



Attitudes and behaviours of marine recreationists towards conservation and environmental protection: A case study of Tel Aviv, Israel

Michelle E. Portman^{*}, Andre Zhulpa Camporesi

MarCoast – Ecosystems Integration Lab, Faculty of Architecture and Urban Planning, Technion – Israel Institute of Technology – Technion City, Haifa, 32000003, Israel

A B S T R A C T

The association between participation in outdoor recreational activities and environmental perceptions and behaviors has been investigated in previous studies, including by conservation scholars. However, few of these have focused specifically on the relationship between participation in marine recreational sports and attitudes and perceptions towards marine conservation. Understanding this relationship is particularly important because although considered the public domain, the marine environment is generally challenging to access and ocean health is under significant threat. This public perception study investigates whether environmental behaviour, interest in and knowledge of marine conservation issues is associated with marine sport activities, particularly, engagement in surfing and SCUBA diving. Researchers administered a survey to recreationalists in and around the beaches of Tel Aviv, Israel. Based on statistical analysis of 170 responses, the study rejects the hypothesis that those who practice these sports are more environmentally aware. Generally, the responses of those who practice surfing on a regular or frequent level indicate lower levels of environmental behaviors and interest in ocean topics, but somewhat higher levels of knowledge about the marine environment. Most of the associations identified from among the responses of SCUBA divers were not statistically significant, which results also from less responses received from those who practice the sport. In any case these findings can be used in the future for designing ocean, coastal and general environmental protection campaigns targeting participants of these and other sports whose participants are dependent on ocean and coasts.

1. Introduction

Marine conservation is an essential field that must be looked at from myriad perspectives. Pollution, climate change, overfishing and mining are a few examples of threats to the marine environment in the last decades that make marine conservation so important [1,2]. Nearshore marine ecosystems are important economic assets and venues for tourism and leisure [2,3]. This makes it crucial to address marine conservation not only from a physical perspective but also from social-behavioural one and to understand potential benefits and biases the public can bring to its advancement. Knowledge and interest in marine protection on the part of those most dependent on marine and coastal ecosystems are important leveraging points for engendering the political will needed to improve the ocean environment (e.g., Refs. [4–6]).

This research explores marine conservation from a social and human perspective, relating it to the public's utilization of, and interaction with, the marine environment through recreational sports. It explores a possible driving force behind environmental behaviours and examines whether marine recreationists' awareness of marine conservation is associated with how they experience the sea. It follows up on questions raised by other scholars about how recreational activities influence

environmental perceptions and behaviors (e.g., Ref. [7]); as such, this research is predicated on the notion that recreational experience is a predictor of recreationists' behaviour and thought with regard to environmental awareness and interest in environmental protection (e.g., [8–10,52]).

Such consideration of motivational forces based on experience is not new. Brymer et al. [9] studied the relationship between environmental attitudes and the practice of sports that involve a high degree of risk and require high levels of physical exertion at great speed or height [11]. Brymer et al. [9] documented the perceptions of free-skiers, climbers and mountaineers who explained that the activities they practiced triggered in them the feeling of oneness with the natural world and interest in protecting it. Other researchers claim that outdoor recreationists tend to be concerned about the environment, depending on the type of activity; those who prefer consumptive activities (e.g., hunting or fishing) tend to be less concerned than those who prefer non-consumptive outdoor activities (see Ref. [10]).

With regard to sustainability, UNESCO's Man and the Biosphere Program adopted environmental perception studies as a useful diagnostic tool in 1968 when it declared such studies a foundation for environmental management (see Ref. [12]). Since then, public perception studies have been applied to explore positions on environmental

^{*} Corresponding author.

E-mail address: mep@technion.ac.il (M.E. Portman).

issues, such as the European Commission's survey on public perceptions on environmental risks [13]. Public perception surveys are used to assess general or specific needs, establish relationships and analyze trends regarding the public's view of the topic investigated; they assume that the respondent is an individual who has the power to influence environmental policies and to positively impact the success of the policy process [14].

Early on, in view of the 1978 Tbilisi Intergovernmental Conference on Environmental Education, Hungerford and Volk [15] described the environmentally responsible citizen as someone who is concerned about and aware of the environment and its allied issues and is motivated to behave "environmentally". A *pro-environmental behaviour* is defined as a "behaviour that consciously seeks to minimize the negative impact of one's action on the natural and built world" ([16]; p.240). Finally, *attitude* is a "psychological tendency expressed by evaluating a particular entity with some degree of favour or disfavour" [17]. *Environmental attitudes* are defined by one's "predisposition to respond consistently in a favourable (or unfavourable) manner with respect to the environment" [18] and therefore closely linked to how one perceives environmental degradation.

Many studies that link sports and recreational activities to environmental behaviours often involve some type of intervention, frequently an educational one (e.g., Refs. [19,51]). With regard to marine activities, Rangel et al. [6] researched how snorkelling could bring about awareness of marine biodiversity among participants and, hence, reduce the probability of human impacts. Taking place in Algarve, Portugal, their research explored the influence of activities conducted before the snorkeling activity and implemented with the aim of influencing perceptions. We are interested in studying associations between marine recreationists' activities and their propensity for environmental perceptions without added interventions.

Marine recreation is an activity, sport or game engaged in for leisure and enjoyment, taking place in the ocean milieu. Here we study the perceptions of those who engage in wave surfing and SCUBA diving at a recreational, non-commercial and non-competitive level. Without any direct intervention (i.e., experimentation), this study surveys these two sports participants' perceptions with regard to environmental behaviors as well as interest in and knowledge of marine conservation.

2. Perceptions and conservation

2.1. Background

Environmentally-focused public perception studies are important for understanding how to promote conservation. In recent years, the relevance of perceptions to environmental protection has increased, countering claims that environmental problems will only be solved by technological solutions [14]. Balmford and Cowling's statement ([20] p. 692) that conservation is primarily "about people and the choices they make" reinforces the importance of public awareness for conservation. Yet, it is still uncommon to find scholarship that links specific activities to ocean conservation [21].

Public perception surveys about ocean health have highlighted general patterns of respondents' knowledge and behaviours. An early marine-related public perception study conducted for the UK National Maritime Museum [22], surveyed visitors about what they perceive to be the most interesting topics and most pressing problems related to the marine environmental field. The most prevalent answers varied from pollution to climate change. Other significant concerns were overfishing and stock depletion. The research showed that despite a general positive interest towards marine-related issues, visitors' indicated significant gaps in knowledge and a general unwillingness to seek further information independently. The study concluded that the museum should provide significant opportunities for raising awareness about marine conservation [22].

Similarly, Hawkins et al.'s [21] study, also conducted in the UK,

highlighted a general sense of pessimism and lack of knowledge about marine conservation among the public. Predicated on the idea that public opinion can drive and shape environmental policies and affect their success, Hawkins et al. [21] conducted three nationwide surveys at 5-year intervals in 2005, 2010 and 2015. Each of them revealed negative views of ocean health and management, as well as mixed results in terms of ocean literacy and knowledge of marine policies. However, the enthusiasm regarding marine topics was high with the majority of respondents stating that they favour devoting more than 40% of UK national waters to protected marine area that would be free from fishing and damaging activities.

Although important, Fletcher et al. [22] and Hawkins et al. [21] fail to analyze the association between people's environmental awareness and favoured activities. Clearly, the connection between positions on conservation and public use and activities is important. While practice of sports is generally a factor in discourse about environmental perceptions and motivation, extreme sports such as free-skiing and mountain climbing (e.g. Ref. [9]), have received the bulk of significant attention in this regard, perhaps because they are considered harbingers of ecological impact and are investigated to improve protected area use and management [23]. Because of the focus on psychological motivation towards risk-taking related to extreme sports (such as adrenaline-seeking, see Refs. [24]), studies often fail to investigate a possible connection of participants to the natural milieu itself [9,25]. Yet, recent phenomenological studies suggest that extreme sports participants might be the precursors of a trend in environmental awareness (e.g. Ref. [8]), based on the notion these sportspersons develop feelings of connection with the natural world where they practice it [9,25].

As for the marine environment, while there have been many studies that focus on the impact of SCUBA diving to marine protected areas, where diving often takes place (e.g. Refs. [26,27]), few studies have examined the effects of the diving experience on the diver. Notable exceptions include Rangel et al.'s [6] study of snorkellers in the marine environment and Giglio et al.'s [28] review of diver characteristics.

Strong relationships to the natural world can be developed through any kind of sport or activity that involves contact of participants with their environment. Overcoming risk is not the only incentive for experiences with nature; more relaxing activities also beget personal connections with the environment. A study conducted by Mullins [8] investigated how canoe expedition participants gained a sense of belonging to the environment and knowledge of environmental-related topics. The environment-experience combination proved useful for increasing awareness and sharing knowledge, and thus important to environmental education and pedagogy [8,29]. A connection to nature resulting from expeditions and recreation may counteract a tendency for individuals to see themselves as separate from nature and therefore trigger intentions to change harmful environmental behaviours [30].

Surfers' have been investigated in the past. Research conducted in the coastal locality of Garopaba in Brazil, presents surfers as archetypes in conservation achievement because their sport depends entirely on the natural elements of the marine and coastal environment [5] in ways similar to extreme sports and canoe expeditions mentioned above. Wade [25] describes surfers' unique dependence on the quality of the environment they surf in. Surfing is often presented as an "immersive bodily practice", that stimulates a feeling of the environment as part of oneself ([31]; p. 35). From its origins, dated around 1880 in Polynesia and Hawaii, surfing has been considered by some to be more of a philosophy than a mere sport, and more of a soul-centred activity than a bodily experience [32]. Similarly, SCUBA is dependent on high quality environment for a more pleasurable and interesting experience, thus it frequently takes place in protected areas [33].

The economic and social importance of recreational surfing and SCUBA diving justify the context of this investigation. At least 30 million people had been certified for diving worldwide as of 2012, and about one million people learn to dive each year [33]. SCUBA diving has been described as a multi-billion dollar industry [34]. Cisneros-Montemayor

and Sumaila [35]; as cited by Gladstone et al. [36]; estimated that the sport, together with recreational fishing and whale watching, involve 121 million people globally, expenditures of about USD\$47 billion, and about 1 million jobs. Surfing, important for economic development, is a sport that many communities thrive on [37]. A 2014 study estimated that there are approximately 518,000 surfers and 271,000 SCUBA divers among UK residents (DEFRA 2014). These figures contest to both the economic importance of these marine sports and the need to understand these stakeholders' perceptions both for their potential to harm and to protect the marine environment.

Wade [25] and Scott and Rogers [38] claim that surfers and divers are devoted to the protection of their local surf or dive site because water pollution, bacteria proliferation, jellyfish invasion and other risks are perceived as potential health dangers and could lead to beach closing. Such situations could be partially ameliorated by the same people who enjoy the area [6,39]. Scott and Rogers' study [38]; focused on water quality and its influence on beachgoers' decisions in the Gulf of Maine, found that impaired coastal water quality effects commercial activities and recreational users. Among the latter group, surfers are a particularly sensitive because of the time they spend in the water during all seasons and conditions.

2.2. Building on past studies

This study draws on past investigations that connect between users and perceptions of the marine environment and marine conservation, particularly the Ocean Topic Public Attitude Survey (OTPAS) conducted in the years 2012–2013 and Holland-Smith et al.'s [39] study. The latter investigated surfers' views, seeking to draw inferences about the connection between British surfers and their level of environmental awareness. The research consisted of a qualitative thematic analysis of eight surfers' responses to open-ended in-depth interview questions. This allowed exploration of factors related to surfing that influenced engagement in pro-environmental behaviours [39].

The OTPAS, conducted and published by Weiner et al. [45], was administered to hundreds of ocean users in Honolulu, Hawaii as part of an assessment for the Center for Ocean Sciences Education Excellence Island Earth, a US National Science Foundation funded program. It highlighted how attitudes towards ocean conservation are predicted by the ways in which individuals engage with the ocean through commercial, scientific and cultural practices. Significant relationships were found between certain types of ocean use and willingness to participate in conservation activities [45]. The OTPAS consisted of multiple choices, ranking and word interpretation questions, and focused on three main factors: the importance of different ocean-related issues, interest in learning about certain topics, and participation in cultural and social environmental-oriented activities.

Another example is that of the New Zealand Department of Conservation's (DOC's) investigation of the attitudes and behaviours of New Zealanders towards coastal management, marine protected areas and marine biosecurity. The DOC survey assessed New Zealanders' values, attitudes and perceptions by asking questions designed to highlight specific behaviour and knowledge patterns [40]. It asked, for example, how important is marine conservation compared to other environmental issues and what people perceive as the main threats to the health of the marine environment. Although different in its scope and main purpose (the DOC's investigation aimed to improve marine and coastal management), some aspects, such as definitions of pro-environmental behaviours and sample questions informed our study.

In addition to serving as examples for the formulation of our study's questionnaire, past studies indicate the importance of understanding users' perceptions of the marine and coastal environment. This research complements other studies by investigating whether the level of recreational activity practiced is associated with greater concern for, and knowledge of, marine conservation. It seeks to confirm or reject the following hypothesis: *Are people who practice marine recreational activities*

more concerned about ocean conservation, and do they have more environmentally friendly behaviours related to the marine environment than those who do not practice these activities? It does so by answering the following question: *Is there an association between the frequency a marine sports activity is engaged in and 1) environmental behaviours, and 2) knowledge and concern about marine conservation?*

3. Methods

The research questionnaire (see Appendix 1) for this study was designed to enable respondents to give clear and simple answers to questions about four different aspects of their lives: a) the level of intensity with which they practice ocean-related sports, b) their general behaviour towards the environment and habits when interacting with the marine environment, and c) their interest in ocean issues and d) knowledge of ocean conservation. The questionnaire investigated whether the practice of surfing or SCUBA diving is associated with greater levels of environmentally responsible behaviour, interest and knowledge of marine conservation issues. Specifically, it was expected that those who participate in these two sports more frequently are more interested in and knowledgeable about marine conservation.

Firstly, the questionnaire sought to differentiate between groups of respondents according to the intensity at which they practice marine sports, either surfing or diving. Secondly, their report conduct, attitudes and behaviours were analysed and used as determinants of environmental and marine conservation awareness and concern. The questionnaire consisted of 59 questions, organized into 5 sections: 1) general background about the respondent; 2) engagement in a recreational activity, either surfing and/or SCUBA diving; 3) environmental behavioural patterns; 4) environmental knowledge and concern; and 5) an ocean literacy quiz.

The third part of the questionnaire distinguished between behaviours and concerns and consisted of a section to be answered only by surfers and another only by divers. The fourth sections distinguished between general environmental knowledge and concern and those more specifically related to the marine environment. All questions were multiple choice, binary Yes/No or Likert-type questions. Only the general background section, at the beginning of the questionnaire, allowed submission of short open-ended answers.

With regard to marine conservation interest and knowledge, the respondents were asked whether they looked for information about marine conservation issues and how often, as well as how interested they were in specific topics and how much they knew about them. The first part that aimed to understand levels of knowledge (and making up the "Ocean quiz" part of the questionnaire) asked questions about specific terminology. Respondents were asked about general terms (such as "biomass") and more specific marine and coastal related terms (such as "wrack zone"). The second part of the Ocean quiz asked multiple choice questions about facts related to the marine conservation, such as what causes the loss of coral reefs and what are sources of marine noise pollution.

The questionnaires were made available as hardcopy at several surf and dive schools in Tel Aviv and surrounding areas. GoogleForms was used and accessed through a URL link that was made available via the hardcopy version or through social media including Facebook and LinkedIn. In the end, there were so few hardcopy responses (only 3), in order to avoid bias from differences between the printed and digital forms, only the digital responses to the survey were counted. Also, only responses submitted by respondents over the age of 18 were considered. The time it took to answer the questionnaire was about 12 min; this included reading the introduction and ethics consent, following the instructions and answering all the questions. Participation was voluntary and without compensation. Ethics approval no. 2018–063 was obtained for this study following a review from the Technion's Behavioural Sciences Research Ethics Committee.

For analysis purposes, the level of activity (i.e., the frequency of

engaging in either surfing or SCUBA diving) was divided into the categories: intermittent, regular and high frequency. A fourth category, of “non surfer” or “non diver”, was used for those who indicated that they **never** engaged in the said activity, either surfing or diving or both. The three categories of frequency of activity (hereafter “activity level”), combined answers for: 1) the average number of activities reported per month (either 1–2 (Intermittent), 3–4 (Regular) or 5 or greater (Frequent)), and 2) surfing and diving trips reportedly taken on average per year (either 1–2 (Intermittent), 3–4 (Regular) or 5 or greater (Frequent)).

While the survey instrument was somewhat varied in its approach, the statistical analysis focused on three topics related to behaviors, perceptions/attitudes and knowledge: a) behaviour patterns (questions 17–27 in Appendix 1), coded “BEH”; b) interest in topics related to marine conservation (question 51 in Appendix 1), coded “INT”; c) knowledge of terms related to marine conservation (question 52 in Appendix 1), coded “TERM”. The variable values for BEH, INT and TERM were calculated using grouped responses which had been recoded to 0–2 and summed. The distribution of calculated summed scores (i.e., additive of all answers received for questions grouped together under each topic) determined category bounds. In other words, categories are based on cumulative percentages of the frequency of calculated scores received for each dependent variable group.

Since both the dependent (explained) and independent (explanatory) variables in this study were transformed to ordinal (ranked) scales, the analysis consisted of cross tabulations and ordinal logistic regressions for descriptive and inferential statistics respectively [1]. Cross tabulation provides the multivariate frequency description and a basic understanding of how the distributions of dependent variables (BEH, INT and TERM) are associated with activity levels; ordinal logistic regression model were used separately for each of these dependent variables and then compared to understand the interactions between the different pairs of categorical variables (and some responses to parts of the questionnaire were not used). For both the Frequency and Logistic procedures SAS 9.4 statistical software was used [50].

4. Results

From among the total number 170 questionnaire respondents, 52.7% were male and 47.3% were female. The ages of respondents varied from 19 to 54 years with the average ($\bar{x} \pm \text{sd}$) being 32 ± 7.6 years. Among those who answered that they surf 43.2% are female and 56.8% male. Surfers ranged in age from 19 to 42 years ($N = 74$, $\bar{x} = 28 \pm 4.5$). Those who answered that they SCUBA dive were from the ages of 19–54 ($N = 54$, $\bar{x} = 37.5 \pm 8$) and 45.4% female and 56.8% male (no other answers were given). Those who answered the surfing section ranged in age from 19 to 42 years old ($N = 74$, $\bar{x} = 28$, $\text{std} = 4.5$). Those who answered that they SCUBA dive were from the ages of 19–54 ($N = 54$, $\bar{x} = 37.5$, $\text{std} = 8$) and 45.4% female (54.6% male).

The majority of the survey respondents visited the beach often during the summer months and rarely during the wintertime. Fifty-three respondents indicated that they never surf (Q12, See Appendix 1). One hundred and one actively indicated that they never participated in SCUBA diving (see Q12 in Appendix 1). In some cases, there was missing information, as computed and reported as “Frequency Missing” (See Appendix 1). This number indicates respondents who did not indicate surfing or diving in Question 12 and did not fill out “... for Surfers only” or “... for Divers only” (Questions 13 and 14; Questions 15 and 16, respectively in Appendix 1 N) and therefore were not included in the analysis for either the Behaviour questions, the Interest questions or the Term Knowledge questions. There were some inconsistencies in the responses which is why these number differ slightly for each of the dependent variables.

The results show no positive association between high levels of surf activity (frequency of surfing) and environmental behaviours. The people who surfed the most (“Very Frequent” in Fig. 1) reported

practicing fewer environmental behaviours in their daily life (in terms of recycling, plastic use, organic shopping and environmental actions) than those who were more frequent surfers (“Regular” in Fig. 1). This is quite pronounced even in from the descriptive statistics. If we understand environmental behaviors as indicating lower environmental awareness, then our results are disappointing in view of the hypothesis and assumptions. With regard to SCUBA divers, the situation is much less pronounced. Those who indicate behaving “environmentally” are largely intermittent divers (10.9%). Intermittent and Regular divers also exhibit moderate levels of environmental behaviour, respectively (7.69%) and (5.77%).

With regard to interest in marine conservation topics and issues, again frequent surfers indicated either low or moderate interest in marine conservation topics, respectively 17.74% and 2.42%. None of those who surf Very frequently have a high interest in marine conservation. Among the divers, those who dive very frequently or intermittently are relatively evenly distributed, showing similar percentages of low, medium and high interest in marine conservation. Interestingly, those who dive the most make up the greatest number of those who indicated a high level of interest in marine conservation, but the difference between the categorical activity level among divers for this dependent variable (INT) is not significant (see below).

Lastly, for the term knowledge (TERM), results indicate that those who surf regularly have the greatest knowledge of terms related to marine issues and this is quite pronounced (23.53%). Considering that almost as many Intermittent and Very frequent surfers indicated low and medium interest in marine issues, seems again to render the hypothesis invalid with regard to surfers. Similarly, those who dive infrequently are most knowledgeable based on familiarity with marine conservation concepts (terms and issues). Those most familiar (HIGH TERM) indicated diving activity levels that were Intermittent 18.42%, 7.89% and 5.26% respectively. Of note for SCUBA divers in general was that very few respondents indicated any other category than high levels of knowledge. Only 4 (out of the 53 who reported engaging in SCUBA diving) reported medium levels of term knowledge and one reported a low level of knowledge. The rest, 28 (Intermittent), 12 (Regular) and 8 (Very frequent), reported high levels of term familiarity.

As explained in the methods section, ordinal logistic regressions were fitted to estimate an association between probability of the dependent variables (i.e., BEH, INT and TERM) being at a higher level and the explanatory variables SURF and DIVE remained categorical variables. For the models run on BEH, the overall results provided by Type III GLIMMIX Procedure analysis (hereafter “Type 3 Analysis”; SAS 9.4), are significant (Surf: Wald chi-square = 27, $p < .0001$; Dive: Wald Chi-square = 18.4, $p = 0.0004$). For the models run on INT, the overall results of the Type 3 Analysis, are also significant (Surf: Wald Chi-square = 13.1, $p = 0.0044$; Dive: Wald Chi-square = 17.6, $p = 0.0005$). Lastly, the results of the logistic regression for TERM similarly indicate significant effects of the two factors SURF and DIVE (Surf: Wald Chi-square = 18.6, $p < .0003$; Dive: Wald Chi-square = 9.2, $p = 0.03$). Based on these models’ results, a pairwise comparison could be conducted to determine more specifically between which groups of the explanatory variable significant difference exists in the probability that the dependent variable, BEH, INT or TERM, will be at a high level. The statistically significant results are listed in Tables 1–3. See Appendix 2 for detailed results of the pairwise comparisons, including those that are not statistically significant.

For the first dependent variable indicating general environmental behaviour, BEH, significant differences were found between non-surfers, or those who surf regularly or intermittently, and the Frequent surf group (See Table 1). Odds Ratio (OR)¹ for these pairwise comparisons are: for non surf OR = 14.1 ($p < 0.0001$), for Regular activity level surfing OR = 6.3 ($p = 0.0008$), and for Intermittent surfing OR = 14.7 ($p < 0.0001$). There is also marginal significant difference between those who do not surf and the Regular surf category: OR = 2.3 ($p = 0.05$). For DIVE, significant differences were found between those who do not dive

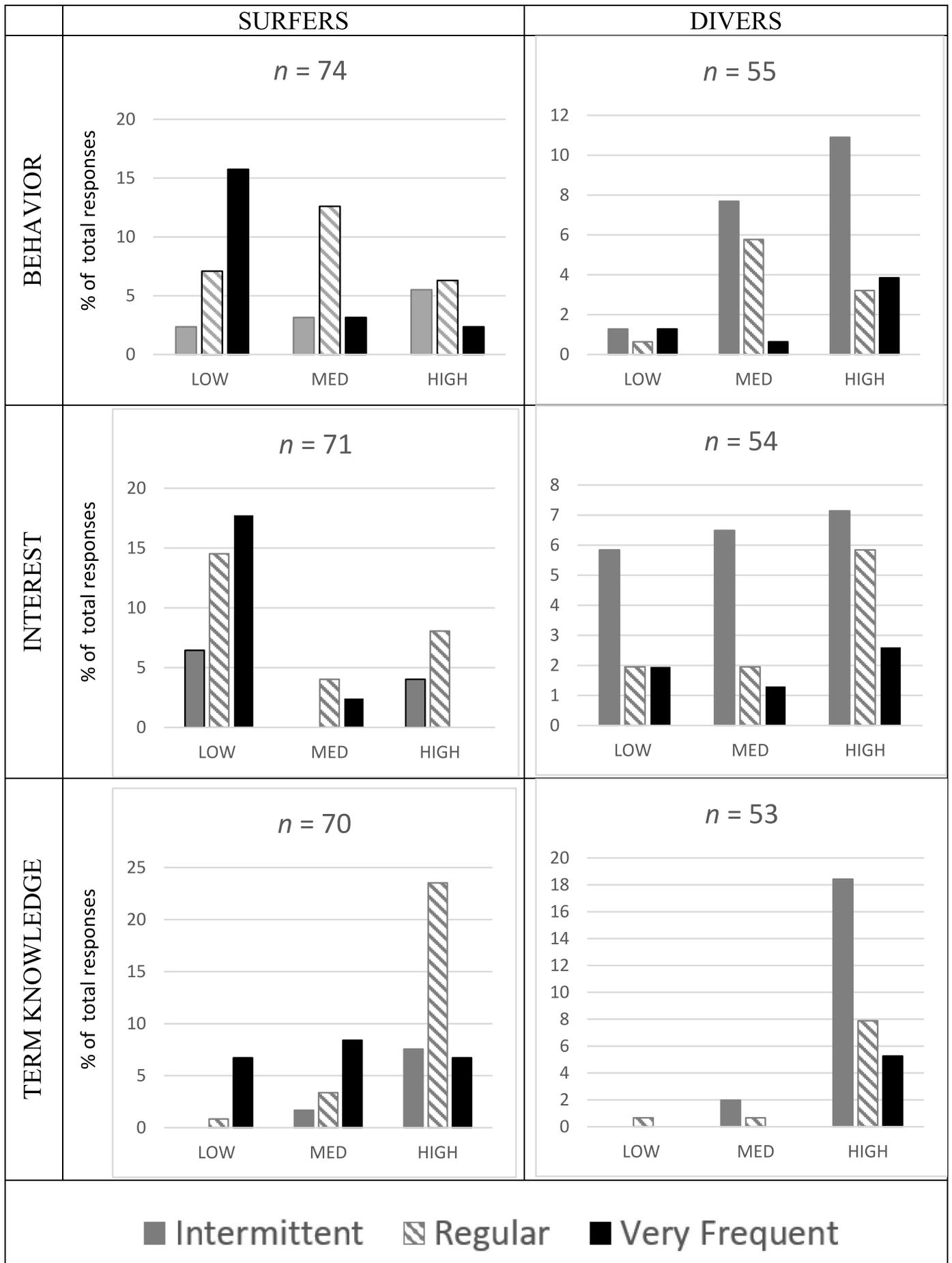


Fig. 1. Percentage of respondents (y-axis) reporting environmental behaviors, interest and knowledge of marine conservation terms, respectively, by categories (low, medium, high) according to activity level (x-axis): intermittent, regular and frequent. For the full categorization (including non-participants and missing responses) see [Appendix 2](#).

and those who dive at any of three activity levels with the odds ratios being for Intermittent diving OR = 0.22 ($p = 0.0002$), for regular diving OR = 0.4 ($p = 0.08$) and for frequent diving OR = 0.18 ($p = 0.01$).

For the dependent variable indicating interest in marine conservation topics, INT, significant differences were between non-surfers and those who surf frequently, as well as with those who surf intermittently or regularly with those who surf frequently (See [Table 2](#)). Odds ratios for these pairwise comparisons are: for non surf OR = 11.6 ($p = 0.0003$), for intermittent activity level surfing OR = 6.6 ($p = 0.0216$), and for regular surfing OR = 7.0 ($p = 0.0063$). For DIVE, as for the previous variable BEH, significant differences were found between those who do not dive and those who dive at any of three activity levels. The ORs for each activity level – Intermittent, Regular or Frequent – are respectively: OR = 0.32 ($p = 0.0046$), OR = 0.15 ($p = 0.0007$), OR = 0.29 ($p = 0.0597$). Between the other levels of SCUBA diving, the differences are not significant.

For TERM, indicating levels of knowledge in marine conservation topics, significant differences were between non-surfers and those who surf frequently as well as between those who surf intermittently and regularly with the Frequent surf group (See [Table 3](#)). Odds ratios for these comparisons are for non-surf OR = 5.02 ($p = 0.0010$), for intermittent surfers OR = 8.71 ($p = 0.0141$), for regular surfers OR = 10.32 ($p = 0.0002$). Among SCUBA divers, the only significant difference is between non-divers and those who practice the sport intermittently and regularly, with the latter only being a marginally significant difference. Odds ratios for these pairs are respectively, OR = 0.1730 ($p = 0.0068$) and OR = 0.29 ($p = 0.1094$).

From the results of the logistic regression and subsequent analysis of the pairwise comparisons, the activity level groups that are most likely to be associated with greater environmental behaviors, greater interest and knowledge can be identified. A summary of findings indicates that surfers seem to be more of a mixed group with significant differences found between almost all categories of activity levels. As for divers, particularly for likelihood of greater interest in marine topics (INT) and for greater environmental behaviors (BEH), significant differences are mostly among non-divers when compared to all three of the categorical activity levels. In other words, there is low variability among those who SCUBA dive. The greatest differences are simply between those who dive at any level, and those who do not dive at all. Also, worth pointing out is that for the TERM variable, lack of significant difference between non-diver group and intermittent and regular divers is likely influenced by the small number of survey responses from members of those groups.

5. Discussion

Numerous scholars have looked at what is involved in marine and ocean literacy, how to improve it and of course, what human activities can best improve marine conservation efforts [2,41], from the establishment of marine protected areas to increasing human-ocean interactions [42] to familiarizing the general public with the marine environment. Similar to research conducted for other sports (e.g. Refs. [8,9,23]), assumptions are based in this research on the premise that greater interaction within the marine and coastal environment begets marine conservation concern. From this assumption, this study's hypothesis of greater general environmental behaviours as well as greater interest in and knowledge of the marine environment developed. However, based on the results, the hypothesis was rejected. While some significant connections can be made regarding activity levels of SCUBA divers and environmental behaviors, knowledge and familiarity with marine conservation, for surfers the connection cannot be made.

Overall there was neither a positive association nor any significant

association between the practice of a marine activity (surfing or SCUBA diving) and the level of environmental responsibility, interest and knowledge of marine conservation issues. Surprisingly, surfers showed the opposite association, suggesting that those who surf more often do not practice environmental behaviors and are not particularly interested in the marine environment. If anything, those who surf regularly might be slightly more familiar with the marine environment (See [Fig. 1](#)). This suggests that those who practice surfing frequently are attracted by the sport itself rather than by a deep concern for the sea or the environment. Among those who practice the sport at a high frequency, concern for the sea was likely not a factor drawing them to the sport to begin with nor was it developed while practicing the sport.

Interestingly, these results differ from what might be expected from previous studies about sport practitioners [5,6,9]. In fact, the assumption that practicing a certain activity related to nature begets a more developed sense of respect for nature was not confirmed among those surveyed. In addition, two methodological messages are apparent from these findings: a) more direct questions should be asked of marine recreationists (e.g., how a respondent got involved in the sport they practice), and b) a larger sample of marine sports should be investigated to determine if some marine recreationists (e.g., recreational anglers) are more interested or knowledgeable about the marine environment than others. For example, recreational fishermen may be more interested in conservation of commercial fish species because their sport is more dependent on a functioning marine ecosystem; or recreational sailors may be more interested in climate change mitigation, knowing that it will affect ocean storminess.

Some scholars contend that evidence is still needed to prove that knowledge, education, and public awareness of the oceans leads to sustainable behaviour and concern for the oceans (e.g. Ref. [44]), while others (e.g. Ref. [10]), found that education is generally a significant factor associated with environmental behaviors. In relation to this study, it would therefore be interesting to investigate whether differences in socioeconomic status and level of education can be discerned between surfers and divers. Then, correlation with such differences could be investigated with regard to environmental behaviors, knowledge of the ocean environment and interest in marine conservation.

The different results from among the two groups SURF and DIVE, suggest that environmental behaviors and marine interest and knowledge levels should be explored in relation to demographic and socioeconomic characteristics of those who practice these sports (e.g., Ref. [45]). It is possible that those who practice SCUBA diving are better off economically and therefore able to make more "travel abroad" trips, more museums and aquariums visits while also having the luxury of practicing more environmental behaviors related to their sport of choice [16,33].

Of note are several limitations of this study which should be considered a precursor to a more in-depth analysis of these particular sports (surfing and diving) in greater numbers and in varied contexts. First, this study analysed the activity levels, such that associations were sought based on frequency of activity, rather than just binary analysis of whether a respondent practices or does not practice the sport. From the regression analysis using Least Square Means, differences were commonly found between those not practicing the sport at all (Non-surfer and non-Divers) and those who practiced at varying levels. Additionally, a third population should be tested: those who practice both surfing and SCUBA diving. Also, activity levels asked about in the questionnaire are not necessarily appropriate for both sports. Since SCUBA diving is a much more expensive sport (requiring for example, the filling of oxygen tanks for every dive), the monthly and even yearly frequencies asked about should perhaps be different between the two

Table 1

Pairwise comparison of Surf and Dive activity level categories for differences of Least Squares Means for the BEH variable. Only pairs with p-value ≤ 0.05 are shown (see Appendix 2 for all model results).

Activity Level ^a	Activity Level	Estimate	Standard Error	z val	Pr > z	Lower	Upper	e ^x
Non surf	Reg surf	0.8132	0.4193	1.94	0.0524	-0.00853	1.6350	2.2552
Non surf	Freq surf	2.6469	0.5265	5.03	<.0001	1.6150	3.6788	14.1104
Int surf	Freq surf	2.6871	0.6826	3.94	<.0001	1.3492	4.0250	14.6894
Reg surf	Freq surf	1.8337	0.5448	3.37	0.0008	0.7659	2.9014	6.2567
Non dive	Int dive	-1.5336	0.4093	-3.75	0.0002	-2.3358	-0.7314	0.2157
Non dive	Reg dive	-0.9121	0.5217	-1.75	0.0804	-1.9346	0.1104	0.4017
Non dive	Freq dive	-1.7070	0.7014	-2.43	0.0149	-3.0816	-0.3323	0.1814

^a Activity levels are Intermittent (Int), Regular (Reg) and Frequent (Freq) as explained in the Methods section.

Table 2

Pairwise comparison for Surf and Dive activity level categories of difference of Least Squares Means for the INT variable. Only pairs with p-value ≤ 0.05 are shown (see Appendix 2 for all model results).

Activity Level ^a	Activity Level	Estimate	Standard Error	z Val	Pr > z	Lower	Upper	e ^x
Non Surf	Freq Surf	2.4501	0.6823	3.59	0.0003	1.1127	3.7875	11.5896
Int Surf	Freq Surf	1.8939	0.8243	2.30	0.0216	0.2783	3.5095	6.6453
Reg Surf	Freq Surf	1.9470	0.7123	2.73	0.0063	0.5509	3.3432	7.0080
Non Dive	Int Dive	-1.1267	0.3974	-2.84	0.0046	-1.9056	-0.3478	0.3241
Non Dive	Reg Dive	-1.8803	0.5557	-3.38	0.0007	-2.9694	-0.7912	0.1525
Non Dive	Freq Dive	-1.2331	0.6549	-1.88	0.0597	-2.5167	0.05054	0.2914

^a Activity levels are Intermittent (Int), Regular (Reg) and Frequent (Freq) as explained in the Methods section.

Table 3

Pairwise comparison for Surf and Dive activity level categories of difference of Least Squares Means for the TERM variable for Surf and Dive activity level categories. Only pairs with p-value ≤ 0.1 are shown (see Appendix 2 for all model results).

Activity Level ^a	Activity Level	Estimate	Standard Error	z Val	Pr > z	Lower	Upper	e ^x
Non Surf	Freq Surf	1.6133	0.4921	3.28	0.0010	0.6489	2.5778	5.0195
Int Surf	Freq Surf	2.1646	0.8822	2.45	0.0141	0.4354	3.8938	8.7111
Reg Surf	Freq Surf	2.3337	0.6173	3.78	0.0002	1.1238	3.5436	10.3160
Non Dive	Int Dive	-1.7547	0.6478	-2.71	0.0068	-3.0244	-0.4850	0.1730
Non Dive	Reg Dive	-1.2485	0.7799	-1.60	0.1094	-2.7770	0.2801	0.2869

^a Activity levels are Intermittent (Int), Regular (Reg) and Frequent (Freq) as explained in the Methods section.

sports.

This research is useful for highlighting behavioural patterns in a limited population sample of 170 responses. Thapa's [7] study conducted 593 on-site interviews of recreationists with 309 of those individuals mailing back a follow up questionnaire. Thapa et al.'s [46] previous study collected data from 370 SCUBA divers. Hawkin et al.'s [21] study reported having collected 498, 598 and 234 responses to surveys administered in 2005, 2010 and 2015 respectively. Also, a limited geographical area considered (Tel Aviv, Israel and surrounding areas). The patterns of behaviours evidenced could be typical of Israeli surfers and beach users but might vary from place to place and therefore it would be interesting to undergo similar research in different areas of Israel, as well as in different places in the world.

Lastly, it may be that the public's interest towards marine issues is quite high (as confirmed by Hawkins et al. [21]), but this is not necessarily reflected in a high level of knowledge about these topics – at least among the marine sports practitioners investigated in this study (See Fig. 1). As pointed out in several studies (e.g. Ref. [16,47]), the association between environmental responsibility and daily behaviours is important and its relevance in the environmental field is shown to be complex (e.g., Refs. [25,48]). Along the lines of Holland-Smith et al.'s [39] call to use information based on the investigation of associations between outdoor activities, links to the environment and how environmental groups could use this to gather support for their campaigns, even a negation of the hypothesis tested is useful. Holland-Smith et al.'s [39] qualitative study, which analysed the interviews of only eight surfers, suggested that "new [environmental] campaigns can be developed to motivate them and promote pro-environmental behaviour". The need for such campaigns is obviated by our findings.

While the questionnaires provided significant information, we statistically analysed only three dependent variables. Any further studies should perhaps focus more specifically on marine conservation concern, less on general environmental behaviors and seek to refine dependent variables that are strikingly different. While it is true that interest in the marine environment and knowledge can be very different (indicated by the variables INT and TERM, respectively) results of the statistical analyses of responses were generally similar for both surfers and divers. Another limitation is the lack of education and income data since these are likely variables related to environmental attitudes and could shed light on where and how to structure marine conservation campaigns.

6. Conclusions

This study shows interestingly unexpected results: Based on our investigation of those engaged in surfing and SCUBA diving, the hypothesis that marine sports practitioners are more environmentally responsible and more aware of marine conservation issues was rejected. Although perhaps disappointing, our study also illustrates how important information can be derived by public perception studies for marine and coastal conservation.

Humans are both users and stewards of the marine environment, so it is important to understand people's attitudes and behaviours towards the sea and to identify populations that can be targeted for awareness campaigns and educational efforts. Perhaps most importantly, findings suggest that surfers and SCUBA divers should be targeted when disseminating information about marine conservation and environmental protection. This is because while on the one hand, their sports activity is dependent on a healthy and functioning ocean ecosystem that

they are familiar with, on the other hand, they may be 'in the dark' about the need to protect it.

Declaration of competing interest

None.

Acknowledgements

The authors would like to thank the (Center for Urban and Regional Studies (CURS)) at the Technion's Faculty of Architecture and Town Planning for a grant that provided technical assistance (No. 1017838) for this research.

Appendix A

<https://doi.org/10.1016/j.marpol.2020.104133>

References

- [1] E. Fabbrizzi, M. Scardi, E. Ballesteros, L. Benedetti-Cecchi, E. Cebrian, G. Ceccherelli, S. Fraschetti, Modeling macroalgal forest distribution at mediterranean scale: Present status, drivers of changes and insights for conservation and management, *Front. Marine Sci.* 7 (20) (2020), <https://doi.org/10.3389/fmars.2020.00020>.
- [2] M. Shen, D. Mao, H. Xie, C. Li, The social costs of marine litter along the east China sea: evidence from ten coastal scenic spots of Zhejiang Province, China, *Sustainability* 11 (6) (2019) 1807.
- [3] D. Cook, L. Malinauskaitė, B. Davíðsdóttir, H. Ögmundardóttir, J. Roman, Reflections on the ecosystem services of whales and valuing their contribution to human well-being, *Ocean Coast Manag.* 186 (2020) 105100, <https://doi.org/10.1016/j.ocecoaman.2020.105100>.
- [4] B.S. Steel, C. Smith, L. Opsommer, S. Curie, R. Warner-Steel, Public ocean literacy in the United States, *Ocean Coast Manag.* 48 (2005) 97–114.
- [5] F. Sperotto, A contribuição do surf para a conservação ambiental do município de Garopaba-SC, *Rev. Grad.* 4 (2) (2011) 1–6.
- [6] M.O. Rangel, C.B. Pita, J.M.S. Gonçalves, F. Oliveira, C. Costa, K. Erzini, Eco-touristic snorkeling routes at Marinha beach (Algarve): environmental education and human impacts, *Mar. Pol.* 60 (2015) 62–69, <https://doi.org/10.1016/j.marpol.2015.05.017>.
- [7] B. Thapa, The mediation effect of outdoor recreation participation on environmental attitude-behavior correspondence, *J. Environ. Educ.* 41 (3) (2010) 133–150.
- [8] P.M. Mullins, Living stories of the landscape: perception of place through canoeing in Canada's north, *Tourism Geogr.* 11 (2) (2009) 233–255, <https://doi.org/10.1080/14616680902827191>.
- [9] E. Brymer, G. Downey, T. Gray, Extreme sports as a precursor to environmental sustainability, *J. Sport Tourism* 14 (2–3) (2009) 193–204.
- [10] R. Gifford, A. Nilsson, Personal and social factors that influence pro-environmental concern and behaviour: a review, *Int. J. Psychol.* 49 (3) (2014) 141–157, <https://doi.org/10.1002/ijop.12034>.
- [11] E. Brymer, L.G. Oades, Extreme sports: a positive transformation in courage and humility, *J. Humanist. Psychol.* 49 (1) (2007) 114–126, <https://doi.org/10.1177/0022167808326199>.
- [12] N. Ishwaran, Science in intergovernmental environmental relations: 40 years of UNESCO's Man and the Biosphere (MAB) Programme and its future, *Environ. Dev.* 1 (1) (2012) 91–101, <https://doi.org/10.1016/j.envdev.2011.11.001>.
- [13] I. Steinberga, D. Ilin, M. Hrabar, A. Stancu, K. Brooks, L. Papadopoulou, P. Orr, H. Martinez, I. Lema, S. Ariccio, S. Ieva, S. De Dominicis, G. Carrus, R. Garcia Mira, M. Bonaiuto, A. Dumitru, J. Kobal, European Commission Directory General for the Environment, Survey of Public Perceptions of Environmental Risks, Project Code: ENV.F.3/ETU/2014/0037, 2015. Accessed on June 11, 2019 via, <https://publications.europa.eu/en/publication-detail/-/publication/b40916e9-b378-11e5-8d3c-01aa75ed71a1>.
- [14] R.E. Löfstedt, Why are public perception studies on the environment ignored? *Global Environ. Change* 5 (2) (1995) 83–85, [https://doi.org/10.1016/0959-3780\(95\)00020-0](https://doi.org/10.1016/0959-3780(95)00020-0).
- [15] H.R. Hungerford, T.L. Volk, Changing learner behavior through environmental education, *J. Environ. Educ.* 21 (3) (1990) 8–21, <https://doi.org/10.1089/eco.2013.0020>.
- [16] A. Kollmuss, J. Agyeman, Mind the gap: why do people act environmentally and what are the barriers to pro-environmental behavior? *Environ. Educ. Res.* 8 (3) (2002) 239–260, <https://doi.org/10.1080/13504620220145401>.
- [17] A.H. Eagly, S. Chaiken, *The Psychology of Attitudes*, Harcourt Brace Jovanovich, Fort Worth, TX, 1993.
- [18] A. Uitto, K. Juuti, J.M.J. Lavonen, V. Meisalo, Who is responsible for sustainable development? Attitudes to environmental challenges: a survey of Finnish 9th grade comprehensive school students, in: A. Laine, J. Lavonen, V. Meisalo (Eds.), *Current Research on Mathematics and Science Education: Proceedings of the XXI Annual Symposium of the Finnish Association of Mathematics and Science Education Research (Tutkimuksia/Helsingin Yliopiston Soveltavan Kasvatustieteen Laitos; No. 253)*, vol. 253, University of Helsinki, Helsinki, 2004, pp. 80–102. Accessed on November 10, 2019 at, <https://researchportal.helsinki.fi/en/publications/who-is-responsible-for-sustainable-development-attitudes-to-envir>.
- [19] M.E. Portman, Y. Teff-Seker, Community-level environmental projects as learning tools for planners: a case study of graduate planning students, *Environ. Educ. Res.* 23 (3) (2017) 415–435.
- [20] A. Balmford, R. Cowling, Fusion or failure? The future of conservation biology, *Conserv. Biol.* 20 (2006) 692–695.
- [21] J.P. Hawkins, B.C. O'Leary, N. Basset, H. Peters, S. Rakowski, G. Reeve, C. M. Roberts, Public awareness and attitudes towards marine protection in the United Kingdom, *Mar. Pollut. Bull.* 111 (1–2) (2016) 231–236.
- [22] S. Fletcher, J.S. Potts, C. Heeps, K. Pike, Public awareness of marine environmental issues in the UK, *Mar. Pol.* 33 (2) (2009) 370–375.
- [23] S. Burgin, N. Hardiman, Extreme sports in natural areas: looming disaster or a catalyst for a paradigm shift in land use planning? *J. Environ. Plann. Manag.* 55 (7) (2012) 921–940, <https://doi.org/10.1080/09640568.2011.634228>.
- [24] D.R. Self, E.D.V. Henry, C.S. Findley, E. Reilly, Thrill seeking: the type T personality and extreme sports, *Int. J. Sport Manag. Market.* 2 (1–2) (2007) 175–190. <https://doi.org/10.1504/IJSM.2007.011397>.
- [25] A. Wade, *Surf Nation: in Search of the First Fast Lefts and Hollow Rights of Britain and Ireland*, Simon and Schuster, London, UK, 2007.
- [26] D. Davis, C. Tisdell, Recreational SCUBA-diving and carrying capacity in marine protected areas, *Ocean Coast Manag.* 26 (1) (1995) 19–40, [https://doi.org/10.1016/0964-5691\(95\)00004-L](https://doi.org/10.1016/0964-5691(95)00004-L).
- [27] K.-C. Ku, T.-C. Chen, A conceptual process-based reference model for collaboratively managing recreational SCUBA diving in Kenting National Park, *Mar. Pol.* 39 (2013) 1–10, <https://doi.org/10.1016/j.marpol.2012.09.008>.
- [28] V.J. Giglio, O.J. Luiz, C.E.L. Ferreira, Ecological impacts and management strategies for recreational diving: a review, *J. Environ. Manag.* 256 (2020) 109949, <https://doi.org/10.1016/j.jenvman.2019.109949>.
- [29] P.M. Mullins, Conceptualizing skill within a participatory ecological approach to outdoor adventure, *J. Exp. Educ.* 37 (4) (2014) 320–334.
- [30] W.P. Schultz, Conservation means behaviour, *Conserv. Biol.* 25 (6) (2011) 1080–1083.
- [31] N. Thrift, Still life in nearly present time: the object of nature, in: P. Macnaghten, J. Urry (Eds.), *Bodies of Nature*, 2001, pp. 34–57.
- [32] L. Heywood, M. Montgomery, Ambassadors of the last wilderness? Surfers, environmental ethics and activism in America. *Tribal play: subcultural journeys through sports*, *Sociol. Sports* 4 (6) (2008) 153–172.
- [33] G. Musa, K. Dimmock (Eds.), *SCUBA Dive Tourism*, Routledge, London, 2017.
- [34] T.F. Ong, G. Musa, An examination of recreational divers' underwater behaviour by attitude-behaviour theories, *Curr. Issues Tourism* 14 (8) (2011) 779–795.
- [35] A.M. Cisneros-Montemayor, U.R. Sumaila, A global estimate of benefits from ecosystem-based marine recreation: potential impacts and implications for management, *J. Bioecon.* 12 (3) (2010) 245–268.
- [36] W. Gladstone, B. Curley, M.R. Shokri, Environmental impacts of tourism in the Gulf and the Red Sea, *Mar. Pollut. Bull.* 72 (2) (2013) 375–388.
- [37] R.J.W. Brewin, L. de Mora, T. Jackson, T.G. Brewin, J. Shutter, On the potential of surfers to monitor environmental indicators in the coastal zone, *PloS One* 10 (7) (2015) 1–22, <https://doi.org/10.1371/journal.pone.012770>.
- [38] S.Q. Scott, S.H. Rogers, Surf's up? How does water quality risk impact surfer decision? *Ocean Coast Manag.* 151 (2018) 53–60.
- [39] D. Holland-Smith, A. Love, R. Lorimer, British surfers and their attitudes and values towards the environment, *Ecopsychology* 5 (2) (2013) 103–109.
- [40] A. Arnold, A review of public attitudes towards marine issues within and beyond New Zealand, *DOC Sci. Intern. Ser.* 170 (2004). <https://pdfs.semanticscholar.org/fbb4/0c39df9d2d65ce765fab3ef66bcb382e9ad.pdf>.
- [41] T. Potts, C. Pita, T. O'Higgins, L. Mee, Who cares? European attitudes towards marine and coastal environments, *Mar. Pol.* 72 (2016) 59–66, <https://doi.org/10.1016/j.marpol.2016.06.01210.1080/13504622.2015.1136597>.
- [42] J.R. O'Bryhim, E.C.M. Parsons, Increased knowledge about sharks increases public concern about their conservation, *Mar. Pol.* 56 (2015) 43–47, <https://doi.org/10.1016/j.marpol.2015.02.007>.
- [44] S. Stoll-Kleemann, Feasible options for behavior change toward more effective ocean literacy: a systematic review, *Front. Mar. Sci.* 6 (273) (2019), <https://doi.org/10.3389/fmars.2019.00273>.
- [45] C.S. Wiener, G. Manset, J.D. Lemus, Ocean use in Hawaii as a predictor of marine conservation interests, beliefs, and willingness to participate: an exploratory study, *J. Environ. Soc. Sci.* 6 (4) (2016) 712–723, <https://doi.org/10.1007/s13412-015-0272-6>.
- [46] B. Thapa, A.R. Graefe, L.A. Meyer, Moderator and mediator effects of SCUBA diving specialization on marine-based environmental knowledge-behavior contingency, *J. Environ. Educ.* 37 (1) (2005) 53–67.
- [47] R. Gifford, R. Sussman, Environmental attitudes, in: S.D. Clayton (Ed.), *The Oxford Handbook of Environmental and Conservation Psychology*, Oxford University Press, New York, 2012, pp. 65–80, 2012.

- [48] P.C. Stern, *New Environmental Theories: toward a coherent theory of environmentally significant behavior*, *J. Soc. Issues* 56 (4) (2000) 407–424.
- [50] SAS® 9.4, *Help and Documentation*. Copyright ©, SAS Institute Inc., Cary, NC, USA, 2002-2013.
- [51] Y. Teff-Seker, M.E. Portman, K. Kaplan-Mintz, *Project-based learning in education for sustainable development: a case study of graduate planning students*, *Case Stud. Environ.* (2019) 1–16, <https://doi.org/10.1525/cse.2018.001537>, 2019.
- [52] C.M. Luşby, S. Cottrell, *Understanding motivations and expectations of scuba divers*, *Tourism Mar. Environ.* 5 (1) (2008) 1–14, <https://doi.org/10.3727/154427308785855279>.