

DIVER PERCEPTIONS OF FLORIDA KEYS REEF CONDITIONS BY SPECIALIZATION LEVEL

Sarah Young

Human Dimensions of Marine and Coastal Ecosystems
University of Massachusetts, Amherst
syoung@nrc.umass.edu

David Loomis

University of Massachusetts, Amherst

Abstract.—Understanding different user-group values, preferences, and perceptions can lead to more efficient and effective management decisions, reducing conflict and helping to balance eco-societal goals. User perceptions of reef condition, ecological health, and impacts to reefs can provide valuable information to managers on motivations, values, willingness to comply with regulations, satisfaction of experience, and potential sources of conflict. Perceptions and values within user groups are heterogeneous in terms of motivations, satisfactions, and characteristics. Specialized divers tend to have more specific resource requirements. This study uses specialization theory to subdivide divers in the Florida Keys into meaningful specialization categories to achieve a more sophisticated understanding of diver perceptions of reef condition. The responses to six structured questions were analyzed to assess perceptions of ecological health and impacts to reefs. Overall, the survey results were varied, with only highly specialized divers showing significantly different responses to hypothetical variations in reef condition.

1.0 INTRODUCTION

Coral reefs are recognized as having significant biological, social, and economic value to both the communities they support and wider society (Cesar 2000). Managing areas of reef to meet both ecological and user demands presents a complex challenge. When environmental and recreation managers understand different user-group values, preferences, and perceptions, they can make decisions that promote more efficient and effective resource management, reduce conflict, and help to balance ecological and societal goals. User perceptions of reef condition, ecological health and impacts to

reefs can provide valuable information to managers on motivations, values, willingness to comply with restrictions, satisfaction of experience, and potential sources of conflict. For example, it would be very difficult to enforce a no-access regulation based on ecological criteria to an area that users perceive to be in good condition. Perception of resource condition and acceptability of different reef conditions can also be used for monitoring social carrying capacity and the shifting baseline of resource acceptability. However, information relating to individual user groups may be insufficient. Even within a user category, such as divers, values differ significantly. This study uses recreational specialization theory to group divers into different specialization levels and investigates whether these groups have different perceptions of reef condition, ecological health, and impacts on reefs.

Recreation specialization theory (henceforth referred to as “specialization theory”) was first proposed by Bryan (1977), later refined by Ditton et al. (1992), and subsequently used as a framework to investigate a variety of natural resource conservation issues. (For a selection of applications, see Dearden et al. [2006], Mangun et al. [2007], and Oh and Ditton [2008]). Specialization theory postulates that outdoor recreation participants (e.g., anglers, SCUBA divers, boaters) can be placed on a continuum from general interest and low involvement to expert interest and high involvement in a leisure social world. Each level of specialization involves a change in distinctive behaviors, skills, and directions. These include equipment preference, type of experiences sought (goals), desired setting for the activity, attitudes toward resource management, preferred social context, and vacation patterns. The concept of recreation specialization allows researchers to analyze subgroups of populations, rather than aggregate the attitudes and preferences of novice, medium, and advanced participants.

This study used data from divers in the Florida Keys to describe differences in the perception of

resource condition between divers at different levels of specialization. Specialization theory has eight propositions (Ditton et al. 1992), including elements that help characterize users, such as centrality to life, investment in equipment, and willingness to support rules. Proposition 6 states: “As level of specialization in a given recreation activity increases, dependency on a specific resource will likely increase” (Ditton et al. 1992, p. 40). Based on this proposition, we hypothesized that highly specialized divers would rate low-quality habitat as significantly less acceptable than would less specialized divers, who have lower resource dependency. In Proposition 7, Ditton et al. (1992, p. 40) say: “As level of specialization in a given recreation activity increases, level of mediated interaction relative to that activity will likely increase.” Accordingly, we predict that highly specialized divers will be more critical of resource condition and negative impacts because of the divers’ greater levels of mediated interaction.

2.0 METHODS

The data come from a larger project called the Florida Reef Resilience Programme (FRRP), which aimed to integrate biological and social data from the Florida Keys to support management (Loomis et al. 2008). Data were collected from nonresident divers in the Florida Keys between June 2006 and July 2007. To ensure a representative sample, names and addresses of divers were collected through intercepts of people participating in a diving activity. Intercepts began in June 2006 and took place during approximately 1 week of each month during the 13-month period. Intercepts were conducted both in water and on land throughout the Florida Keys. Samples were collected on weekdays, weekends, and holidays throughout the year. To maximize response rates for the survey, materials were sent out using the Dillman (2000) Total Design Method. All participants were mailed a packet of survey materials that contained a cover letter thanking them for their participation and ensuring their confidentiality, a 16-page questionnaire, a business reply envelope, and a map of the Florida Keys.

Questions were designed using the specialization index developed and validated by Salz et al. (2001),

which incorporates the four social world dimensions of orientation, experiences, relationships, and commitment. Initially divers were broken into four specialization levels from low to high, as the theory suggests, but there were no divers in the least specialized category, and only two in the moderate level. Therefore, these categories were combined to create final categories of ‘least,’ ‘moderate,’ and ‘high’ specialization divers.

Four groups of survey questions asked participants to:

- 1) Rate the acceptability of different reef condition scenarios on a 1 to 7 scale, from 1 = extremely unacceptable to 7 = extremely acceptable. Reef condition scenarios presented different percent covers of white coral (bleached, unhealthy), percent algal cover, levels of visibility, and different kinds of fish assemblages;
- 2) Rate the perceived condition of 10 reef features: amount of algae, underwater visibility, color of coral, number of fish, different kinds of fish, size of fish, amount of coral disease, amount of live coral, size of coral, and different kinds of coral. A scale of 1 to 7 was used, with 1 indicating poor condition and 7 indicating good condition;
- 3) Rate the overall perceived ecological health of coral reefs in the Keys, from 1 = poor to 5 = excellent and indicate whether the reefs are declining substantially = 1 to improving substantially = 5; and
- 4) Rate the impacts of natural and human factors (water quality, scuba diving, commercial fishing, hurricanes, snorkelling, recreational fishing, and global climate change) on coral reefs using a 7-point scale, where 1 = extremely negative and 7 = extremely positive.

Statistical software package SYSTAT (Chicago, IL) was used to analyze the data and generate descriptive statistics. Significant differences between groups were identified using the Tukey test for unplanned pairwise comparisons, which helps preserve the family-wise type I error rate with an alpha level of 0.1 and 0.05.

3.0 RESULTS AND DISCUSSION

The FRRP questionnaire had an overall response rate of 57.9 percent and 938 of the participants were nonresident divers. The majority of divers fell into the moderate level of specialization (378 participants, 44.7 percent), 217 (25.7 percent) were in the least specialized category, and 250 (29.6 percent) were highly specialized. The concentration of divers in the moderate and high levels of specialization implies dedication to, and investment in, the sport of diving. The amount of mediated interaction increased significantly as level of specialization increased ($p \leq 0.05$ for each group interaction).

3.1 Acceptability of Different Reef Conditions

When participants were asked to rate the acceptability of different reef condition scenarios, there were significant differences between specialization subgroups (Table 1). Mostly white (bleached) coral, 60 percent white, and 30 percent white were significantly less acceptable to highly specialized divers ($p \leq 0.000$). In turn, reefs with no white coral were significantly more acceptable ($p \leq 0.000$) to highly specialized divers. The results were similar for

algal cover; reef with 100 percent or 60 percent algal cover was significantly more acceptable to less specialized divers ($p \leq 0.001$). Specialization was not related to acceptability of different levels of visibility in this case. Highly specialized divers were significantly more concerned about seeing no fish or few fish compared to less specialized divers (significant with $\alpha = 0.1$).

These results support the hypothesis that highly specialized divers find low quality conditions less acceptable than do less specialized divers. This response indicates a greater degree of resource dependency among highly specialized divers.

3.2 Perceived Condition of Reef Features

In the second group of survey questions, participants were asked to rate the condition of different aspects of the reef on a scale of 1 to 7, where 1 = poor and 7 = good (Table 2). All reef conditions were rated as above average (>3.50); the number of fish received the highest score across groups ($\chi=5.02$). There were no significant differences by specialization.

Table 1.—Acceptability of different reef conditions by diver specialization

	Specialization level			F-ratio	P-value
	Least	Moderate	High		
Coral mostly white	3.34	2.82	2.08	24.932	0.000
Coral 60% white	3.46	3.00	2.29	28.870	0.000
Coral 30% white	3.79	3.55	3.09	13.650	0.000
Reefs with no white coral	4.95	5.25	5.80	12.483	0.000
100% algal cover	2.65*	2.43	2.09	6.927	0.001
60% algal cover	3.10*	2.90	2.52	9.224	0.000
30% algal cover	3.92	3.74	3.32	1.488	0.226
No algae present	5.27	5.49	5.54	1.537	0.216
Vis. 10 feet	2.41	2.29	2.39	0.572	0.564
Vis. 25 feet	4.21*	3.94	3.89	2.698	0.068
Vis. 50 feet	5.98	5.77	5.81	2.556	0.078
Vis. 75 feet	6.68	6.61	6.68	0.828	0.437
No fish	1.39	1.45	1.24	5.106	0.006
Many fish, few kinds	3.72	3.79	3.52	2.525	0.081
Few fish, many kinds	4.38	4.49	4.12	5.431	0.005
Many fish, many kinds	6.82	6.82	6.87	0.742	0.476

BOLD = significantly different ($\alpha = 0.1$) using Tukey's test.

* = Significant difference between least and highest.

Table 2.—Divers' perceptions of the condition of reef features by specialization

	Satisfaction Level			Mean across specialization	F-ratio	P-value
	Least	Moderate	High			
Amount of algae	4.64	4.55	4.43	4.54	1.855	0.157
Underwater visibility	4.83	4.61	4.82	4.75	2.261	0.105
Color of coral	4.48	4.59	4.54	4.54	0.524	0.593
Number of fish	4.97	5.09	4.99	5.02	0.778	0.460
Different kinds of fish	4.95	5.02	4.96	4.98	0.289	0.749
Size of fish	4.73	4.80	4.70	4.74	0.400	0.670
Amount of coral disease	4.19	4.05	4.06	4.10	1.044	0.353
Amount of live coral	4.64	4.72	4.61	4.66	0.507	0.602
Size of corals	4.59	4.72	4.57	4.63	1.186	0.306
Different kinds of coral	4.51	4.75	4.70	4.65	2.218	0.109

Table 3.—Divers' perception of ecological health and trend in health by specialization level

	Specialization level			F-ratio	P-value
	Least	Moderate	High		
Rate ecological condition	2.854	2.919	2.848	0.558	0.573
Rate ecological health	2.41	2.57	2.55	2.331	0.098

BOLD = significantly different ($\alpha = 0.1$) using Tukey's test.

* 1 = Declining substantially, 2 = Declining somewhat, 3 = Staying the same, 4 = Improving somewhat, 5 = Improving substantially

The second hypothesis was that highly specialized divers would rate the overall condition of reefs more critically (lower) than less specialized divers due to their resource sensitivity and higher level of mediated interaction. The data do not support this hypothesis. The specialization proposition may be flawed, or the level of mediated interaction associated with higher specialization groups may not translate into perceived condition scores. This result may also show that there is a difference between responses to *abstract* or hypothetical conditions, as in the previous question, and ratings of *observed* conditions.

3.3 Perceived Ecological Health of Reefs

Participants were asked to rate the current condition of reefs on a scale of 1 (poor) to 5 (excellent). All specialization subgroups responded somewhere between fair and good ($\chi^2=2.89$) and there were no significant differences between specialization groups (Table 3).

Regarding ecological health trends, participants were asked to indicate on a 1 to 5 scale whether reef health was improving, declining, or staying the same. Results show that less specialized divers perceived reefs as being in worse condition and somewhat in decline, as compared to more specialized divers, who rated the reefs closer to "staying the same" ($\chi^2 = 2.53$).

Data did not support the hypothesis that more specialized divers would rate the condition of reefs as worse than less specialized divers. In fact, the least specialized divers perceived reef health as declining with a significantly lower score ($p \leq 0.098$).

3.4 Perception of Impacts on Reefs

Another hypothesis was that highly specialized divers would rate impacts more negatively than less specialized divers. Participants were asked to rate a variety of possible impacts on a scale from 1 (extremely negative impact)

Table 4.—Divers' perception of impacts to reefs by specialization (7-point scale)

	Specialization Level			F-ratio	P-value
	Least	Moderate	High		
Impact Questions 1					
Water quality	4.22	4.17	4.23	0.112	0.894
SCUBA diving	3.89*	4.12	4.19	2.879	0.057
Commercial fishing	2.78	2.85	2.61	2.846	0.059
Hurricanes	2.48	2.46	2.46	0.016	0.984
Snorkeling	3.84	4.03	4.00	1.649	0.193
Recreational fishing	3.39	3.39	3.20	2.269	0.104
Global climate change	2.82	2.72	2.77	0.353	0.703

BOLD = significantly different ($\alpha = 0.05$) using Tukey's test. * = Significant difference between least and high.

Table 5.—Divers' perception of impacts to reefs by specialization (5-point scale)

	Specialization Level			F-ratio	p-value
	Least	Moderate	High		
Reefs are able to recover easily from commercial fishing damage	2.06*	2.06	1.82	7.095	0.001
Snorkelers/divers cause some damage	3.38	3.28	3.37	0.869	0.420
Recreational anglers cause some damage	3.50	3.39	3.40	1.054	0.349

* = Significant difference ($\alpha = 0.05$) between least and high.

to 7 (extremely positive impact). The impacts were a mix of environmental and anthropogenic factors (see Table 4). There were two significant differences between specialization groups. The least specialized divers gave SCUBA diving a significantly lower impact rating than did more specialized divers ($p \leq 0.057$) (Table 4). Highly specialized divers perceived commercial fishing as having a significantly more negative impact ($p \leq 0.059$).

Finally, participants were asked their level of agreement with statements about reef impacts on a scale of 1 (strongly agree) to 5 (strongly disagree) (Table 5). Most of the answers were consistent across specialization levels. There was a significant difference ($p \leq 0.001$) by specialization level for commercial fishing; less experienced divers were more likely to think that commercial fishing causes damage. The data thus did not support the hypothesis that highly specialized divers would rate impacts more negatively than less specialized divers, except in the case of perceptions of commercial fishing impacts.

4.0 CONCLUSION AND IMPLICATIONS

The divers' survey data provide limited support for the initial hypothesis that because of higher resource dependence and greater level of mediated interaction, highly specialized divers are more likely to rate reef conditions as less acceptable, more degraded, and highly impacted. The first question on the survey presented hypothetical situations of varying resource quality; responses showed the greatest disparity between the specialization levels, as compared to the questions based on observation. High levels of algal cover and coral that was mostly white, 60 percent white, or 30 percent white were significantly less acceptable to more specialized divers. A suggested explanation for this response is that highly specialized divers, having experienced a wider variety of conditions, are better able to envisage the difference between 60 percent and 30 percent algal cover and therefore are more able to distinguish between the suggested scenarios. More specialized divers were also significantly more concerned about seeing no fish or few fish compared to less specialized divers. In terms of

management, these results serve as a useful baseline for monitoring changes in perceptions and acceptability of different condition scenarios. In terms of management implications, the results suggest that there would be a high level of support from specialized divers for initiatives that address decreased coral bleaching, increased fish abundance, and reduced algal cover.

Divers of different specialization levels provided relatively similar assessments of ecological reef health and trends (fair to good and somewhat in decline, respectively). The different diving specialization groups also perceived the suggested impacts to reefs as having a similar level of effect (except for commercial fishing).

These data do not support the hypotheses for a variety of possible reasons. The specialization theory propositions that highly specialized divers are more resource-dependent or that they have higher levels of mediated interactions may be false. Or the links between resource dependency, mediated interaction, and perceived reef condition may be weak. These results may also be explained by the particular characteristics of the user group studied. Diving is an expensive, equipment- and skill-driven recreational activity. There were very few divers in the low specialization category, which may mean that the “spread of specialization levels” is less broad than for other activities, leading to more uniform group perceptions.

5.0 CITATIONS

Bryan, H. 1977. **Leisure value systems and recreation specialization: The case of trout fishermen.** Journal of Leisure Research. 9: 174-187.

Cesar, H.S.J., ed. 2000. **Collected essays on the economics of coral reefs.** Kalmar University, Sweden: CORDIO.

Dearden, P.; Bennett, M.; Rollins, R. 2006. **Implications for coral reef conservation of diver specialization.** Environmental Conservation. 33(4): 353-363.

Dillman, D.A. 2000. **Mail and Internet surveys: The tailored design method (second ed.).** New York: Wiley.

Ditton, R.B.; Loomis, D.K.; Choi, S. 1992. **Recreation specialization: re-conceptualization from a social worlds perspective.** Journal of Leisure Research. 24(1): 33-51.

Loomis, D.; Anderson, L.; Hawkins, C. 2008. **Understanding coral reef use: SCUBA diving in the Florida Keys by residents and non-residents during 2006-2007.** HDMCE Analysis Series 2008-1-003.

Mangun, J.C.; Throgmorton, K.W.; Carver, A.D. Davenport, M.A. 2007. **Assessing stakeholder perceptions: Listening to avid hunters of western Kentucky.** Human Dimensions of Wildlife. 12: 157-168.

Oh, C.; Ditton, R.B. 2008. **Using recreation specialization to understand conservation support.** Journal of Leisure Research. 40(4): 556-573.

Pandolfi, J.M.; Bradbury, R.H.; Sala, E. 2003. **Global trajectories of the long-term decline of coral reef ecosystems.** Science. 301(5635): 955-958.

Salz, R.J.; Loomis, D.; Finn, K. 2001. **Development and validation of a specialization index and testing of specialization theory.** Human Dimensions of Wildlife. 6: 239-258.

The content of this paper reflects the views of the authors(s), who are responsible for the facts and accuracy of the information presented herein.