstrated that while being fatalistic about some marine environmental issues, the participants still tried to contribute to mitigation strategies through daily living and collective actions. Awareness of marine environmental issues significantly influenced concern, while pro-environmental behaviours were particularly influenced by demographic parameters like age and water use, with younger people and water users being more engaged. Recommendations stemming from this research included communication, education and active engagement campaigns to enhance awareness of marine environmental issues, particularly those which are perceived as distant and less tangible, and promote greater involvement in pro-environmental behaviours at home and as part of collective efforts. Multi-stakeholder cooperation would be necessary to streamline marine conservation interventions and public engagement in marine environmental issues and marine policy. The results of this study confirm the importance of researching public perceptions of marine environmental issues, shedding light on their complexity and creating opportunities to recommend avenues to improve awareness, concern and pro-environmental behaviours among coastal recreational users with different characteristics.

There are some limitations to this study, which must be considered in the interpretation of the findings and in executing future research. For example, the study did not consider the full spectrum of coastal users, limiting their general representation and offering only a partial perspective on perceptions. Although justified, the study location was a circumscribed area on the coast of Italy, offering a single geographic perspective and preventing some data generalisations. There may have been other important influential variables which were not included in this study, resulting in the generation of only partial information on perceptions. Nevertheless, the study still contributed to an understanding of coastal users’ perceptions of marine environmental issues.

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