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Visitors' Environmental Concerns in Gray's Reef National Marine Sanctuary: An Offshore Marine Protected Area

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Abstract: Marine sanctuaries serve as popular destinations for ecotourism, natural resource exploration, and recreation across the US. While often positive, visitation in marine and coastal areas can cause ecological threats to these ecosystems. Increased visitation in marine environments has led to the need for management due to negative ecological and social impacts. Understanding environmental values, attitudes, and perceptions is important to the success of environmental protection. Using online surveys sent via Qualtrics asking questions regarding the users' knowledge, attitudes, and perceptions of ocean resources, goods and services, this research focused on identifying user profiles and understanding their environmental perception associated with Gray's Reef National Marine Sanctuary, an offshore marine protected area, and surrounding coastal Georgia. The results show that across multiple types of threats or phenomena, respondents are most concerned about threats to resources related to pollution. Furthermore, they support marine protection and are willing to adjust their consumption habits, such as recycling and energy use, to ensure the sustainable use of ocean resources. The inclusion of insights achieved through research about visitor perceptions into management decision making and planning can positively contribute to the success of environmental protection.

Keywords: environmental concern; Gray's Reef National Marine Sanctuary; attitudes; perception; survey research; marine protected areas

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1. Introduction

The use of marine resources, including outdoor recreation in marine protected areas combined with a growing global population, create more and more stressors to these environments [1,2]. People are often attracted to these areas because of the natural qualities of an attractive environment and the recreational opportunities that can be found at them [3]. The United States includes over 600,000 square miles of underwater parks designated as National Marine Sanctuaries (NMS) and managed by the Office of National Marine Sanctuaries (ONMS) within the National Oceanic and Atmospheric Administration [4] These areas often serve as popular destinations for natural resource exploration, recreation, tourism and research, and they offer many other ecosystem services. Unchecked, the increased use of these areas can result in negative impacts to the environment [1]. A synthesis of human impact research on the ocean shows that no area is unaffected by human influence, and over 40% of all ocean areas are strongly affected by multiple factors [1].

Previous works highlight fishing, pollution, mechanical habitat destruction, the introduction of alien species, and climate change as the most mentioned negative impacts humans have on coastal and marine environments [5–7]. People rely on a functioning environment and ecosystems [8]. Overuse, exploitation, and destruction are potentially serious threats to both human beings and their environment, leading to the need for adjustments in how the environment and natural resources are being used [9] However, changing behavior sustainably and successfully to a more environmentally friendly behavior is difficult [9].

Behavior is influenced by an individual's physical and psychological capability, social and physical and opportunities, and reflective or automatic motivation [10]. Interventions to this complex behavior system might lead to a change of behavior, but can vary on an individual level [10]. For example, one person may have no problems with a specific opportunity, while another person could still be constrained by a physical capability [10]. There are ways to avoid negative impacts, and human behavior can positively impact the environment, such as through the concept of stewardship behavior [10]. In addition to the environmentally friendly behavior of individuals, other positive impacts on the environment can be achieved through tourism, recreation, and visitation to protected areas if sustainability is considered in their management [11,12]. The ecological environment benefits directly from protected areas, while their touristic and recreational use represents potential for the economic growth of local communities and regions through revenues from that sector [12]. Furthermore, protected area use management often provides opportunities for outreach and educational programs [13].

There is little that remains static in the human–environment relationship [14,15].

In addition, different people can show contrasting and varying reactions to the same environment or situation [16]. Environmental concern is a specific or general attitude that influences a person's intention to behave, as well as an environmentally relevant value orientation [8]. Moreover, it is understood as an evaluation of behavior, including its environmental consequences [8]. In order to contribute to ocean protection, the monitoring and understanding of visitor use is fundamental. It can help improve and engage management in protected areas [17].

The main question addressed by this research is how visitors perceive ocean and coastal areas and environmental stressors using a survey of participants' knowledge, attitudes, and perceptions (KAP) of natural resources, activities, and potential threats to such resources. In this case, few environmental problems have been noted by resource managers, thus the study was designed to identify potential future concerns and to build stewardship among current users.

The area of study was Gray's Reef National Marine Sanctuary (GRNMS) and the surrounding coastal area of Georgia. Addressing people's perceptions can lead to insights about the status of an ecosystem in addition to the usual ecological monitoring [18]. Thus, analyzing visitors' perception about ecosystem health, including their environmental concerns, can help managers of national marine sanctuaries create better policies [17–19]. The primary purpose of this study was to examine the perception of ecosystem health and environmental concerns of potential users of Gray's Reef National Marine Sanctuary (GRNMS). The differences and relations across different socio-demographic groups and categories of recreational users and their environmental concerns were assessed. The specific research questions of this paper are:

R_1: What are the socio-demographics of the visitors of GRNMS regarding their age, gender, race, education level, annual income, and employment status?

R_2: What are the participants' concerns towards the ecosystem health in coastal Georgia and GRNMS?

R_2a: What are the participants' concern levels towards the ecosystem health in coastal Georgia/outside of GRNMS?

R_2b: What are the participants' concern levels towards the ecosystem health in GRNMS?

R_2c: How does the reported concern levels/scores relate to different socio-demographics?

2. Methods

2.1. Methods

In the fall of 2020, West Virginia University (WVU) researchers conducted an online survey focused on both users and non-users of Gray's Reef National Marine Sanctuary and the surrounding coastal areas of Georgia. The database and sample for this study represent potential users of GRNMS. One first screening question of the survey instrument asked the

respondents whether they visited GRNMS within the calendar year of 2019 one or more times. Respondents answering the question with affirmatively were defined as users of GRNMS and were included in the sample analyzed for this study. The methodology followed that of the National Marine Sanctuary Visitor Counting Process (NMS-COUNT). The NMS-COUNT process engages academics, agency scientists, and managers in an iterative process of four phases: (1) the research and identification of visitor estimation methods applicable to a specific site, (2) an expert panel to provide input on site-specific methods, use indicators (social, environmental, temporal, spatial intensity, etc.) and confidence levels, (3) the development of a site-specific methodology and sampling plan, and (4) field testing and analysis (Figure 1).

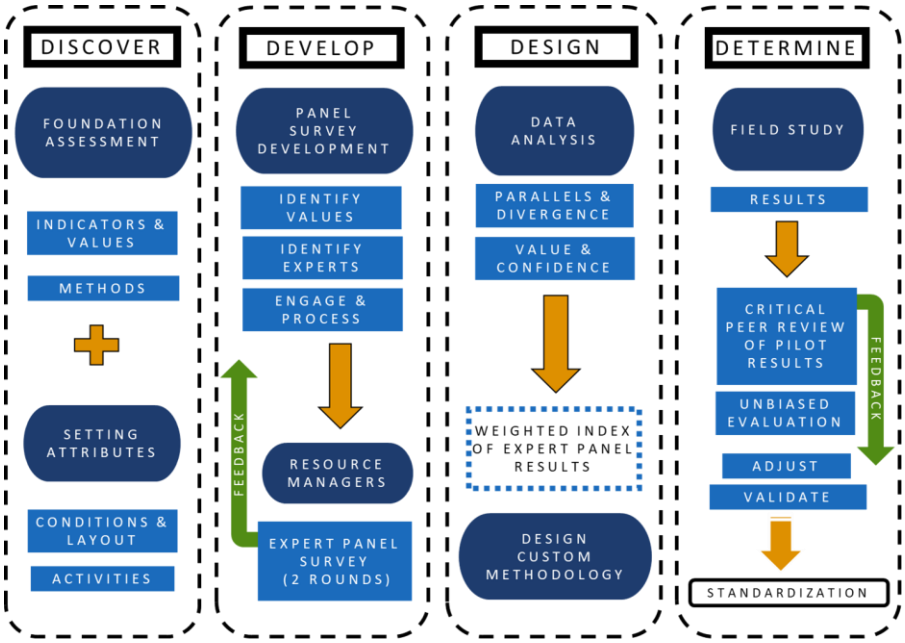

Figure 1. The National Marine Sanctuary Visitor Counting Process (NMS-COUNT) conceptual model illustrating four phases of study for customized application to unique Sanctuary settings. It is described in Burns et al. [20] as a potential method for visitor counting in unique/remote aquatic settings where traditional sampling techniques are not always applicable.

2.2. Study Area

The area of this study was Gray's Reef National Marine Sanctuary (GRNMS) and the surrounding coastal areas of Georgia (Figure 2). Gray's Reef National Marine Sanctuary is located in the Atlantic Ocean 19 miles off the coast of Georgia, and is 22 square miles in size [4] It was designated as a National Marine Sanctuary in 1981 [4]. National marine sanctuaries are marine protected areas designated according to their special conservation, recreational, ecological, historical, scientific, educational, cultural, archaeological, and aesthetic attributes and features [19], and are managed by NOAA's Office of National Marine Sanctuaries (ONMS). Gray's Reef National Marine Sanctuary is one of the largest near shore live-bottom reefs of the southeastern U.S. [4,19]. Despite being a reef, GRNMS is comprised of "scattered sandstone rock outcroppings that rise above the sandy substrate of the nearly flat continental shelf" [19] (p. 6), and includes soft corals, non-reef-building hard corals, attached bivalves and sponges, associated fishes, sea turtles, marine mammals, and pelagic birds. The location is at the intersection between the temperate and tropical waters [4] at the South Atlantic Bight, and is influenced by the Gulf Stream as well as tidal currents, river runoffs, local winds, winter storms, hurricanes, and seasonal atmospheric changes due to the closeness to the coast [19], which makes this an attractive and important habitat for several fish species that are commonly targeted by recreational anglers [19,21]. Thus, the dominant user group in GRNMS are recreational fishers [21,22]. However, fishing

techniques are limited to the use of rod and reel or handline fishing gear inside the Sanctuary, in addition to the main attraction of recreational fishing and fishing tournaments [21,22]. Gray's Reef NMS also provides opportunities for experienced/advanced diving. Since 2011, one third of the Sanctuary has been a designated research area, where activities such as fishing and recreation are restricted [4,19].

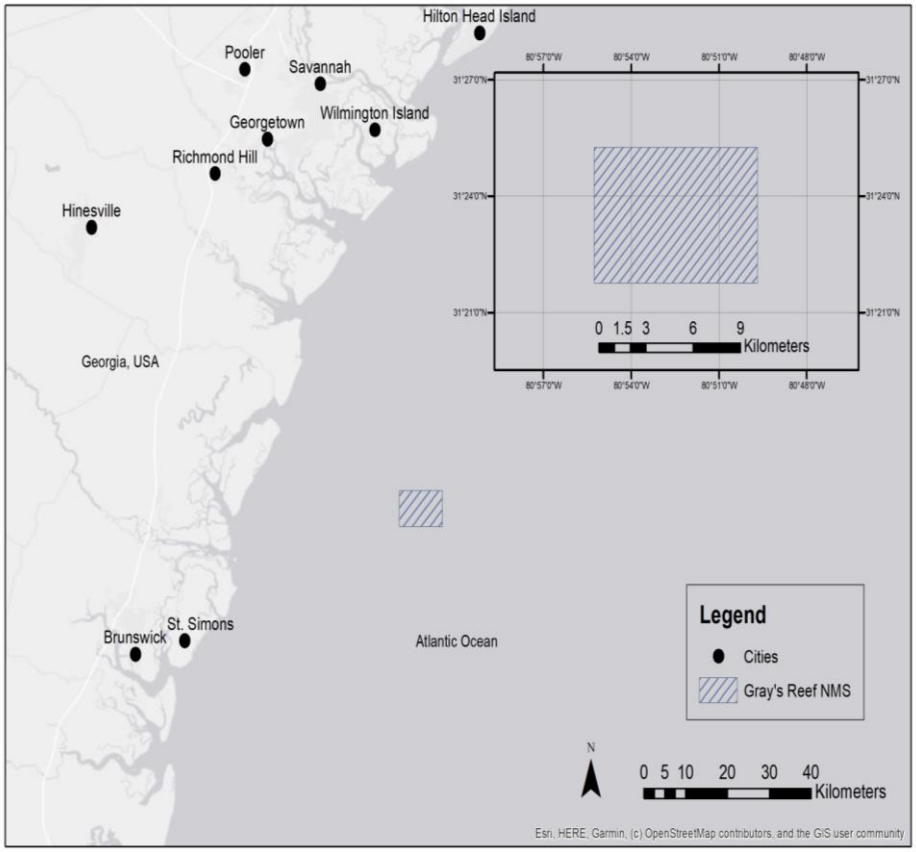

Figure 2. Study area surrounding coastal Georgia, USA with Gray's Reef National Marine Sanctuary shown as the hatched box boundary approximately 19 miles (30 km) east of the USA mainland in the Atlantic Ocean. The inset map in the top right corner shows a detailed view of the Sanctuary boundary with a geographic coordinate reference.

2.3. Participants

This study aimed to understand who uses GRNMS and to get more information about the demographic profile of potential visitors and users of GRNMS. The participants were defined as persons who hold a saltwater permit fishing license in the state of Georgia. Contacts were obtained through the Georgia Department of Natural Resources angler license database. Potential respondents were contacted based upon their selection of the saltwater information program permit registration in the state of Georgia. The distribution resulted in 1060 effective survey contacts with a response sample size of 928 (87% effective response rate). Effective survey contacts are defined as recipients who received the email and opened it, and thus it did not go into a junk mail folder or to a fake email address. The first question of the survey instrument asked whether people visited GRNMS within the calendar year of 2019. Almost 11%, which was 99 respondents, reported that they had visited GRNMS in the identified time period. These respondents are defined as "users" of GRNMS, and they made up the sample of this study.

2.4. Research Design

The data collection method used in this study was an online survey questionnaire that focused on potential users of the study area, that being the GRNMS and coastal Georgia.

The survey was distributed via Qualtrics to potential participants following the Dillman method [23], which describes the most advantageous web surveying practices and the four traditional sources of survey errors, sampling, coverage, measurement, and nonresponse. One disadvantage of sending an online questionnaire could be that participants do not have an opportunity to ask questions about unclear items. To reduce this source of error, the different stakeholders included in the larger scale NMS-COUNT project were able to collaborate and provide feedback with regard to the survey instruments. Furthermore, the survey instrument used in this study builds upon previous surveys using KAP assessments in NMS settings done by the NOAA, such as in the study by Grace-McCaskey [12]. The response rate is dependent on the length and design of the questionnaire. There is a risk that the recipient of the email would not be interested in participating or forget to finish their survey. To minimize these risks, as was indicated in the Dillman & Bowker [23] method, a first reminder email to the respondents who had not completed the survey was sent one week later, and a second reminder was sent two weeks later.

2.5. Measures

The pre-existing survey described and used for this study was developed in response to a request by GRNMS marine resource managers (NOAA). Their intention was to better understand resource users' knowledge, attitudes, and perceptions (KAPs) regarding the Sanctuary and its resources and management practices. The complete survey included 48 questions organized in seven sections. The first section addressed the participants' opinions about ocean and coastal resources' protection and management. There were 13 questions in this section. In the second section, the objective was to identify the best ways to communicate with potential users of GRNMS by understanding the sources of information they use and trust. This section included five questions. Section three addressed peoples' opinions on the status of the condition of the resources and the pressures in GRNMS. Section four (with six questions) asked about visitors' recreation activities in the ocean and coastal areas. Here, participants were asked to identify both the activities in the areas in and around Georgia, and the portion of those in the GRNMS. In section five, eight questions were asked about recipients' main or primary recreation activity in the ocean and coastal areas off the Georgia coast, including activities in the GRNMS. The next section addressed ways participants value ocean and coastal resources and the marine environment. The goal was to learn about the ways they value the products and services that are derived from ocean and coastal resources, and the things they would do to help ensure their sustainability for the future. Therefore, two questions were asked. The last section addressed the participants' socio-demographic information, and included 13 questions.

For this study, the demographic questions, as well as questions about how concerned the participants were with regard to the health of ocean and coastal areas outside and inside of the GRNMS were used. The response options regarding environmental concern entailed a five-point Likert-type scale with the following possible answers: (1) No Concern at All, (2) Not Very Concerned, (3) Neutral, (4) Somewhat Concerned, and (5) Extremely Concerned.

2.6. Procedures

As part of the larger NMS-COUNT project [20], the data collection in 2020 needed to be adjusted due to COVID-19 research restrictions. The sampling plan for the study in Gray's Reef National Marine Sanctuary (GRNMS) aimed to collect visitor use data during the spring and summer of 2020. The field personnel of the study were going to conduct interviews with recreational operators that worked in the fishing and diving industry along the Georgia coast. The sampling plan also covered boat-based observations inside the GRNMS territory. The field coordinator in charge of the boat-based observations would have conducted interviews with visitors such as anglers and divers that were recreating in the GRNMS. Due to disruptions related to COVID-19 travel bans and research restrictions, the team needed to adjust the in-person parts of the process, and they transformed it into

an online methodology. The survey was first distributed on 21 August 2020. The emails that were sent to the contacts included a link to the survey (Qualtrics) and a description of the purpose of the project and the data collection method. Up to two reminder emails followed the first email. These were sent to contacts who had yet to complete the survey.

2.7. Data Analysis

The database, including the survey responses, was exported from Qualtrics as an SPSS file and then analyzed using IBM SPSS 28 (Statistical Package for the Social Sciences, IBM Corporation). In Qualtrics, the answers were recoded from categorical to numerical data (e.g., 1 = male, 2 = female) to run statistical tests. An alpha level of 0.05 was used to determine the significance for all analyses. To answer research question R_1: "What are the socio-demographics of the visitors of GRNMS regarding their age, gender, race, education level, annual income, and employment status?", the frequencies of gender and race were calculated. Furthermore, frequencies, standard deviations, and means of age, education level, income category, and employment status were computed. In order to answer research question R_2: "What are the participants' concerns towards the ecosystem health in coastal Georgia and GRNMS?", several statistical tests were run. Descriptive statistics such as the frequencies and mean of rated concern levels of visitors regarding the ocean resource condition inside GRNMS or in coastal Georgia were calculated and assessed separately. Subsequently, multiple regressions were run to assess the relationship between socio-demographic groups and the environmental concern scores of visitors to the GRNMS or to coastal Georgia using response variables of different concern items as the dependent variable and testing it across socio-demographic groups as the independent variables. The questions selected from the survey instrument for the data analyses in this study can be seen in Table 1.

Table 1. Questions Selected from Survey Instrument, Items, Related Alternative Categorical Answer, and Recoded Numerical Value/Scale.

Questions	Sub-Questions/Items	Alternative Answers and Recoded Numerical Value
On a scale of 1 to 5, where 1 means No Concern at All and 5 means Extremely Concerned, to what extent are you concerned about the health of ocean & coastal areas around Georgia outside/inside GRNMS?	Ocean acidification Climate change Sea level rise Overfishing Coral reef health or other live bottom habitat Marine animal's health Shipping Dredging/Offshore dredge disposal Beach renourishment Energy production Alternative Energy-Production Mining of minerals Habitat loss from coastal development Pollution Human produced noise	1—No Concern at All 2—Not Very Concerned 3—Neutral 4—Somewhat Concerned 5—Extremely Concerned

Note(s): Question 1 (Q1) and Question 2 (Q2) distinguish between concerns outside of the GRNMS, meaning concerns regarding ocean resources in coastal Georgia, while Q2 asks for concerns about the inside of the GRNMS. Both questions ask the respondents to rate their concern with regard to the same 15 items.

Fransson and Gärling [8] found in their literature and existing research review that some socio-demographic groups are associated with environmental concern levels. The authors state that there are different determinants of environmental concern, including gender, age, education, and income. Additionally, socio-demographics are linked to environmental attitudes and perceptions, which in turn are predictors for environmentally responsible behavior [24]. A person's social, cultural, and economic background, as well as lived individual experiences, influence or form their values and attitudes [11], such as

concerns about the environment. Thus, the perception of ecosystem health of the different demographic categories (age, gender, income level, race, education, and employment rate) was expected to show some significant differences and/or relationship. The assessment of the latter can be critical for resource managers in the Sanctuary [12].

3. Results

3.1. Sample Profile

The socio-demographic data collected included the respondents' age, gender, race, ethnicity, education level, income level, and employment status (Table 2). The results of the data analysis show that three quarters of respondents were over 50 years old at the time they took the survey. Only two respondents (5%) were 30 years of age or younger. Respondents were 58.05 years old on average. The median age was 62 years,, meaning that half of the respondents were 62 years or older. The standard deviation was 14 years. Male respondents greatly outnumbered females (85%). Most people surveyed (95%) classified themselves as White, with the rest as Black or African American, while no other categories were reported regarding race or ethnicity. Overall, the majority of respondents were employed full time, and reflected a high annual household income. More than two thirds of the people (71%) reported full-time employment status, followed by 23% who indicated that they were retired. Half of the people selected one of the two highest income categories ($100,000–$150,000 or more) as representing their annual household income before taxes in 2019. Most of the interviewees reported some college degree (27%) or a Bachelor's degree (27%) as their highest completed level of education.

Table 2. Socio-demographic Profile of Survey Respondents, Shown with Frequency and the Percentage of Responses for Each Survey Question, with the According Sample Size (N).

Socio-Demographic	Profile	Valid Percent (%)	Frequency	N
Age (recoded) *	30 or younger	5.1	2	39
	31–50	20.5	8	
	51 and over	74.4	29	
Gender	Male	84.6	33	39
	Female	15.4	6	
Race **	White	94.7	36	38
	Black or African American	5.3	2	
Latino or Latino **	No	100	39	39
Education	9th–12th grade, no diploma	2.5	1	40
	12th grade High School Grad	12.5	5	
	Some College	27.5	11	
	Associate Degree	12.5	5	
	Bachelor's Degree	27.5	11	
	Master's Degree	12.5	5	
	Professional School Degree	2.5	1	
	Doctor's Degree	2.5	1	
Income (recoded) *	Under $50,000	10.5	4	38
	$50,000–$99,999	39.5	15	
	Over $100,000	50	19	
Place of residency	Coastal Zip Code	57.9	22	38
	Non-coastal Zip Code	42.1	16	
Employment status **	Employed Full Time	71.1	27	38
	Employed Part Time	2.6	1	
	Retired	23.7	9	
	None of the Above	2.6	1	

Note(s): * These categories are summarized in fewer categories for easier presentation; ** Categories with potential response items in the survey without recorded answers are not presented in this table.

3.2. Environmental Concern

Overall, the results show that the respondents of the survey reported generally neutral to moderate levels of concern about the given response items/sub-question items inside the Sanctuary and surrounding coastal Georgia. The overall mean of the concern levels in coastal Georgia show a numerical response value of 3.5/5.0, which is between "neutral" and "somewhat concerned". The overall concern levels of all responses regarding the ocean condition inside GRNMS specifically were slightly lower, with a mean value of 3.43/5.0. The median of all concern items regarding coastal Georgia was three or higher. This showed that at least half of the responses indicated that respondents felt neutral or somewhat concerned about them.

3.3. Environmental Concern in Coastal Georgia around GRNMS

Considering each concern item separately, the results show that outside of Gray's Reef and coastal Georgia, the respondents were most concerned about pollution, followed by the health of marine animals, coral health, and other live bottom habitats, habitat loss from coastal development, and overfishing (Table 3).

Table 3. Respondents' Concern Levels of Ocean Resources Outside GRNMS.

Item	M	MD	SD	SE	N
Ocean acidification	3.50	4.00	1.247	0.131	90
Climate change	3.09	3.00	1.371	0.145	90
Sea level rise	2.97	3.00	1.292	0.137	89
Overfishing	3.60	4.00	1.372	0.145	90
Coral reef health or other live bottom habitat	4.01	4.00	0.954	0.101	90
Marine animal's health	4.12	4.00	0.872	0.092	90
Shipping	3.26	3.00	1.076	0.113	90
Dredging/Offshore dredge disposal	3.54	4.00	1.216	0.129	89
Beach renourishment	3.37	4.00	1.200	0.127	89
Energy production (oil & gas)	3.28	3.00	1.227	0.129	90
Alternative Energy production (wind, tidal, wave)	3.16	3.00	1.217	0.128	90
Mining of minerals (including sand)	3.44	3.00	1.191	0.126	90
Habitat loss from coastal development	3.88	4.00	1.160	0.122	90
Pollution	4.36	5.00	0.998	0.105	90
Human produced noise (from human activities)	3.00	3.00	1.349	0.142	90

Note(s): M, MD, SD, SE, N represent the mean, median, standard deviation, standard error of the mean, and total responses.

3.4. Environmental Concern inside of GRNMS

Respondents inside of Gray's Reef indicated similar concerns. Concern about pollution was followed by concern about coral health and other live bottom habitats, marine animal's health, habitat loss from coastal development, and then concern about the mining of minerals (Table 4). For both locations or areas, respondents indicated the concern levels regarding climate change as the lowest concern level on average, as well as human-produced noise and sea level rise.

Table 4. Respondents' Concern Levels Regarding Ocean Resources Inside GRNMS.

Item	M	MD	SD	SE	N
Ocean acidification	3.28	4.00	1.200	0.139	74
Climate change	2.89	3.00	1.330	0.155	74
Sea level rise	2.92	3.00	1.301	0.151	74
Overfishing	3.49	4.00	1.387	0.161	74
Coral reef health or other live bottom habitat	3.92	4.00	1.095	0.127	74
Marine animal's health	3.86	4.00	1.174	0.136	74
Shipping	3.18	3.00	1.186	0.138	74

Table 4. *Cont.*

Item	M	MD	SD	SE	N
Dredging/Offshore dredge disposal	3.52	4.00	1.229	0.146	71
Beach renourishment	3.21	3.00	1.352	0.159	72
Energy production (oil & gas)	3.41	4.00	1.249	0.148	71
Alternative Energy-production (wind, tidal, wave)	3.29	3.00	1.250	0.147	72
Mining of minerals (including sand)	3.61	4.00	1.205	0.142	72
Habitat loss from coastal development	3.69	4.00	1.263	0.149	72
Pollution	4.14	4.00	1.079	0.127	72
Human produced noise (from human activities)	3.07	3.00	1.313	0.156	71

Note(s): M, MD, SD, SE, N represent mean, median, standard deviation, standard error of the mean, and total responses.

4. Relationship between Socio-Demographics and Concern Levels

In order to examine the relationship between the concern levels of respondents and their socio-demographic background, several multiple regression analyses were used. Each concern item was used as the dependent variable in separate multiple linear regression models using 7 socio-demographic predictor variables, represented by gender, age, race, ethnicity, education, employment, and income (Tables 5 and 6). Ethnicity was automatically removed from the models in SPSS due to lacking values for all categories. Race was used in the models, however it only included two categories with values, with only two responses indicating Black or African American.

Some regression models examining the relationship between socio-demographics and environmental concern showed statistically significant results, even though overall model fit was marginal with low R^2 values. For coastal Georgia, the full regression model results for the reported concern levels about sea level rise (p = 0.043, R^2 adj = 0.208), concern about beach renourishment (p = 0.014, R^2 adj = 0.278), and concern about mineral mining (p = 0.034, R^2 adj = 0.218) were significant. For GRNMS specifically, none of the full regression models of the participants concerns showed a statistical significance. However, single predictor variables in the models (for concerns in coastal Georgia as well as GRNMS) showed significant results (Table 5).

Table 5. Results of the Multiple Linear Regression Analyses for Marine Environmental Concern Levels Outside of GRNMS/ in Coastal Georgia. p-values are shown with significant items noted and described below.

Concern Items (Coast)	Gender	Age	Race	Edu-Cation	Employment	Income
Ocean acidification	0.475	0.988	0.620	0.949	0.742	0.637
Climate change	0.272	0.403	0.289	0.846	0.644	0.144
Sea level rise **	0.680	0.187	0.548	0.088 +	0.532	0.131
Overfishing	0.536	0.160	0.192	0.628	0.557	0.021 *-
Coral reef health or other live bottom habitat	0.042 *-	0.266	0.157	0.134	0.443	0.013 *-
Marine animal's health	0.586	0.827	0.165	0.536	0.324	0.210
Shipping	0.388	0.009 *+	0.156	0.348	0.294	0.385
Dredging/Offshore dredge disposal	0.536	0.150	0.624	0.144	0.942	0.141
Beach renourishment **	0.052 +	0.002 *+	0.348	0.695	0.267	0.181
Energy production	0.813	0.211	0.920	0.485	0.607	0.019 *-
Alternative energy production	0.788	0.107	0.789	0.462	1.000	0.098 -
Mining of minerals **	0.812	0.079 +	0.643	0.095 +	0.522	0.063 -
Habitat loss	0.380	0.389	0.021 *+	0.225	0.067 -	0.002 *-
Pollution	0.902	0.045 *+	0.090 +	0.822	0.152	0.038 *-
Human produced noise	0.963	0.662	0.816	0.459	0.661	0.017 *-

Note(s): The p-value of the predictor variable is presented. * significant predictor variable ($p < 0.05$). ** significant regression model ($p < 0.05$); + positive relationship (positive standardized coefficients beta); - negative relationship (negative standardized coefficients beta).

In coastal Georgia and the GRNMS surrounding areas, age as a predictor variable showed a significant positive relationship with issues of concern, such as shipping ($p = 0.009$; standardized coefficients Beta $\beta = 0.547$), beach renourishment ($p = 0.002$; standardized coefficients Beta $\beta = 0.633$), and pollution ($p = 0.009$; standardized coefficients Beta $\beta = 0.433$) (Figure 3).

Income as a predictor variable showed a negative trend with statistical significance in some of the regression models with concern items (overfishing ($p = 0.021$; standardized coefficients Beta $\beta = -0.495$), coral health ($p = 0.013$; $\beta = -0.517$) (Figure 4), energy production ($p = 0.019$; $\beta = -0.499$), habitat Loss ($p = 0.002$; $\beta = -0.660$), pollution ($p = 0.038$; $\beta = -0.441$), and human produced noise ($p = 0.017$; $\beta = -0.514$)) (Table 5).

Race and gender had only binary reported response items. In terms of gender, the survey used binary response alternatives, recoded as numerical values of 1 for male and 2 for female response items. Race had more potential response alternatives, but respondents only indicated two categories of those. Binary response variables should be interpreted with caution. Significant results and the direction of the relationship being negative or positive shows whether one group has greater concerns than the other. Gender showed a significant negative relationship to the concern of coral health and other live-bottom habitats, meaning that female respondents reported lower concern levels for this item than their male respondents. Race showed a statistically positive relationship to the concern levels about habitat loss, meaning that respondents identifying as Black or African American reported higher levels of concern about this item than the White respondents.

Most other non-significant predictors for concern items presented weak relationships, with the exception of eight items. These results showed a non-significant result but a stronger relationship with a p-value between 0.05 and 0.099 ($p < 0.1$). This included education with regards to concern about sea level rise or the mining of minerals, income and concern about alternative energy production and mining of minerals, employment relating to concerns about habitat loss, race and concerns about pollution, age and concerns about the mining of minerals, and gender relating to concerns about beach renourishment (Table 5).

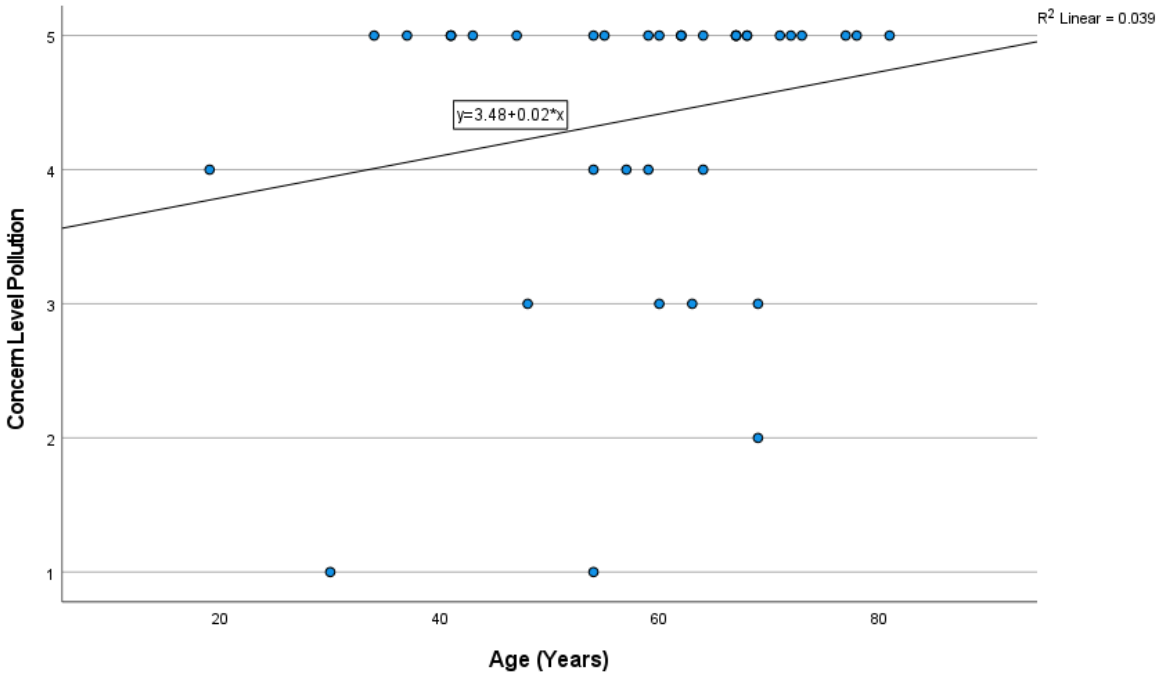

Figure 3. Relationship Between Concern Scores Regarding Pollution and Age with Statistically Significant Slope ($p = 0.009$; standardized Beta $\beta = 0.433$).

Finally, the multiple regression models assessing the relationship between the socio-demographics and concern items regarding marine resources inside of the GRNMS did not show any significant results overall (Table 6). However, two predictor variables showed

a significant relationship with a concern item. The respondents reported concern scores about shipping related positively with age (p = 0.033; β = 0.476) as a predictor variable. This means that for every increase in the unit of age, the concern level is expected to go up by 0.48 units. Furthermore, education as a predictor variable showed a positive relationship with concern about sea level rise (p = 0.048; β = 0.366). Six further predictor variables with regard to different concern items show a stronger relationship, but are non-significant with a p-value between p = 0.05 and p = 0.099 ($p < 0.1$). Those variables were education relating to concern about climate change, dredging, and energy production. Race relating to concern about habitat loss and pollution, as well as employment relating to pollution, also had p-values greater than 0.05 and smaller than 0.1.

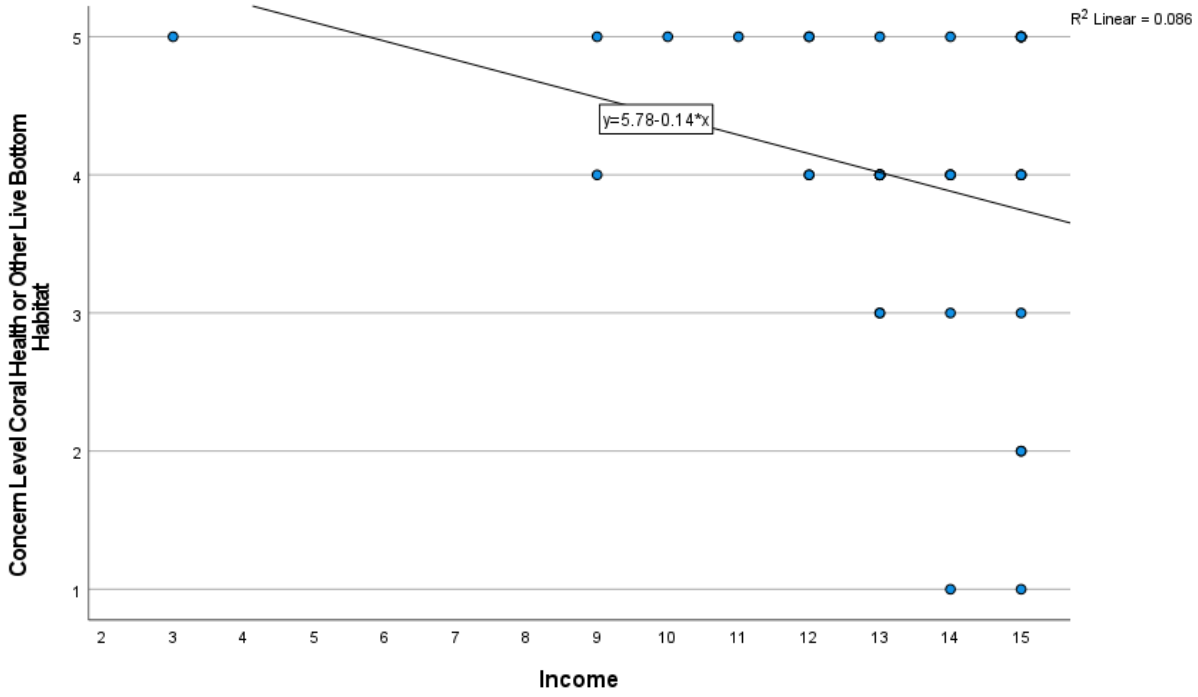

Figure 4. Relationship Between Income Level and Concern About Coral Health and Other Live-Bottom Habitat with Statistically Significant Slope (p = 0.013; standardized Beta β = −0.517).

Table 6. Results of the Multiple Linear Regression Analyses for Marine Environmental Concern Levels Inside of GRNMS.

Concern Items (GRNMS)	Gender	Age	Race	Edu-Cation	Employment	Income
Ocean acidification	0.856	0.417	0.955	0.133	0.603	0.315
Climate change	0.873	0.872	0.543	0.082 +	0.604	0.390
Sea level rise	0.846	0.959	0.276	0.048 *+	0.508	0.320
Over fishing	0.486	0.719	0.304	0.668	0.701	0.337
Coral reef health or other live bottom habitat	0.567	0.998	0.397	0.350	0.897	0.155
Marine animal's health	0.583	0.518	0.267	0.636	0.535	0.332
Shipping	0.653	0.033 *+	0.670	0.496	0.329	0.673
Dredging/Offshore dredge disposal	0.398	0.352	0.792	0.063 +	0.716	0.789
Beach renourishment	0.300	0.243	0.219	0.430	0.408	0.110
Energy production	0.119	0.230	0.929	0.075 +	0.245	0.102
Alternative energy production	0.522	0.883	0.192	0.285	0.452	0.612
Mining of minerals	0.673	0.285	0.509	0.254	0.690	0.579
Habitat loss	0.151	0.418	0.066 +	0.143	0.198	0.100
Pollution	0.764	0.125	0.058 +	0.832	0.074 -	0.285
Human produced noise	0.713	0.404	0.976	0.401	0.376	0.227

Note(s): The p-value of the predictor variable is presented. * significant predictor variable ($p < 0.05$); + positive relationship (positive standardized coefficients beta); - negative relationship (negative standardized coefficients beta).

5. Discussion

5.1. Visitor Profile

Visitor use monitoring in marine offshore settings is challenging due to the lack of infrastructural characteristics to potentially count traffic and intercept visitors for surveying [20,21]. Therefore, there is no or limited information or existing literature about current user profiles in GRNMS. This study aimed to begin to fill that gap. One potential limitation of this study is the sample selection that is derived from the Georgia Department of Natural Resources angler license database. These people are selected based on their saltwater fishing license. We do not have specific information about the non-respondents and people that were not reached by this survey, which represents a common weakness of remote survey methods [23]. However, former research identified recreational fishing as the primary recreational activity in the GRNMS [19,21], followed by diving. Therefore, it can be assumed that the sample applies to some potential visitors to Gray's Reef. In addition, other research found that between 82% and 87% of saltwater recreational anglers were male in a study profiling saltwater recreational anglers (based on the National Saltwater Angler Survey from 2013) [24]. Furthermore, the educational levels of recreational anglers on a national level were distributed more evenly, with approximately a quarter having a high school degree, Associate's degree, or Bachelor's degree, and the remainder made up of people with an educational level of 12th grade or less or those having an advanced, professional, or doctoral degree [24]. The profiles of recreational scuba divers identified by the Diving Equipment and Marketing Association (DEMA) and a study about the demographics of sport divers in offshore Texas waters [25,26] partly resulted in a similar "average" diver as the average user in this study. The average advanced diver is male (70% or more), but different than in our sample's mean age, being in their mid-30s [26,27]. Most of the respondents amongst advanced divers had an annual household income of $100,000 to $150,000 (70%) and a completed college or grad school degree (68%) [27]. Most users of the Florida Keys National Marine Sanctuary were also identified as predominantly middle-aged, well-educated, white males with high annual household incomes [27]. The trends in this latter study's findings align with the results of this study, except for the age. In this study, the mean age of the participants was in the mid-50s, with a higher median of 60 years. The high percentage of older respondents in the sample reflects the relatively high percentage of retired respondents (23%).

Overall, the description of the sample profile shows that there is a lack of diversity among the respondents. This lack of diversity reflects a common underrepresentation of minorities in land outdoor recreation in the US, such as in visitations to national forest lands [28]. An analysis of constraints shows that a lack of time and resource-related constraints, the latter primarily amongst minority respondents, were the most frequently mentioned challenges [28]. Both could apply to recreationists in GRNMS as well. A boat is necessary to get to the sanctuary. Either owning a boat, renting one, or participating in a guided tour requires financial resources and represents a major barrier to visit the offshore marine protected area. Only 5 percent of the respondents were non-White, which is not representative of the racial heterogeneity nationally or statewide (Georgia). In the state of Georgia, approximately 60% of the population is White, 33% is Black or African American, 10% is Hispanic or Latino, 5% is Asian, and under 1% each is Native Hawaiian or other Pacific Islander and American Indian and Alaska Native [29]. However, this underrepresentation is a common pattern in protected area visitation [28], and leads to several managerial challenges [30]. One ideal goal of resource managers should be to represent the interests of the public, because they depend on the public's support for current and future conservation efforts [30]. In the case of the underrepresentation of African Americans in outdoor recreation, this lack could negatively affect the success of protection efforts in the future by decreasing public support and simultaneously decreasing of potential funding due to the expected growing diversity in the country [30].

Thus, first identifying and understanding the visitor's profile, identifying constraints of non-recreationists, and finally supporting and incorporating ethnic and racial, gender,

income and educational heterogeneity across visitor demographics is critical in protected area management in order to ensure equitable and inclusive recreational opportunities [25,28,30].

5.2. Environmental Concern

In previous studies about public perception of marine protection in a global comparison, pollution, climate change, loss of biodiversity and habitat degradation were the most frequently perceived threats to oceanic ecosystems and marine environments [7,31]. The highest priorities for European policy development were indicated as pollution and overfishing, which in turn were issues perceived as having a direct negative impact on the human environment [31,32]. This study also sought to describe the concerns of people who are using or visiting the study area, both outside and inside of the GRNMS. As with the findings in other studies, the highest perceived concern by the respondents of this study was related to pollution. Potts et al. [31] argue that the high scoring could be explained by recent events including marine oil spills. Regarding marine environmental problems, pollution was the item that European respondents identified as having the most knowledge about in terms of how well informed they were [32]. This could lead to the assumption that knowledge about a specific environmental issue and environmental concern are related. These approaches could also explain the reported high concern scores regarding pollution in this study that was not specifically assessed within the survey instrument.

In the literature, concern about climate change was often mentioned as one of the most notable factors in public marine perception research. However, in this study the concern about climate change resulted in one of the lowest reported concern scores, confounding expectations. Petrosillo et al. [11] found that visitors' perceptions related to spatial aspects is more important than temporal factors in a study about tourist perceptions of recreational environment and management in a marine protected area in Italy. The authors discuss their findings with the tourists' interest in experiencing actual natural attractiveness rather than in the linked potential environmental impact caused by the recreational activity [11]. This could explain some of the respondents' concern levels in this study, such as the low level of concern about climate change. The impacts of climate change could potentially be perceived as a problem with larger temporal characteristics, meaning long-term impacts in the future rather than having an immediate impact on the resource at the time of use. In areas that are not necessarily perceived as immediately impacted by climate change, environmental threats such as pollution, which is more visible to the public in the form of plastic pollution, for example [7], or fishing, could potentially have more of an impact on the spatial components of the resource user's recreational experience.

Furthermore, the topic of climate change has become increasingly politicized and polarized [33]. Political opinion can influence environmental perception [34,35], which could also provide further interpretation of the respondents' reported concern levels, and could be a reason why concern scores for pollution were much higher than the ones for climate change. However, the political opinion was not part of the survey or of this study.

In a study about public opinions about marine resources and the coastal environment in Maine (U.S.), age was found to be a predictor for concern levels [35]. Younger respondents were more likely to see climate change as a threat, while older respondents reported higher concerns about beach pollution and overfishing [35]. Nonetheless, it can also be emphasized that besides age, the generation a person belongs to is crucial in terms of marine environmental perception [8,31]. The results of this study show that age had a significantly positive relationship with concern about shipping, beach renourishment, and pollution. Lived experiences could explain the perceptive patterns across the age strata [11,35]. The heterogeneity in environmental concern across age could be explained by a small number of respondents, and therefore the smaller variance in the data collected from younger age groups in the sample of this study.

Overall, concern levels were a little higher for surrounding marine areas than inside the Sanctuary itself, which could be based on the awareness of the exact location of GRNMS or the overall familiarity with regulations inside the Sanctuary. Petrosillo et al. [11] found

that whether people are aware or unaware of being in an MPA does not influence how they perceive negative or positive impacts to the environment due to visitation, pollution, traffic, or economic development. However, the authors found a significant impact of the awareness of being in an MPA to the perception of the effectiveness of conservation efforts [11]. Furthermore, previous research suggests that a negative perception of the status of resource and area protection does not mean that the conditions are poor, but that there is a need for more communication and information to the public [11]. All respondents from this sample seem to be aware of GRNMS, indicating that they visited the area once or more in 2019. However, the amount of knowledge about the area as well as knowledge about marine environmental issues overall was not a focus of this study, but could provide a greater explanation of specific concerns toward specific resources inside versus outside of the GRNMS. Furthermore, an increase of communication to potential and actual users of the GRNMS could be beneficial for the GRNMS as well, and could be implemented through visitor centers, educational programs, and outreach, for example [5].

Several studies have also found significant relationships between environmental concerns and educational levels [8,10,27,35]. The educational level and the amount of specific knowledge about the (local) marine environment are not necessarily the same, meaning that someone can have a high educational level but no detailed knowledge about coral reef habitats or marine environmental issues. For instance, people that frequently observe, experience, and use marine resources often have a significant understanding of marine environments [13]. This leads to a differentiation between education, knowledge and the level of knowledge about specific issues [35]. In general, the public is more familiar with the nearshore coastal ocean [7], which might lead to a slightly higher level of knowledge and concern about the marine area closer to the coast compared to the one farther offshore, such as the GRNMS.

In this study, income had significant negative relationships with concern levels for overfishing, coral health, energy production, habitat loss, pollution, and human produced noise. Research about the relationship of income and environmental concern has shown that they are linked, but the type of relationship is not consistent, or strong, but is generally described as positive [7]. Nevertheless, the results here do not reflect the general trends in the literature.

Income in combination with environmental concern can predict other environmental attitudes and behaviors, such as the reduction of energy use [36]. A study in Switzerland found that the higher the income and the lower the concern, the higher the emissions of a person [36]. The results of this study show that higher income was negatively related to some environmental concern items. This means that higher income groups were less concerned than lower income groups. However, the diversity amongst income levels in the sample is relatively small. The sample profile showed relatively high income levels, which is a common profile pattern among offshore fishing and diving users [24–26], who are the main identified users of the GRNMS. In previous environmental concern research, a commonly applied theory was that environmental concern was positively associated with education and income because people belonging to higher and upper classes have already satisfied their basic material needs and therefore can aim for other needs [8], such as sustaining a healthy environment. However, findings regarding the socioeconomic influence on environmental concerns were inconsistent [8]. More specifically, the socioeconomic status showed a weak association with environmental concerns in lower income countries with poor environmental conditions, but a stronger and more positive relationship in higher income countries with better environmental conditions [37]. However, low income Americans are often mistakenly expected to have lesser environmental concerns, even though they are often particularly affected by and exposed to the consequences of environmental problems [38,39], which again illustrates the lack of diversity in the sample and leads to the question of how such results would appear with a more diverse sample and user profile. Simultaneously, this shows the importance of working towards providing access and recreation opportunities to diverse visitors [39]. In terms of developing more just

environmental policies and meeting sustainability goals, organizations and governments can benefit from identifying ways for broadening and increasing public engagement [38].

6. Conclusions

The objectives of this study were to describe the sample of potential users of the GRNMS, to define environmental concerns for the GRNMS and surrounding coastal Georgia, and to contribute to the understanding of potential relationships between the resource user profile and the reported environmental concerns. The study was able to fill some of the gaps of the potential resource users' characteristics and their perceptions in the study area. Even though the comparison of studies shows both consistency and inconsistency in terms of socio-demographic predictors for environmental concern [40], the results of this study and findings in some other studies align. The "average" respondent was male, white, 58 years of age, had a high income of $100,000 dollars or more per year, and at least some college education. In general, the concern levels for marine environmental resources and issues were moderate across these demographic strata. The highest level of concern was reported for pollution in the whole study area, followed by the health of marine animals, and coral health and habitat loss from coastal development. The lowest rating regarding concern was that regarding climate change. The multiple regression analysis showed some trends regarding the relationship of age with environmental concern. Age had a significant positive relationship with concerns about shipping, beach renourishment, and pollution.

Environmental concerns and attitudes can lead to environmentally friendly behavior [8]. Knowing the resource users' perceptions and attitudes can provide insights to resource managers that can help in implementing and developing policies with high chances of success by finding insights about whether people understand management policies by identifying knowledge gaps and potential improvements for outreach and educational programs, and finally by understanding the support of specific restrictions, regulations and other implementations, such as fees [11,12,16–18]. At the same time, understanding user perceptions can highlight the potential need for action and adaptive management to increase potential users' awareness, information, and knowledge in areas where it might be lacking [17].

To ensure a successful future with regard to resource protection while at the same time providing equal and just opportunities to access and recreate in protected areas, including marine protected areas, managing agencies and organizations should understand visitor profiles, identify non-recreationists constraints, and make an effort to increase ethnic, racial, gender, income and educational diversity in potential visitors' profiles [27,28,30].

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