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PROFILING SALTWATER RECREATIONAL ANGLERS TOWARD THE THREATS OF MARINE ENVIRONMENT

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ABSTRACT

This study utilized cross-sectional data extracted from the 2013 National Saltwater Angler Survey, conducted by NOAA Fisheries Service, to examine saltwater recreational anglers' concerns to the threats of marine environment, identify groups exhibiting common patterns of responses, and examine the association between clusters of identified socio-demographic characteristics. The format of marine environmental threats in this study was composed of 13 Likert-scaled items scored from severe threat to not a threat at all. Concerns of marine environmental threats from these participants were examined through factor analysis which identified three reliable factors. Cluster analysis was used to identify three prominent clusters. Statistical tests were used to investigate the association between socio-demographic characteristics, including age, gender, income level, educational level, region of the respondent, and the identified factors and clusters. Results of this study may provide insight to understanding saltwater recreational anglers' concerns of marine environmental threats and could be an indicator of potential participation and behavior of saltwater recreational fishing projects.

Contribution/Originality: This study focuses on trying to understand saltwater recreational anglers' perceptions on what they may consider a threat to the marine environment they interact in. This gives us the opportunity to receive some empirical insight on the groups' common response patterns. This insight can thus provide baseline information about what they may deem as a concerning factor towards marine environmental threats. In return, there is growth to take these results and apply them towards marine fisheries awareness programs and/or management campaigns that can improve the quality of marine life. There is not a lot of collected data on this particular group, whom may offer a different perspective on how marine life has changed over time. Through their expertise, their insight would be considered quality information which can be transmitted into collectable data.

1. INTRODUCTION

The marine environment provides a range of important ecological goods and services for our society. To ensure the sustainability of this environmental ecosystem, we need to require an understanding of the beneficial implications it should human visitors but also the risks our actions may have on marine life. With these factors in mind, there is a need for policy that help promote long-term resilience and sustainability.

In the United States, the National Ocean Policy was created by Executive Order 13547 on July 19, 2010. Out of the National Ocean Policy, the interagency National Ocean Council, which consists of 27 federal agencies,

departments, and offices, was made to work on the nation's ocean management and research efforts (National Ocean Council, 2013). As environmental conditions worsen through the effects of global climate change, mixed with an ever-growing human population and carbon footprint, the National Ocean Policy is a progressive step towards the right direction for ocean policy.

The National Ocean Policy focuses on nine primary goals that seek to address the most pressing issues regarding the ocean, coastal, and Great Lakes ecosystems and their resources. Among the nine goals, they included how to shift regulators to a more holistic ecosystem-based management perspective, how to better integrate scientific information into policy decisions, and how to create a spatial planning process for determining what kinds of activities should take place in different parts of the U.S. waters (NOC, 2013). Torres *et al.* (2015) also puts a heavy emphasis on strategies and agency-specific tasks that may benefit long-term sustainability.

There are concerns for the future state of the marine environment. Certain themes that are highlighted by the National Ocean Policy include pressing issues such as the ocean economy, safety and security, coastal and ocean resilience, local choices, and scientific information. Emerging areas like illegal, unregulated and unreported fishing and seafood fraud, harmful algal blooms/hypoxia, regional marine plans, ocean acidification, coastal resilience and sea level rise tools, and coastal mapping) further highlight issues relating to human health, economic stability, aquatic health and protection (NOC, 2013).

Current threats towards marine ecosystems come in various forms, such as the dramatic loss of marine biodiversity and habitat (Beatley, 1991; Norse, 1996; Snelgrove, 1999) overexploitation and harvesting (Beddington *et al.*, 2007) the introduction of exotic species; waste pollution (i.e., plastic debris) (Derraik, 2002) developing offshore wind power (Acheson, 2012) and the potentially serious effects of global climate change.

The National Oceanic and Atmospheric Administration (NOAA) Fisheries Service's report about 88% of saltwater recreational anglers ranked overfishing in commercial fisheries, 86% ranked industrial pollution, and 79% ranked marine habitats loss or degradation as severe or moderate threats to the marine environment. Conversely, 67% of respondents ranked alternative energy (e.g. wave or wind) development, and 51% ranked shipping as not a threat at all or not very severe threats to the marine environment (Brinson and Wallmo, 2013).

Although human perceptions, understandings, and responses have been widely explored through some environmental problems, much less attention has been given to human impacts on marine environment. Not many systematic studies have been conducted on understanding how saltwater recreational anglers perceive marine environmental threat(s), specifically on profiling this interest group by using the marine environmental threat scale approach. If there is qualitative data conducted on these anglers, their insight could contribute to more efficient strategies for long-term fisheries management.

The objectives of this study were to understand saltwater recreational anglers' perceptions to marine environmental threats; to identify saltwater recreational angler groups exhibiting common response patterns; and to examine inter-personal and inter-group differences between certain threats. The results of this study may provide baseline information about saltwater recreational anglers' understanding towards marine environmental threats and which groups and issues should be targets for marine fisheries awareness and management campaign.

2. DATA

For this study, the data was extracted from the 2013 National Recreational Angler Survey (Brinson and Wallmo, 2013) which was developed by NOAA Fisheries Service and collected by the CIC Research in 2012, targeted saltwater anglers, 16 years of age and older who had been saltwater fishing at least once in their life, to elicit their perceptions, preferences, and attitudes about saltwater recreational fishing and recreational fisheries management. This survey was implemented in six regions in the United States, including North Atlantic, Mid-Atlantic, South Atlantic, Gulf of Mexico, West Coast, and Alaska.

In the survey, respondents were asked, "In your opinion, how much of a threat, if any, does each of the following factors pose to the marine environment?", to indicate 13 statements regarding the threats of marine environment, using a Likert-type scale that ranged from 1 (not a threat at all) through 4 (severe threat), and 5 (I am unsure). This study examined the psychometric properties of marine environmental threat scale from the 7,763 saltwater recreational anglers who provided complete information for all 13 marine environmental threats (Table 1).

Table-1. Descriptive Statistics of Marine Environmental Threat Scale

In your opinion, how much of a threat, if any, does each of the following factors pose to the marine environment?	Mean	S.D.	Communalities
Industrial pollution	3.47	0.758	0.560
Oil and gas extraction	3.10	0.995	0.678
Climate change	2.72	1.106	0.520
Ocean acidification	3.38	1.134	0.458
Shipping	2.60	1.101	0.495
Overfishing in commercial fisheries	3.59	0.708	0.640
Overfishing in recreational fisheries	2.59	1.090	0.388
Non-native species	3.33	1.006	0.454
Aquaculture	3.04	1.392	0.552
Alternative energy (e.g. wave or wind) development	2.28	1.358	0.464
Algal blooms	3.46	1.048	0.515
Marine habitats loss or degradation	3.46	0.838	0.521
Dams/barriers	3.10	1.135	0.428

(Not a threat at all = 1, Not a very severe threat = 2, Moderate threat = 3, Severe threat = 4, I am unsure = 5)

3. METHODS

Market segmentation is a widely accepted concept in marketing research and planning (Myers, 1996). Market segmentation is a process of dividing the heterogeneous market into meaningful homogeneous subgroups of consumers who have common needs and wants. Furthermore, Weinstein (2004) offered the following definition: "Segmentation marketing means knowing your customers, giving them exactly what they want or may want, building strong relationships with channel affiliates and co-marketing partners, and communicating via highly targeted promotional media."

Most multivariate analytical techniques can be used in some way to create post hoc market segments. The factor-cluster technique is utilized by researchers interested in market segmentation studies. Statistically, factor-cluster analysis is a method that performs a factor analysis on data, assigning factor scores to each individual case. These factor scores are used to run a cluster analysis algorithm. The K-means, or quick cluster, method is then designed to create a small number of clusters from a large data set.

The market segmentation techniques used in this study were: factor analysis for data preparation, cluster analysis for data examination, and discriminant analysis for classification. First, the dimensionality of the 13-item marine environmental threat scale was assessed by examining its factor solution. A principal component analysis was used to determine the factors identified in this sample size. Second, a K-means cluster analysis was conducted to identify to respondent groups exhibiting common response patter. Third, a series of statistical tests was utilized to examine the association between socio-demographic characteristics and the identified factors and clusters.

4. RESULTS

4.1. Factor Analysis

Factor analysis can reduce the number of variables to a more manageable size while also removing correlations between each variable. In this study, the 13-item marine environmental threat scale was analyzed with varimax rotation, providing a clearer separation of the factors. Specifically, the amount of variance explained by the extracted factors (i.e., their eigenvalues) was noted. In addition, item-factor correlations (i.e., factor loadings) and

other indices of model adequacy were examined. The factor loading of the three resulting factors was shown in Table 2. The Kaiser-Meyer-Olkin (KMO) measure of sampling adequacy was 0.880, which met the fundamental requirements for factor analysis. The Bartlett's test of Sphericity showed that nonzero correlations existed at the significance level of 0.001.

The Cronbach's alpha is widely used to measure how closely related a set of items are as a group. The internal consistency coefficient score of the 13-item marine environmental threat scale showed the Cronbach's alpha of 0.824 was acceptable. Each of these three factors had a satisfactory Cronbach's alpha of 0.736, 0.722, and 0.521, respectively, which explained a cumulative 51.338 percent of the variance in statement response (Table 2).

Table-2. Factor Analysis of Marine Environmental Threat Scale

In your opinion, how much of a threat, if any, does each of the following factors pose to the marine environment?	***Environmental Change***	***Industrial Development***	***Fisheries Activities***
Aquaculture	0.732		
Algal blooms	0.673		
Alternative energy development	0.604		
Dams/barriers	0.569		
Non-native species	0.559		
Ocean acidification	0.544		
Oil and gas extraction		0.807	
Climate change		0.693	
Industrial pollution		0.673	
Shipping		0.606	
Overfishing in commercial fisheries			0.784
Overfishing in recreational fisheries			0.532
Marine habitats loss or degradation			0.512
Eigenvalue	2.698	2.371	1.605
% of variance	20.757	18.237	12.344
Cumulative %	20.757	38.994	51.338
Reliability Alpha Coefficient	0.736	0.722	0.521
Reliability Alpha Coefficient of All 13 Items = 0.824			
Kaiser-Meyer-Olkin (KMO) Measure of Sampling Adequacy = 0.880			
Bartlett's Test of Sphericity: Approx. Chi-Square = 23703.761; *df* = 78; Sig. < 0.001			

As a result of exploratory factor analysis, three factors were identified. Each factor was named after a defined variable that made the greatest contribution in each dimension. An initial interpretation of these factors suggested that Factor 1 named "*Environmental Change*" comprised of six items (structure coefficients ranging from 0.732 to 0.544) and explained 20.757 percent of the variance with an eigenvalue of 2.698. Factor 2 had an emphasis in "*Industrial Development*" which comprised of four items (structure coefficients ranging from 0.807 to 0.606) and explained 18.237 percent of the variance with an eigenvalue of 2.371. Lastly, Factor 3 focused on "*Fisheries Activities*" which comprised of three items (structure coefficients ranging from 0.784 to 0.512) and explained 12.344 percent of the variance with an eigenvalue of 1.605 (Table 2).

4.2. Cluster Analysis

Cluster analysis determines which group(s) of respondents have similar responses on key variables. In this study, the K-means clustering analysis was applied to identify a solution with a specified number of clusters to the saved factor scores. The factor scores of marine environmental threat dimensions were used to cluster saltwater recreational anglers. Consequently, a three-cluster solution was agreed upon, which was labeled as "*Utilized Concern*", "*Environmental Concern*", and "*Developmental Concern*" clusters (Table 3).

"*Utilized Concern*": this cluster was the largest group, comprising of approximately 45.0 percent of respondents, named because of the strongly positive factor score associated with "*Industrial Development*" and "*Fisheries Activities*"

factors, negatively identified with "*Environmental Change*" factor among these respondents. "*Environmental Concern*" cluster: this was the smallest group comprising of approximately 27.0 percent of the respondents. These respondents were positively connected with "*Environmental Change*" and "*Fisheries Activities*" factors, particularly negatively and strongly identified with "*Industrial Development*" factor. "*Fisheries Concern*" cluster: with 28.0 percent of the respondents, this group was named after the negatively strong association with "*Fisheries Activities*" and "*Environmental Change*" factors, but positively identified with "*Industrial Development*" factor (Table 3).

Table-3. Cluster Analysis of Saltwater Recreational Anglers

	Utilized Concern	***Environmental Concern***	***Fisheries Concern***
Environmental Change	-0.1352	0.3559	-0.1257
Industrial Development	0.6243	-1.1209	0.0778
Fisheries Activities	0.5132	0.3693	-1.1775
n = 7763	3490	2095	2178
Percentage	45.0	27.0	28.0

4.3. Discriminant Analysis

Results of the cluster analysis were tested for accuracy using the multiple discriminant analysis, which is used primarily to predict membership in two or more mutually exclusive groups. In this case, the null hypothesis of equal population covariance matrices is rejected at 1% level of significance (the Box's M = 1180.211; F = 39.302; p = 0.000), and the Wilk's Lambda scores were 0.199 (χ^2 = 12517.402; df = 6; $p < 0.001$) and 0.455 (χ^2 = 6112.717; df = 2; $p < 0.001$) for both discriminant functions, respectively, indicating that group means were significantly different. The canonical correlation results were both above 0.7, supporting that there were strong relationships between the discriminant score and the cluster membership (Table 4).

Table-4. Canonical Correlation of Discriminant Functions

Function	Eigenvalue	% of Variance	Canonical Correlation
1	1.283	51.7	0.750
2	1.199	48.3	0.738
* First 2 canonical discriminant functions were used in the analysis.			

4.4. Profile Analysis

After the formation of the three clusters, a series of statistical tests were used to examine the association between socio-demographic characteristics, including age, gender, income level, educational level, region of the respondent, and the identified factors and clusters. The average age for each cluster was in the early-fifties. The differences in average age were relatively minor, at most 1.48 years. One-way ANOVA was performed to examine the effects of respondents' age on the three clusters identified. The result showed that significant differences in respondents' age was found with the three clusters identified ($F(2, 7760) = 7.068$, $p = 0.001$).

Using the Chi-square test, there were significant differences among saltwater recreational angler clusters for all 13 marine environmental threats at a 0.01 level. For most of the "*Industrial Development*" factor items, including "oil and gas extraction", "industrial pollution", "climate change", and "shipping" threats, the "*Utilized Concern*" angler cluster contained a larger portion of "moderate threat" or "severe threat" responses than the "*Environmental Concern*" and the "*Fisheries Concern*" angler clusters (Table 5).

Similarly, for most of the "*Environmental Change*" factor items, including "aquaculture", "algal blooms", "alternative energy development", "dams/barriers", "non-native species", and "ocean acidification" threats, the "*Utilized Concern*" angler cluster also contained a larger portion of "moderate threat" or "severe threat" responses than the "*Environmental Concern*" and the "*Fisheries Concern*" angler clusters (Table 5).

Responses to threat of "overfishing in recreational fisheries", for example, varied significantly among saltwater recreational angler clusters (χ^2 = 1481.899, df = 8, $p < 0.001$). About 28% of the "*Fisheries Concern*" anglers said that

the threat of "overfishing in recreational fisheries" was a *moderate* or *severe* threat to the marine environment, but 39% of the "*Environmental Concern*" and 64.6% of the "*Utilized Concern*" anglers rated the threat as "moderate threat" or "severe threat" to the marine environment (Table 5).

Responses to "marine habitats loss or degradation" threat, varied significantly among saltwater recreational angler clusters (χ^2 = 1774.009, df = 8, p < 0.001). While more than 90% of the "*Utilized Concern*" anglers said that the threat of "marine habitats loss or degradation" was a *moderate* or *severe* threat to the marine environment, 76.9% of the "*Environmental Concern*" anglers, and 67.4% of the "*Fisheries Concern*" anglers rated the threat as a *moderate* or *severe* threat to the marine environment (Table 5).

Table-5. Percentage of Item Response of the Saltwater Recreational Angler Clusters

Item	Utilized Concern		Environmental Concern		Fisheries Concern	
Scale	1 & 2	3 & 4	1 & 2	3 & 4	1 & 2	3 & 4
Industrial pollution	0.5%	94.9%	23.0%	75.6%	14.8%	83.8%
Oil and gas extraction	4.6%	98.1%	64.5%	34.9%	29.2%	67.3%
Climate change	20.1%	71.7%	74.9%	23.1%	49.0%	44.9%
Ocean acidification	9.2%	74.1%	35.8%	35.4%	33.1%	45.8%
Shipping	33.7%	54.9%	79.1%	14.9%	60.9%	29.5%
Overfishing in commercial fisheries	0.1%	95.0%	2.3%	92.3%	21.7%	78.1%
Overfishing in recreational fisheries	30.2%	64.6%	56.9%	39.0%	71.7%	28.0%
Non-native species	14.3%	75.2%	12.3%	67.6%	39.8%	53.1%
Aquaculture	39.9%	40.2%	44.8%	17.9%	50.8%	23.4%
Alternative energy development	70.3%	18.5%	76.6%	9.7%	64.8%	16.1%
Algal blooms	14.0%	71.2%	10.2%	58.4%	32.6%	51.6%
Marine habitats loss or degradation	3.5%	90.3%	8.2%	76.9%	29.0%	67.4%
Dams/barriers	21.7%	65.3%	35.5%	44.9%	47.7%	41.5%

(Not a threat at all = 1, Not a very severe threat = 2, Moderate threat = 3, Severe threat = 4, I am unsure = 5)

The overwhelming majority of each saltwater recreational angler cluster (82.3% to 87.1%) was male. To test the significant differences between male and female respondents associated with the marine environmental threats, the Chi-square test was employed. There were significant gender differences for all 13 marine environmental threat statements at a 0.01 level. Female anglers (57.4%) responses to the threat of "climate change", for example, contained a larger portion of *moderate* or *severe* threat responses than male anglers (49.8%). However, male anglers (55.8%) contained a larger portion of "not a threat at all" or "not a very severe threat" responses to "shipping" threat than female anglers (42.2%) (Table 6). For most of the "*Fisheries Activities*" factor items, 90.3% of male and 85.6% of female checked that the threat "overfishing in commercial fisheries" was "moderate threat" or "severe threat" to the marine environment. While 50% of male and 43.9% of female concerned that "overfishing in recreational fisheries" rating being the threat as "not a threat at all" or "not a very severe threat" to the marine environment. Responses to "marine habitats loss or degradation" threats, male (80.2%) contained the same percentage of "moderate threat" or "severe threat" responses as female (80.4%) (Table 6).

Since one of the purposes in this study was to compare differences in marine environmental threats between female and male saltwater recreational anglers, the factor score of three factors was saved for further statistical analysis. In order to test the significant differences between male and female respondents, the t-test was performed with the three-factor scores. Overall, gender had significant differences in "*Environmental Change*" and "I*ndustrial Development*" at 0.01 level; and no significant differences in "*Fisheries Activities*" factor. The results showed that females were more likely than males in "*Environmental Change*" (t = -5.566; p < 0.001) and "*Industrial Development*" (t = -6.944; p < 0.001), respectively (Table 7).

Table-6. Gender Differences in Marine Environmental Threat Scale

Items	Gender	1	2	3	4
Industrial pollution	Male	1.5%	9.5%	34.1%	52.0%
	Female	1.2%	7.3%	31.2%	57.5%
Oil and gas extraction	Male	6.7%	22.4%	32.9%	33.5%
	Female	4.9%	15.1%	30.5%	45.2%
Climate change	Male	15.8%	28.3%	32.0%	17.8%
	Female	11.4%	26.0%	36.7%	20.7%
Ocean acidification	Male	4.2%	19.5%	33.3%	21.6%
	Female	3.3%	16.6%	31.0%	28.8%
Shipping	Male	13.6%	42.2%	28.1%	7.6%
	Female	9.9%	32.3%	32.8%	13.1%
Overfishing in commercial fisheries	Male	1.1%	5.3%	29.6%	60.7%
	Female	2.2%	6.3%	31.3%	54.3%
Overfishing in recreational fisheries	Male	18.0%	32.0%	28.4%	18.4%
	Female	16.0%	27.9%	28.0%	22.6%
Non-native species	Male	3.2%	18.0%	34.0%	33.2%
	Female	3.0%	16.4%	30.7%	35.2%
Aquaculture	Male	12.4%	33.0%	21.9%	7.6%
	Female	11.6%	27.2%	20.5%	9.2%
Alternative energy development	Male	35.6%	35.9%	10.2%	4.9%
	Female	31.5%	33.7%	12.3%	5.1%
Algal blooms	Male	2.4%	16.2%	35.5%	27.1%
	Female	2.1%	13.7%	32.1%	28.3%
Marine habitats loss or degradation	Male	1.4%	10.8%	36.6%	43.6%
	Female	1.7%	8.7%	33.9%	46.5%
Dams/barriers	Male	6.6%	26.5%	32.8%	21.1%
	Female	6.1%	24.6%	30.6%	18.8%

(Not a threat at all = 1, Not a very severe threat = 2, Moderate threat = 3, Severe threat = 4, I am unsure = 5)

Table-7. Gender Differences in Marine Environmental Threat Factors

Factor	Male		Female		Differences	
	Mean	S.D.	Mean	S.D.	*t*	*P*
Environmental Change	-0.0278	0.9917	0.1430	1.0303	-5.566	0.000
Industrial Development	-0.0346	1.0027	0.1782	0.9670	-6.944	0.000
Fisheries Activities	0.0076	0.9859	-0.0389	1.0692	1.512	0.131

Using the Chi-square test, the identified three clusters demonstrated significant differences in respondent gender composition ($\chi^2 = 23.559$; $df = 2$; $p < 0.001$). This implies that the "*Environmental Concern*" angler cluster had a significantly smaller percentage of female respondents (12.9%) than the "*Utilized Concern*" (17.7%) and the "*Fisheries Concern*" (17.3%) clusters of anglers (Table 8).

Table-8. Gender Composition of the Saltwater Recreational Angler Clusters

Gender	Utilized Concern	Environmental Concern	Fisheries Concern	Total
Male	2874 (82.3%)	1824 (87.1%)	1802 (82.7%)	6500 (83.7%)
Female	626 (17.7%)	271 (12.9%)	376 (17.3%)	1263 (16.3%)
Total	3490	2095	2178	7763

Similarly, the saltwater recreational angler clusters using the Chi-square test demonstrated significant differences in respondents' household total annual income ($\chi^2 = 99.681$; $df = 14$; $p < 0.001$). In the "*Utilized Concern*" angler cluster, 39.5% reported a household total annual income of $59,999 or less. Only 35.0% of the "*Fisheries Concern*" angler cluster and 29.6% of the "*Environmental Concern*" angler cluster had a household total annual income below $60,000. In the higher income level (a household total annual income of $150,000 or more), the "*Environmental Concern*" angler cluster had 18.6%, but the "*Fisheries Concern*" angler cluster had 13.8% and the "*Utilized Concern*" angler cluster had 12.8% of the respondents (Table 9).

Table-9. Income Composition of the Saltwater Recreational Angler Clusters

Income Level	Utilized Concern	Environmental Concern	Fisheries Concern	Total
Less than $20,000	258 (7.4%)	89 (4.2%)	127 (5.8%)	474 (6.1%)
$20,000-$39,999	522 (15.0%)	231 (11.0%)	267 (12.3%)	1020 (13.1%)
$40,000-$59,999	598 (17.1%)	302 (14.4%)	368 (16.9%)	1268 (16.3□)
$60,000-$79,999	569 (16.3%)	302 (14.4%)	365 (16.8%)	1236 (15.9%)
$80,000-$99,999	484 (13.9%)	320 (15.□%)	335 (15.4%)	1139 (14.7%)
$100,000-$149,999	612 (17.5%)	461 (22.0%)	416 (19.1%)	1489 (19.2%)
$150,000-$199,999	225 (6.4%)	178 (8.5%)	144 (6.6%)	5□7 (7.0%)
$200,000 or more	222 (6.4%)	212 (10.1%)	156 (7.2%)	590 (7.6%)
Total	3490	2095	2178	7763

The saltwater recreational angler clusters also demonstrated significant differences in respondent educational level ($\chi^2 = 50.550$; $df = 8$; $p < 0.001$). In the "*Environmental Concern*" angler cluster, 44.4% reported had at least a bachelor's degree or higher. Only 37.1% of the "*Utilized Concern*" angler cluster and 36.9% of the "*Fisheries Concern*" angler cluster received a higher education degree (Table 10).

Table-10. Education Composition of the Saltwater Recreational Angler Clusters

Educational Level	Utilized Concern	Environmental Concern	Fisheries Concern	Total
12th Grade or less	298 (8.5%)	119 (5.7%)	163 (7.5%)	580 (7.5%)
High school graduate or GED	844 (24.2%)	436 (20.8%)	537 (24.7%)	1817 (23.4%)
Associate or technical school degree or college coursework	1053 (30.2%)	609 (29.1%)	675 (31.0%)	2337 (30.1%)
Bachelor's degree	736 (21.1%)	554 (26.4%)	496 (22.8%)	1786 (23.0%)
Advanced, professional, or doctoral degree or coursework	559 (16.0%)	377 (18.0%)	307 (14.1%)	1243 (16.0%)
Total	3490	2095	2178	7763

Using the Chi-square test, there were significant differences among saltwater recreational angler clusters for all six regions ($\chi^2 = 91.877$; $df = 10$; $p < 0.001$). For the Alaska region, the "*Fisheries Concern*" angler cluster contained a relatively larger percentage (2.8%) of the respondents, comparing with the "*Utilized Concern*" (2.3%) and the "*Environmental Concern*" (2.1%) angler clusters. Similar to the West Coast region, there were 15.6% of the respondents in the "*Fisheries Concern*" angler cluster, while the "*Environmental Concern*" angler cluster had 15.2% and the "*Utilized Concern*" angler cluster had 14.9% of the respondents (Table 11).

In the Mid-Atlantic region, the "*Utilized Concern*" angler cluster was 26.4%, the "*Environmental Concern*" angler cluster was 19.9%, and the "*Fisheries Concern*" angler cluster was 18.8% of the respondents. For the North Atlantic regions, 12.3% of the respondents were in the "*Environmental Concern*" angler cluster, 14.3% were in the "*Fisheries Concern*" angler cluster, and 14.4% were in the "*Utilized Concern*" angler cluster. Similarly, the "*Utilized Concern*" angler cluster was 19.5%, the "*Environmental Concern*" angler cluster was 26.6%, and the "*Fisheries Concern*" angler cluster was 26.3% of the respondents in the Gulf of Mexico region (Table 11).

Table-11. Region Composition of the Saltwater Recreational Angler Clusters

Region / Group	Utilized Concern	Environmental Concern	Fisheries Concern	Total
Alaska	82 (2.3%)	44 (2.1%)	60 (2.8%)	186 (2.4%)
West Coast	520 (14.9%)	319 (15.2%)	339 (15.6%)	1178 (15.2%)
North Atlantic	504 (14.4%)	257 (12.3%)	311 (14.3%)	1072 (13.8%)
Mid-Atlantic	921 (26.4%)	416 (19.9%)	409 (18.8%)	1746 (22.5%)
South Atlantic	781 (22.4%)	501 (23.9%)	486 (22.3%)	1768 (22.8%)
Gulf of Mexico	682 (19.5%)	558 (26.6%)	573 (26.3%)	1813 (23.4%)
Total	3490	2095	2178	7763

According to the post hoc comparisons with the Tukey HSD test, significant pairwise clustering differences were obtained in age, gender, income level, educational level, and region between the "*Utilized Concern*", "*Environmental Concern*", and "*Fisheries Concern*" angler clusters. The results revealed that there was a statistically significant difference in age between the "*Utilized Concern*" and the "*Fisheries Concern*" angler cluster, with a mean difference of 1.21 and a *p-value* of 0.005. The "*Environmental Concern*" angler cluster was also significantly different from the "*Developmental Concern*" angler cluster, with a mean difference of 1.48 and a *p-value* of 0.002. However, there was no differences between the "*Utilized Concern*" angler cluster and the "*Environmental Concern*" angler cluster in age ($p = 0.768$) (Table 12).

Statistically, there was a significant difference in income level among three angler groups. However, in terms of gender and educational level, there were no differences between the "*Utilized Concern*" angler cluster and the "*Fisheries Concern*" angler cluster ($p = 0.992$ and $p = 0.985$, respectively), as well as between the "*Environmental Concern*" angler cluster and the "*Fisheries Concern*" angler cluster in region ($p = 0.262$) (Table 12).

Table-12. The Tuckey HSD Test among the Saltwater Recreational Angler Clusters

Dependent Variable	Group (I)	Group (J)	Mean Difference (I - J)	Std. Error	Sig.
Age	Utilized Concern	Environmental Concern	-0.27	0.388	0.768
	Utilized Concern	Fisheries Concern	1.21	0.383	0.005
	Environmental Concern	Fisheries Concern	1.48	0.429	0.002
Gender	Utilized Concern	Environmental Concern	0.05	0.10	0.000
	Utilized Concern	Fisheries Concern	0.00	0.10	0.922
	Environmental Concern	Fisheries Concern	-0.04	0.011	0.000
Income	Utilized Concern	Environmental Concern	-0.52	0.054	0.001
	Utilized Concern	Fisheries Concern	-0.19	0.053	0.000
	Environmental Concern	Fisheries Concern	0.33	0.059	0.000
Education	Utilized Concern	Environmental Concern	-0.18	0.032	0.000
	Utilized Concern	Fisheries Concern	0.01	0.032	0.985
	Environmental Concern	Fisheries Concern	0.19	0.036	0.000
Region	Utilized Concern	Environmental Concern	-0.18	0.040	0.000
	Utilized Concern	Fisheries Concern	-0.11	0.039	0.014
	Environmental Concern	Fisheries Concern	0.07	0.044	0.262

5. CONCLUSIONS

Understanding how saltwater recreational anglers are concerned with marine environmental threats could be one of many critical factors in implementing effective programs for ecosystem-based marine resource management throughout the United States. This study utilized cross-sectional data extracted from the 2013 National Saltwater Angler Survey to identify groups exhibiting common response patterns and to examine the association between socio-demographic characteristics alongside identified factors and clusters.

Three distinct angler groups -- "*Utilized Concern*", "*Environmental Concern*", and "*Developmental Concern*" groups -- were discovered, using K-means cluster analysis. These groups differed significantly in three dimensions through factor analysis from the 13 marine environmental threat scale -- "*Environmental Change*", "*Industrial Development*", and "*Fisheries Activities*" – which were used to determine group placement.

There were significant gender differences for all 13 marine environmental threat statements at a 0.01 level. Also, gender had significant differences in "*Environmental Change*" and "I*ndustrial Development*", and no significant differences in "*Fisheries Activities*" factor. Using the Chi-square test, the identified three clusters demonstrated significant differences in respondent gender composition.

Statistically, there were significant differences among saltwater recreational angler clusters for all 13 marine environmental threats at a 0.01 level. It also showed that significant differences in respondents' age was found with the three clusters identified. Similarly, there were significant differences among saltwater recreational angler clusters for respondents' household total annual income, educational level, and all six regions.

In conclusion, decision-makers must understand there are three groups of anglers identified in the study, each with different wants and needs for their specific concerns of marine environmental threats. Results of this study may provide insight regarding the concerns of marine environmental threats from saltwater recreational anglers as an indicator of potential participation and behavior of saltwater recreational fishing projects.

6. DISCUSSION

In the field of business, market segmentation is the essence of sound business strategy and value creation. Cluster analysis provides a multitude of techniques frequently used in determining the number of segments and its characteristics (Wedel and Kamakura, 2000). This empirical study seeks to provide an up-to-date assessment of cluster analysis application in marketing research by using the data from saltwater recreational anglers' concerns to the threats of marine environment.

In an era that demands both protection and productivity of our nation's waters, the National Ocean Policy is a step towards long-term sustainability: a strong, coherent national policy based on science and local stakeholders. This study illustrated the diversity of saltwater recreational anglers' concerns and contradict the concept of an "average" angler. This study may also place a strong emphasis on the importance of understanding marine ecosystem structure, its function and processes, and how human activities are affecting these, including the socio-economic implications. Thus, all sectors of the community should take their individual steps. Thinking globally and acting locally is a fundamental intention to reduce such an environmental threat.

This study had both theoretical and practical implications. With updated testing of the well-developed conceptual framework of the marine environmental threat scale among saltwater recreational anglers, this research contributed to existing decision-making literature by either providing more evidence of the validity and robustness of this framework or by providing suggestions for adaptation in applying this framework to understand saltwater recreational angler groups across different socio-demographic backgrounds. Also, this research added more to the existing literature on the dynamically changing saltwater recreational anglers.

The results of this study would assist saltwater recreational fisheries managers in designing practical recreational fisheries management strategies to address concerns of anglers of saltwater recreational fishing and to benefit fisheries populations. This research may also provide practical marketing implications for environmental education by proposing effective ways to understand and target these consumers. Research results may provide direction for environmental education developing marketing strategies, which target the saltwater recreational anglers.

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