A Compilation and Comparison of Social Perceptions on Reef Conditions and Use in Southeast Florida

Southeast Florida Coral Reef Initiative
Fishing, Diving and Other Uses
Local Action Strategy Project 10

A Compilation and Comparison of Social Perceptions on Reef Conditions and Use in Southeast Florida

Final Report

Prepared By:

Manoj Shivlani [(1)]

Maria Villanueva [(1)]

[(1)]Rosenstiel School of Atmospheric and Marine Science
University of Miami
4600 Rickenbacker Causeway
Miami, FL 33149-1098

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Table of Contents

Section	**Page**
I. Acknowledgements	3
II. Executive Summary	4
III. Charter fishing operations report	10
IV. Commercial fisher report	46
V. Dive operations report	102
VI. Recreational anglers report	131
VII. Researchers and managers report	155
VIII. Surfer report	182

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Executive Summary

This summary addresses the results from six studies conducted in support of the Southeast Florida Coral Reef Initiative (SEFCRI) Project to *Compile and Compare Scientific Data and Social Perceptions on Reef Conditions and Use*. The project called for the identification, assembly, and assessment of existing historical (use) maps, fishery data related to coral reef biodiversity, data on other fishing and diving impacts, the relative importance of reef versus other, offshore fishing (as measured in terms of participation rates and extraction levels), types, quantity, and trends of commercial and recreational extractive and nonconsumptive uses by county, stakeholder concerns on the indirect impacts on reefs, and stakeholder perceptions on artificial reefs. The six studies, conducted using a variety of survey methodologies, identified and characterized the key, user groups (stakeholders) that utilize and/or rely on the regional coral reefs and associated resources: Commercial fishers; charter, for-hire fishing operations; recreational fishers (consisting of recreational anglers and recreational, consumptive divers); dive operations; researchers and managers; and the surfing community.

Overall, the studies led to the completion of almost 2,000 field-based interviews, mail-back questionnaires, and internet-based surveys. Table 1 shows the number of surveys conducted by stakeholder group and the methodology used to characterize each user type.

Table 1: Stakeholder group populations, samples, and methodologies

Group	*Population (N)*	*Sample (n)*	*Methodology*
1. Commercial fishers	1,247	193	Field-based interviews
2. Charter fishing operations	377	59	Field-based interviews
3. Recreational fishing license holders – anglers	10,000*	1,058	Mail-back surveys
3a. Recreational fishing license holders – lobster divers		400**	Field intercept surveys
4. Dive operations	166	46	Field-based interviews
5. Researchers and managers		55***	Field-based interviews
6. Surfers	900	151	Internet-based surveys

* While over 87,000 individuals held a recreational fishing license in the four SEFCRI counties in 2005, a total of 10,000 surveys were mailed to randomly selected license holders based on findings from a pilot survey session that estimated response rates.

** Surveyors intercepted lobster divers returning from dive trips during the two-day mini-season in July 2006 for a period of two days and at eight sites across the four SEFCRI counties.

***The research team identified key researchers and managers to interview using a variety of sources and did not rely on a randomly selected sample.

As shown in Table 1, recreational fisher mail-back surveys yielded the highest total of surveys among all stakeholder groups. However, other approaches, namely field-based surveys, provided more detailed information as the questionnaires used were longer and the format (in-person interviews) often generated additional, qualitative information. Also, response rates varied considerably across groups and with some stakeholder groups, such as researchers and managers, key informant interviews were preferred over randomly selected ones.

Most of the stakeholders surveyed represented considerable experience in the SEFCRI region. The average tenure for all groups was 11-15 years or greater, with commercial and recreational fishers holding the greatest experience, at an average of 16-20 years. Charter fishing operations, dive operations, researchers and managers, and surfers had 11 years or more of experience, on average. This level of experience across stakeholder groups suggests that the results (especially those related to views on resource conditions) represent changes over half a generation, or a decade, for all stakeholder groups and approaching almost one generation for certain groups.

Use patterns were generally local, as determined by maps generated for each user group, and only commercial fishers (59.8%) and surfers (mean rank = 1.60 out of 5, where 1 is most important and 5 is least important) ranked right conditions as being more important for areas used than proximity from home/port. Otherwise, a majority of charter fishing operations (76%), dive operations (45%), and recreational anglers (44.8%) ranked proximity from home/port as the main factor in areas used.

The number of trips varied for the commercial and charter fishing operations by species targeted, with reef, migratory, and pelagic finfish leading charter fishing trips, and shrimp, spiny lobster, and coastal pelagics leading commercial fishing trips. There were clear regional variations, with invertebrate fisheries dominating in the southern section of the SEFCRI region and coastal pelagics comprising considerable landings and effort in the northern section. Dive operations also took a large number of trips in the SEFCRI region, averaging 263.3 trips to artificial and natural reef dive sites in 2005. Use frequencies among the recreational groups were less extensive than those for their commercial counterparts. For example, surfers reported going out surfing 2-5 times per month on average. Similarly, recreational anglers took an average of 16-20 trips in 2005.

Table 2: Views on conflicts with other stakeholder groups (where the mean score is based on a scale from 1-5, where 1 = worst conflict and 5 = no conflict)

Stakeholder group	*Commercial fishers*	*Recreational anglers*	*Recreational boaters*	*Recreational divers*
Charter fishing operations	2.93	2.91	3.09	3.38
Commercial fishers	N/A	3.26	3.16	3.21
Dive operations	2.89	2.51	2.09	3.84
Recreational anglers	2.29	2.97	2.89	3.50
Researchers and managers	4.30	4.06	3.88	4.13
Surfers	3.92	2.86	2.32	4.51

As shown in Table 2, stakeholder groups' views on inter-group conflict varied considerably. For groups such as dive operations and surfers, recreational boaters conflicted with their activities. Dive operations' concerns stemmed from recreational vessels going over their clients (divers), whereas surfers were more affected by boats operating near the shoreline, particularly personal watercraft. Other groups singled out one or more groups as presenting use conflicts. For example, commercial fishers presented a conflict to recreational anglers, who were themselves considered a conflict by dive operations. Finally, certain groups, such as researchers and managers and commercial fishers, did not report any strong conflicts, due either to their segregating their activities from those of other users (as reported by many commercial fishers) or undertaking activities that are inherently different than those of other users (such as research and management).

Table 3: Views on resource and issue trends (where the mean score is based on a scale from 1-5, where 1 = better conditions and 5 = worse conditions)

Stakeholder group	*Fisheries*	*Coral reefs*	*Artificial reefs*	*Water quality*	*Use conflicts*
Charter fishing operations	3.12	3.67	2.43	3.78	3.73
Commercial fishers	3.28	3.49	2.51	3.73	3.70
Dive operations	3.68	3.70	2.57	3.78	3.60
Recreational anglers	3.47	3.74	2.68	3.78	3.54
Researchers and managers	3.79	3.98	2.90	3.65	3.31
Surfers	3.53	4.06	3.33	3.42	3.40

Table 3 shows the groups' views on resource and issue trends, and the mean scores suggest a negative, overall perception on key resources and conditions. While charter and commercial fishers were less negative on fisheries trends than were the other stakeholders, their mean scores were nevertheless skewed

towards a worsening condition in fisheries. Among the resources that received the highest mean scores were water quality and coral reefs, both of which all groups agreed had deteriorated since when they first began operating in the SEFCRI region. Also, due mainly to what many respondents blamed on an increased population of users, all stakeholders believed that use conflicts had worsened. The only resource whose conditions had improved slightly or remained stable (or at least had not deteriorated to the extent of other resources) was artificial reefs.

Table 4: Preferred forms of management (where the mean score is based on a ranking scale from 1-6, where 1 = most preferred form of management and 6 = least preferred form of management)

Stakeholder group	*Enforcement*	*Zoning*	*Education*	*Limited entry*	*Current*	*Less*
Charter fishing operations	2.14	3.81	2.80	3.56	3.97	5.31
Commercial fishers	3.08	4.19	2.56	3.74	3.52	4.99
Dive operations	2.20	2.11	1.72	4.28	3.72	5.37
Recreational Anglers*	26.7	17.2	35.4	6.7	11.5	2.4
Researchers and managers	3.26	1.91	2.72	4.63	5.70	5.98
Surfers*	22	29	30	2		2

* Recreational angler and surfer surveys did not have a ranking preference and instead requested that respondents select their most preferred form of management. The responses are thus in percentages.

As shown in Table 4, education led all forms of management as the preferred management for most stakeholder groups. Even those groups that preferred another form of management over education, education was never ranked lower than second among any group. Other preferred forms of management varied considerably between groups. For instance, consumptive user groups, such as charter fishing operations, commercial fishers, and (to an extent) recreational anglers ranked zoning and marine protected areas as a less preferred form of management, whereas (mainly) nonconsumptive groups like surfers and dive operations, as well as researchers and managers, ranked zoning and marine protected areas highly. Importantly, all groups showed a low preference towards less management or the current form of management. These findings suggest that all stakeholder groups are generally dissatisfied with how management is currently working (shown also by the negative views on resource trends) and that there is a consensus towards a different approach to management.

Table 5: Views on direct impacts by user groups (where the mean score is based on a scale from 1-5, where 1 = least direct impact and 5 = most direct impact)

Stakeholder group	*Charter fishers*	*Commercial fishers*	*Recreational Boaters*	*Recreational divers*	*Consumptive divers*	*Recreational anglers*
Charter fishing operations	2.14	3.10	2.73	2.90	3.75	3.35
Commercial fishers	N/A	2.27	3.10	3.10	3.43	3.43
Dive operations	3.57	3.78	3.13	2.37	3.09	3.78
Researchers and managers	2.98	3.38	2.73	2.00	3.27	3.34

The four stakeholder groups that were surveyed using in-person interviews provided their views on direct impacts on SEFCRI area coral reefs by user groups (as shown in Table 5). The groups that were most often identified as having the most impacts on the region's coral reefs were sport, or consumptive, divers, recreational anglers, and commercial fishers. Also, each stakeholder group believed that its uses were not among the most impacting, as shown by the low mean scores determined for charter fishers, commercial fishers, and recreational divers by their members.

Table 6: Views on indirect impacts (where the mean score is based on a scale from 1-5, where 1 = least indirect impact and 5 = most indirect impact)

Stakeholder group	*LBS*	*Coastal development*	*Dredging and filling activities*	*Global warming*
Charter fishing operations	4.61	4.44	4.41	3.13
Commercial fishers	4.60	4.14	4.29	3.45
Dive operations	4.71	4.47	4.64	3.64
Researchers and managers	4.21	4.37	3.96	3.86
Surfers*	36	33	19	2

* Surfer surveys did not have a ranking preference and instead requested that respondents select their most preferred form of management. The responses are thus in percentages.

Table 6 shows stakeholder groups' views on indirect threats facing coral reefs in the SEFCRI region. All groups, except for researchers and managers, agreed that the primary indirect threat facing the region's coral reefs are land-based sources of pollution (LBS). While researchers and managers ranked coastal development as a greater threat, the group did rank LBS as a major, indirect impact. By contrast, the least important impact to SEFCRI coral reefs was identified as global warming. This was most likely due to respondents either not fully understanding the effects of climate change on the region (as exhibited by

the high numbers of nonresponses to this question) or not accepting global warming as a local impact.

It is clear from the project findings that the SEFCRI region stakeholders who participated in this study (who, on average, represent a decade or more of local knowledge) agree that resource conditions are generally deteriorating across the region. Coral reefs, fisheries, and water quality have all declined, according to the six stakeholder groups, and use conflicts are worsening due to increased numbers of users. The solution, most argue, is to employ a series of alternate management measures, as a majority rejects the current form of management as ineffective; instead, the groups call for a greater focus on interpretative management, while certain groups favor enforcement and others prefer zoning and marine protected areas. While there is less consensus on specific use conflicts and the relative impacts of stakeholder groups on coral reefs, the results nevertheless reveal a base of concerned users who have witnessed a pervasive decline in their local resources and who are willing to support changes in management direction to rectify current resource conditions.

Finally, although many of the results presented in this summary are extracted from the various stakeholder group study reports, it is emphasized that each study contains more detailed finding and analyses. Thus, to better understand the specific group findings, it is advised that individual reports be consulted.

Charter fishing operations report

Introduction

The Southeast Florida Coral Reef Initiative Project to *Compile and Compare Scientific Data and Social Perceptions on Reef Conditions and Use* called for identification, assembly, and assessment of existing historical (use) maps, fishery data related to coral reef biodiversity, data on other fishing and diving impacts, the relative importance of reef versus other, offshore fishing (as measured in terms of participation rates and extraction levels), types, quantity, and trends of commercial and recreational extractive and nonconsumptive uses by county, stakeholder concerns on the indirect impacts on reefs, and stakeholder perceptions on artificial reefs. Florida's Local Action Strategy (LAS) developed through the State's membership in the U.S. Coral Reef Task Force, and known as the SEFCRI, identified four focus areas targeting threats to the reefs from Miami-Dade County, through Broward and Palm Beach, to Martin County. This project is a part of the Fishing, Diving, and Other Uses (FDOU) focus area.

The project called for the completion of three tasks: (I) The assemblage of existing information on the resource in the study area from all available sources; (II) the collection of historical and present day social perceptions concerning the resources from various stakeholders; and (III) the completion of a project summary that includes the synthesis of the results form the assemblage of existing information and data collection in a final report with supporting documentation.

As part of the project tasks II and III, the present effort identified and characterized the key, user groups (stakeholders) that utilize and/or rely on the regional coral reefs and associated resources: Commercial fishers; charter, for-hire fishing operations; recreational fishers (consisting of recreational anglers and recreational, consumptive divers); dive operations; researchers and managers; and the surfing community. Stakeholder identification and characterization followed the approach utilized by previous efforts in the region and elsewhere (Shivlani, 2006; Thomas J. Murray and Associates, 2005; Suman et al., 1999).

The region hosts a variety and magnitude of uses, as well as a diversity and density of users; thus the project decided that any study that considers historical and present social perceptions from current and past stakeholders must address the following:

1. What does it mean to be a stakeholder in southeast Florida, and how can that universe be defined (or at least circumscribed) to include all relevant uses?

2. Are there privileged, or dominant, narratives that certain stakeholders (and uses) may present that could undermine the narratives of others; and if so, then how can that be surmounted?

In addressing the first concern, this project worked closely with the FDOU team in bounding the universe of stakeholders, based on all available information, both in terms of information concerning regional stakeholders and theoretical and practical studies on

stakeholders in other areas. The second important factor that the project considered was the information it gathered, in that project methodology was refined to reach classes of users to the extent possible. Also, the project focused on the stratification of stakeholder perceptions, where applicable, such that experience and extent of use were considered to provide a more representative opinion.

Charter fishing operations

Sometimes viewed as bridging the commercial and recreational fishing sectors, charter fishing operations are among the most prolific and experienced user groups in the coastal zone. From a commercial fishing perspective, while most of these vessels exercise some form of limited take (and catch and release), several do hold Florida Saltwater Products Licenses (commercial fishing licenses). These latter operations harvest both reef fish and pelagic species, often selling them to fish houses and restaurants or at marina docks (Brinson et al., 2006; Waters et al., 2001; Milon et al., 1997). In the 11-year period between 1990 and 2000, Johnson et al (2007) report that headboat landings accounted for 3% of all landings and 5% of reef fish landings in the SEFCRI region, respectively. From a recreational fishing perspective, charter fishing operations are responsible for considerable sport fishing effort; for example, in 2004, charterboats accounted for 700,000 fishing trips in Florida. Many of the clients that charter fishing operations take out on fishing trips in the SEFCRI region tend to be out-of-state visitors (EDAW, 2005; Brinson, personal communication), showing the importance of charter fishing in drawing extra-regional, recreational fishing interest (and effort).

Several studies (Johnson et al., 2007; Brinson et al., 2006; EDAW, 2005; Die et al., 2003; Waters et al., 2001) have examined the fishery and socioeconomic characteristics of the charter fishing fleets in south Florida. Most notably, Brinson et al. (2006) conducted a socioeconomic characterization of charter fishing operations in the SEFCRI counties. Conducted with 78 operators in the four-county region, the study determined the socio-demographic, economic, and use characteristics of the group and its views towards management concerning billfish stocks. While the focus of that study was primarily on billfish (i.e. sailfish, marlin, and swordfish), its findings represent an important baseline that can be used in conjunction with the present study's findings to characterize charter fishing in the region.

Methodology

The charter fishing operations study followed the methodology developed for the commercial fishing study, in that it used a field-based approach to survey charter fishing operations, whose population was determined using a variety of sources. The study effort consisted of the development of a survey instrument that was modeled after the

commercial fishing study survey instrument[1], initial contact with each operation via telephone to describe the study, and a field session to conduct surveys.

In August 2006, the research team developed a database list of charter fishing operations that represented the population for the SEFCRI region. The research team worked with the DEP FDOU member team to identify the types of operations to be considered, and it was decided that while the focus would be on reef and offshore charter fishing (as these would most often interact with coral reefs and coral reef resources), those flats fishing operations would be included which also fished coral reefs. The operators were selected from the following sources: Web-based charter fishing lists; telephone yellow pages; brochures; and industry contacts. The approach adopted the population estimation methodology used by Brinson et al (2006) for the billfish chartering fishing operations in the SEFCRI region.

Also in August 2006, the research team completed a draft survey instrument that included sections on socio-demographic information, economic investments and operating costs, use patterns, and attitudes, perceptions, and beliefs. The survey instrument was circulated among the FDOU member team and, following revisions, the survey was finalized by mid-September 2006.

The methodology adopted to implement surveys was to randomize the database list of charter fishing operations in the four counties and to contact and survey the appropriate number of operations until the survey totals per county had been reached. The initial population estimation led to the identification of 377 charter fishing operations, of which 123 (32.6%) were located in Broward County, 120 (31.8%) in Miami-Dade County, 88 (23.3%) in Palm Beach County, and 46 (12.2%) in Martin County. Charter fishing operation on the list were then randomized and contacted in order until the sample size, set at 50 operations, were reached; the number of operations per county were completed based on the proportion of the total population per county. Also, as in the commercial fisher survey approach, data collectors conducted surveys opportunistically, i.e. charter fishing they encountered at marinas while conducting other surveys.

The charter fishing operation study led to the completion of 59 surveys during the two month field session (September – October 2006), of which 19 (32.2%) were completed in Palm Beach County, 17 (28.8%) in Miami-Dade County, 16 (27.1%) in Broward County, and seven (11.9%) in Martin County. This meant that Miami-Dade, Martin, and Palm Beach counties were oversampled.

[1] This approach assured a level of consistency that allowed for inter-group comparisons, as well as the development of a common set of maps that could then be layered to show areas of use and changes in use patterns, as well as use conflict hotspots.

Results

The results of the survey are presented in the order of the questions as these were provided to the participants (a copy of the survey is available in Appendix I of this report). Also, county-specific results are shown where relevant.

Socio-demographic information

Of the 59 operators interviewed, 84.8% of the surveyed were conducted with captains. The rest of the respondents consisted of crew (11.9%) that could speak on behalf of the operations and operation owners (3.4%) who were knowledgeable about the operations' use and other characteristics. The average age of the operators was 3.02 (SD = 1.15), or between 41-50 years old. Over 81% of the sample was 41 years or older.

In terms of ethnicity and race, 91.5% of the operators identified themselves as non-Hispanic (6.8% of the 9.7% Hispanic operators were from Miami-Dade County), and all considered themselves as Caucasian.

Respondents supported an average of 2.46 family members (SD = 1.21), including themselves. Most, however, supported only other person (35.6%) or themselves only (25.4%). This may due to the relatively low percentage of personal income (mean = 70%; SD = 34.6) and household income (mean = 64.6%; SD = 35.2) derived from charter fishing.

Rates of affiliation with particular groups were low, with 28.8% of the operators reporting that they were part of a charter fishing organization, followed by 18.6% who belonged to miscellaneous groups, 13.6% who were environmental group members, and 8.5% who were part of the local chambers of commerce. These low rates of affiliation are in direct contrast with Brinson et al.'s (2006) finding, where 65% of the fishing charter operators were affiliated with some type of fishery organization. Two reasons for the apparently lower rates of affiliation may explain the difference: the first is that the present study targeted the entire charter fishing population, whereas Brinson et al. (2006) focused on billfish charter operations, which may enjoy higher rates of group affiliation; a second, but less likely, reason may be that affiliation rates across the industry declined in the intervening years between the studies.

The primary port across the region was Miami (32.2%), followed by Jupiter (18.6%) and Port Everglades (15.3%). Only 17% of the sample reported having a secondary port, of which the Bahamas (5.1%) and the Florida Keys (3.4%) were the most frequently mentioned.

With respect to years fishing, the average tenure among respondents was 4.46 (SD = 1.48), or between 11-15 and 15-20 years. Most operations (78.0%) had been in operation in the SEFCRI region for 11-15 years or longer.

Economic and catch information

Charter fishing operations were asked to provide basic economic information on their operations, including the costs of their primary investments (i.e. vessels, gear) and annual operating costs in 2005.

Over two-thirds of the sample, or 67.8%, reported selling part of their catch in 2005. the average percentage sold was 22.6% (SD = 23.0), with 44% selling only a tenth or less of their catch and 18.4% selling half or more of their catch. Most of the operations (37.5%) sold their catch to restaurants, and 30% sold to fish houses. Another 27.5% sold directly from the dock upon return from their trips.

Table 1: Economic investments and costs per operation among SEFCRI area charter fishing operations

Item	*Average number (standard deviation in parenthesis)*	*Average cost in 2005 (standard deviation in parenthesis)*
INVESTMENTS		
1. Vessel	1.34 (0.76) n = 58	$295,389.78 (539,714.58) n = 59
2. Gear		$24,235.00 (20,573.81) n = 50
OPERATING COSTS		
4. Docking fees		$14,629.17 (18,318.02) n = 48
5. Interest payments		$19,600.00 (23,766.36) n = 9
6. P&I insurance on vessel/crew		$6,988.22 (5,734.90) n = 45
7. Vessel maintenance/repair		$19,963.64 (23,650.20) n = 55
8. Gear maintenance/repair		$4,375.61 (4,702.65) n = 41
9. Other costs		$1,897.39 (2,704.08) n = 59
INCOME		
10. Personal income		70.0% (34.6) n = 59
11. Household income		64.6% (35.2) n = 59

As shown in the table above, charter fishing operations incurred high, but variable, investment costs, consisting of an average of 1.34 vessels costing almost $300,000 per operation. Gear costs, which consisted mainly of rods and reels, were also high and variable, and these averaged almost $25,000 per operation. In terms of annual costs,

charter fishing had much higher costs than other types of operations (ex. commercial fishers and dive operators) due to their high docking fees and vessel and crew insurance. The former is a result of the need for charter vessels to be located in prime locations where charters can be located (i.e. a form of advertising), but where dockage fees are high. The latter cost, related to vessel insurance, is high because charter fishing operations need insurance to cover on-board accidents and other mishaps. Finally, due to the size of the vessels, which averaged 41.8 feet (SD = 21.2), vessel maintenance costs were almost $20,000 per operation.

When asked to identify areas fished, only 5.1% listed only 'reefs' or 'flats', compared to 35.6% who listed 'offshore' areas. An additional 16.9% listed both 'reefs' and 'offshore', and another 20.3% listed all three areas. Altogether, almost 90% (89.8%) stated that they target offshore areas, compared to 42.4% who target reefs, and 25.4% who target flats.

Table 2: SEFRCI area charter fishing effort and changes in landings and effort over time

Species	Trips	Change in landings	Change in trips	Change in size	Targeted (%)
1. Reef fish	117.2 (102.0)) n = 25	0.8 (21.3) n = 24	0.6 (12.2)) n = 24	0.4 (8.6) n = 24	8.5/6.8
2. King mackerel	167.7 (212.7) n = 40	6.9 (45.9) n = 41	-9.9 (23.2) n = 41	-4.8 (15.8) n = 41	30.5/33.9
3. Spanish mackerel	166.5 (245.7) n = 31	11.2 (52.2) n = 33	-10.1 (22.3) n = 33	-5.5 (15.0) n = 33	3.4/3.4
4. Baitfish	219.0 (222.2) n = 32	-9.6 (31.1) n = 31	-9.2 (21.8) n = 31	-1.9 (9.3) n = 32	3.4/5.1
5. Dolphin	162.1 (210.2) n = 41	-30.1 (29.6) n = 40	-9.0 (23.2) n = 42	-3.9 (14.2) n = 42	16.9/15.3
6. Sharks	182.6 (250.7) n = 26	17.9 (28.1) n = 24	-10.4 (21.2) n = 24	-0.8 (2.8) n = 24	1.7/1.7
7. Marlin	36.7 (87.8) n = 11	4.0 (25.0) n = 10	-10.5 (25.9) n = 11	0.0 (0.0) n = 11	1.7/1.7
8. Sailfish	159.2 (210.9) n = 38	28.9 (51.3) n = 37	-8.5 (24.7) n = 37	-1.4 (9.2) n = 37	1.7/1.7
9. Other pelagics	131.6 (131.1) n = 28	0.3 (17.8) n = 29	-11.2 (23.4) n = 29	-1.0 (7.2) n = 29	22.0/18.6

- all statistics represent mean totals, and standard deviations are provided in parentheses.

The table above shows trips and changes in species sizes and fishing patterns, as reported by the sample. The species most often listed by the respondents that they fished in 2005 (according to the operations reporting trips) was dolphin, followed by king

mackerel, sailfish, baitfish, Spanish mackerel, other pelagics, sharks, reef fish, and marlin. Otherwise, 10% or fewer listed any other species, showing the importance of the above listed fisheries.

With respect to the number of trips per species, baitfish led all species, but this was mainly because baitfish are usually targeted by charter fishing operations as live bait on their way out on fishing trips. Otherwise, sharks, king and Spanish mackerel, dolphin, sailfish, and other pelagics attracted the most trips. Importantly, reef fish, while representing an average of 117.2 trips for charter fishers, were among the least fished species (as determined by the number of trips). This was further reinforced when asking the fishers about the species they targeted in their last trip. Over 30% targeted king mackerel, followed by 22% that targeted other pelagics, and 16.9% that targeted dolphin. By contrast, only 8.5% targeted reef fish.

With respect to changes in each major fishery, the sample pointed to dolphin as the species that has decreased the most in landings (-30.1% on average), with a mean decrease of 9% in number of dolphin-related trips and an almost 4% decline in average size. While most species had been perceived to have experienced a decline in overall size, only baitfish (mean decline of -9.6% in landings) and the aforementioned dolphin were reported to have dropped in average landings; by contrast, species such as sailfish, sharks, and king and Spanish mackerel, all of which were perceived to have declined in average size, were listed as species for which landings had increased considerably (6.9% or greater, on average).

Table 3: SEFCRI area charter fishing trip costs

Species	Fuel/oil	Ice	Bait	Food/supplies	Other	Crew
4. Reef fish (n = 27)	155.00 (132.443)	8.89 (8.70)	21.30 (17.30)	15.74 (14.39)	16.44 (59.25)	1.41 (0.97)
5. King mackerel (n = 44)	128.86 (105.04)	8.07 (10.91)	21.41 (17.24)	17.61 (20.64)	10.09 (46.78)	1.61 (0.84)
6. Spanish mackerel (n = 37)	135.13 (112.85)	7.30 (10.58)	21.68 (17.49)	13.38 (13.90)	12.00 (50.89)	1.57 (0.90)
7. Baitfish (n = 34)	134.71 (112.79)	7.35 (10.68)	23.00 (17.41)	15.15 (14.11)	13.06 (53.02)	1.47 (0.90)
8. Dolphin (n = 45)	160.89 (127.42)	8.02 (10.78)	20.93 (17.34)	17.22 (20.58)	9.87 (46.27)	1.62 (0.86)
11. Sharks (n = 27)	129.63 (106.10)	7.89 (10.73)	27.70 (17.30)	12.59 (13.40)	0.0 (0.0)	1.41 (0.97)
13. Marlin (n = 13)	156.15 (107.36)	6.92 (8.04)	19.62 (20.86)	19.23 (29.29)	34.15 (83.37)	1.85 (0.55)
14. Sailfish (n = 41)	129.76 (103.28)	7.93 (10.60)	23.05 (19.49)	17.56 (21.04)	10.83 (48.41)	1.61 (0.86)
9. Other pelagics (n = 29)	135.72 (97.05)	8.10 (10.64)	22.93 (16.98)	12.59 (12.86)	15.31 (57.25))	1.45 (0.95)

- all statistics represent mean totals, and standard deviations are provided in parentheses.

Charter fishers also provided cost information by species. As shown in the table above, costs were highest were dolphin, but that costs varied mainly on fuel and oil costs (travel time, presumably), with some species costing more than others in bait (ex. sharks), other costs (ex. marlin), and the number of crew (ex. marlin). Overall, however, costs did not vary extensively across species, suggesting that there are certain fixed costs in charter fishing operations which are common across species; also, it may be that trips are sufficiently mixed in that multiple species across reef and offshore environments are targeted in the same trip (Brinson et al., 2006; EDAW, 2005).

Over three-quarters of the fishers interviewed, or 76.1%, stated that they select fishing areas based on port proximity, compared to 21.7% who fished areas based on species concentrations and correct water or bottom conditions. Also, almost a third (31.9%) of the respondents had changed fishing areas, for which the most common explanation was that the target species had moved; however, charter fishers did not identify conflicts or overfishing as reasons for changes in fishing areas.

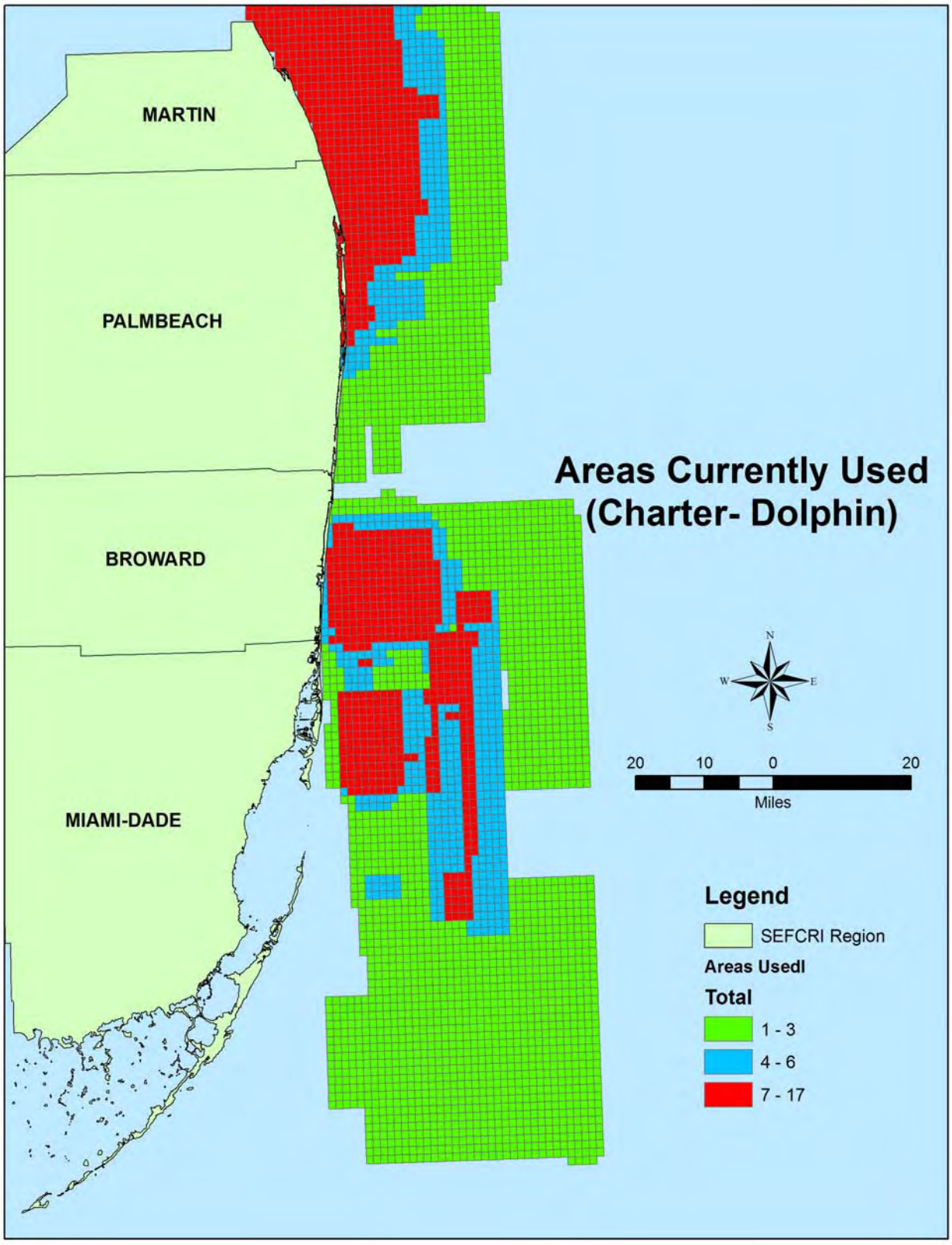

Figure 1: Dolphin fishing trips – present (total refers to number of respondents)

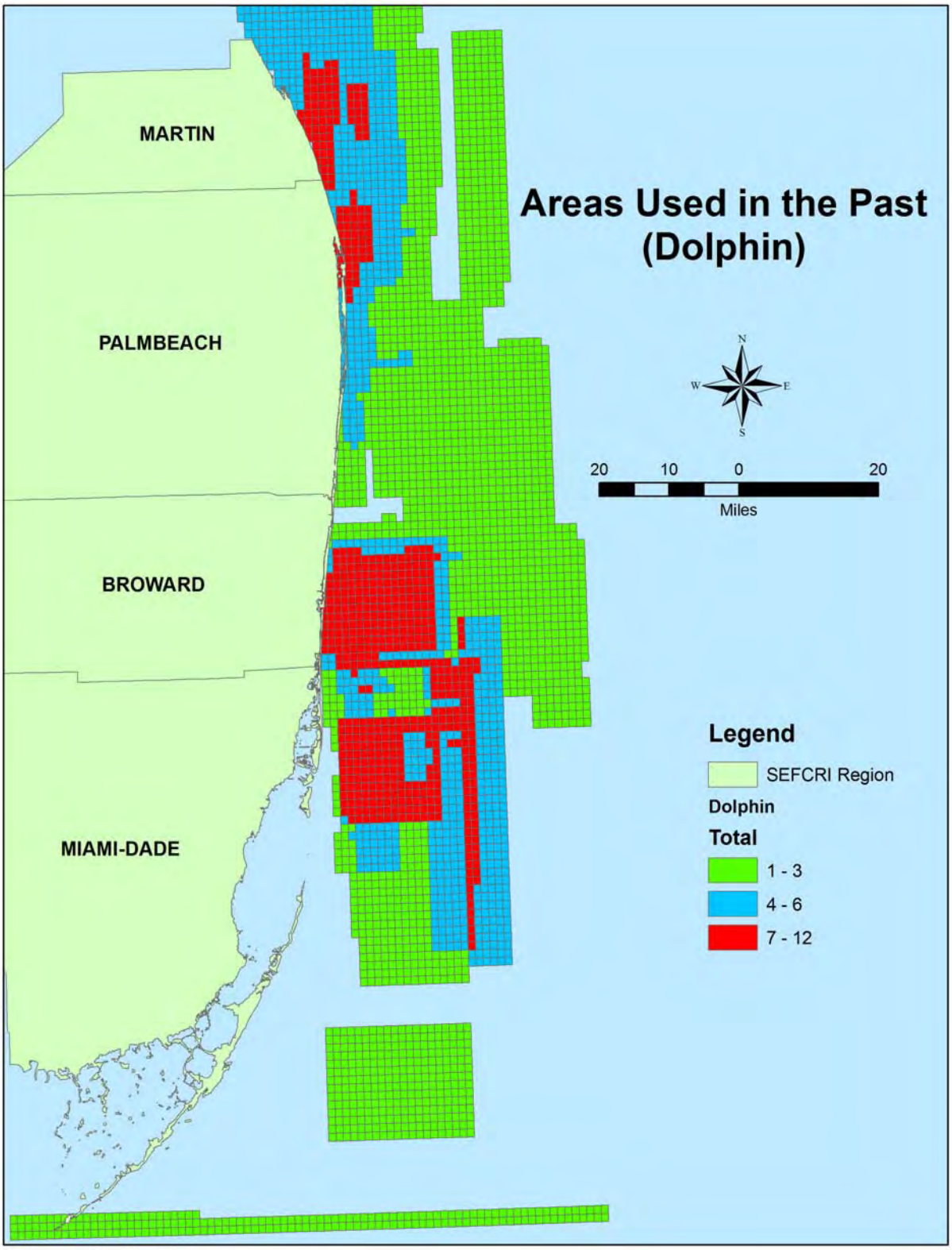

Figure 2: Dolphin fishing trips – past (total refers to number of respondents)

As shown in Figures 1 and 2, charter fishing for dolphin – in terms of total trips – did not change much in the years that the respondents reported fishing. Effort in the northern counties did shift northward, but the fishing areas in Broward and Miami-Dade Counties were largely unchanged.

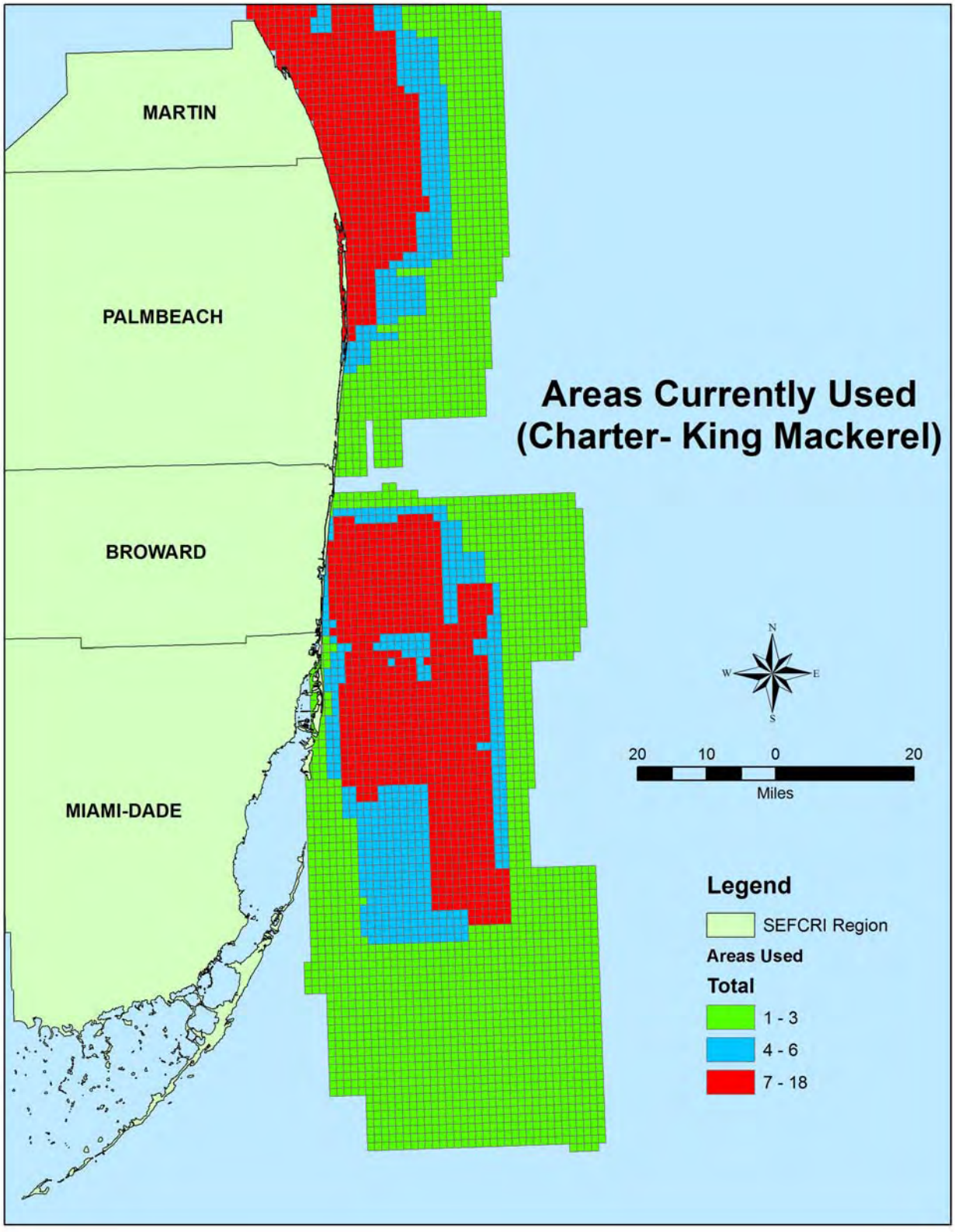

Figure 3: King mackerel fishing trips – present (total refers to number of respondents)

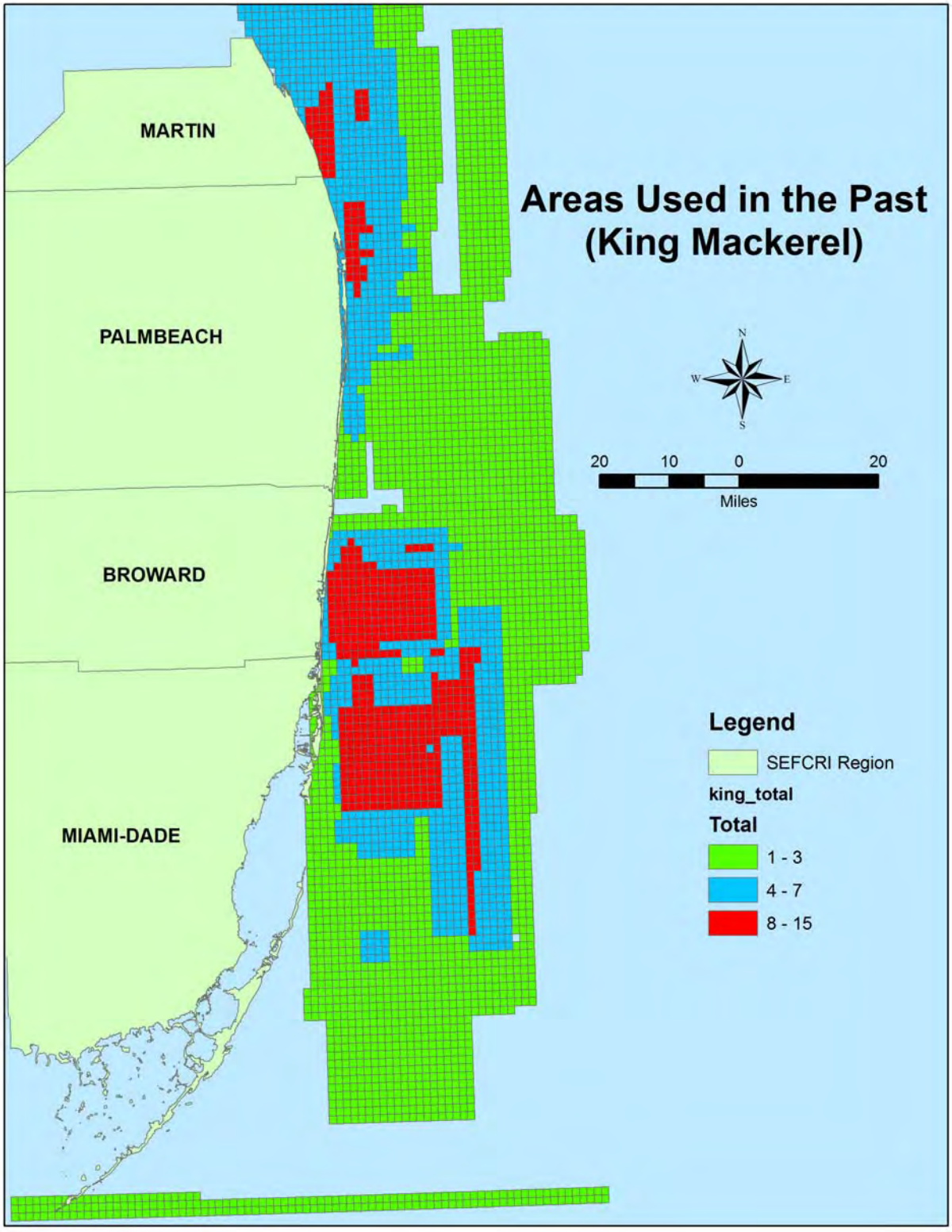

Figure 4: King mackerel fishing trips – past (total refers to number of respondents)

Use within the king mackerel fishery concentrated in nearshore areas off Martin and Palm Beach Counties in the most current years, compared to less intense use in such areas in past years. Also, the fishing grounds for king mackerel increased further south in Miami-Dade County. Overall, however, the fishing effort profiles from past to current years were largely unchanged, with fishing pressure being derived mainly from proximity to ports (ex. most of the fishing in lower Broward and upper Miami-Dade Counties is most likely related to the concentrated of ports in those areas, including Dinner Key, Crandon Park, Miami Beach, Haulover, and Port Everglades).

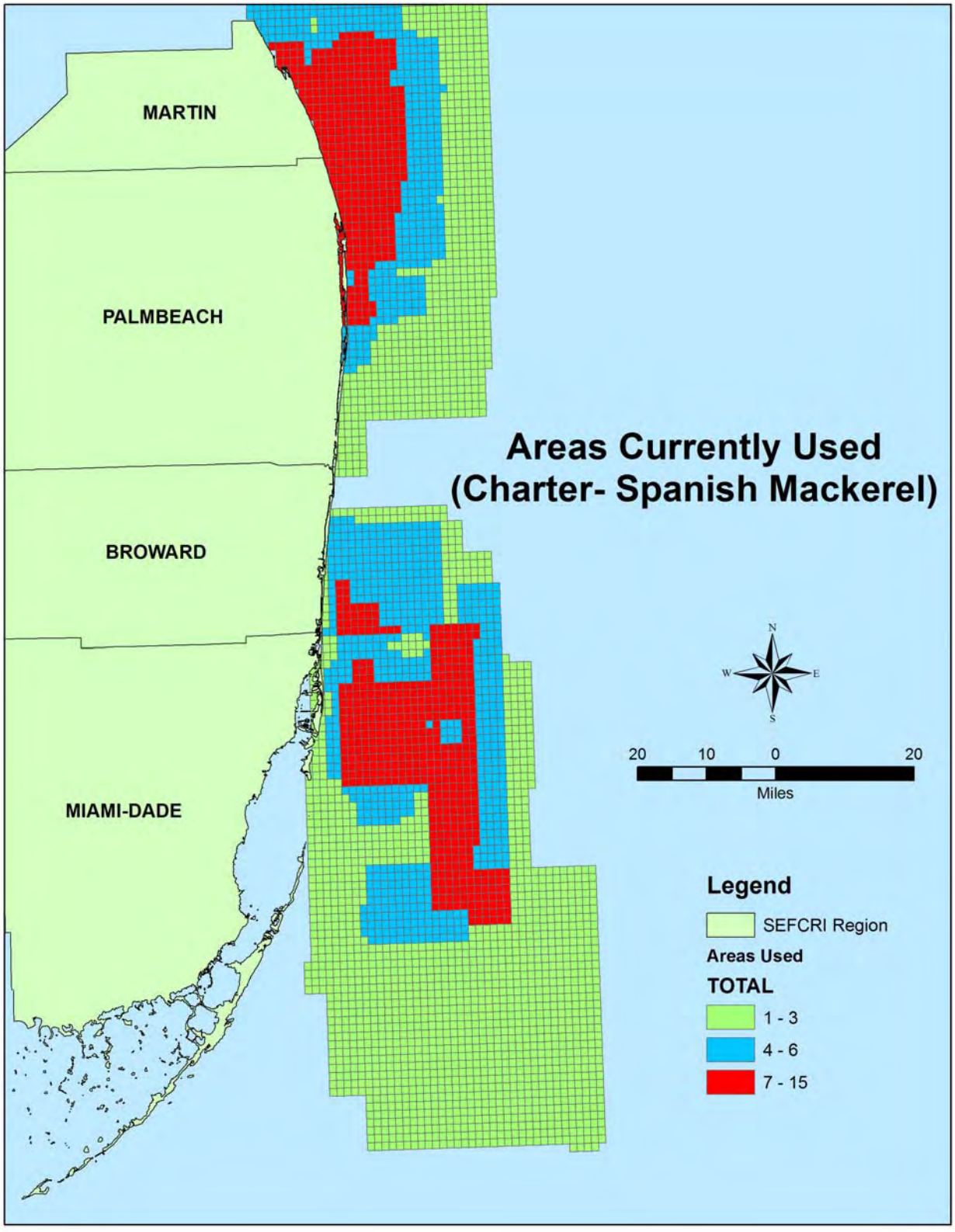

Figure 5: Spanish mackerel fishing trips – present (total refers to number of respondents)

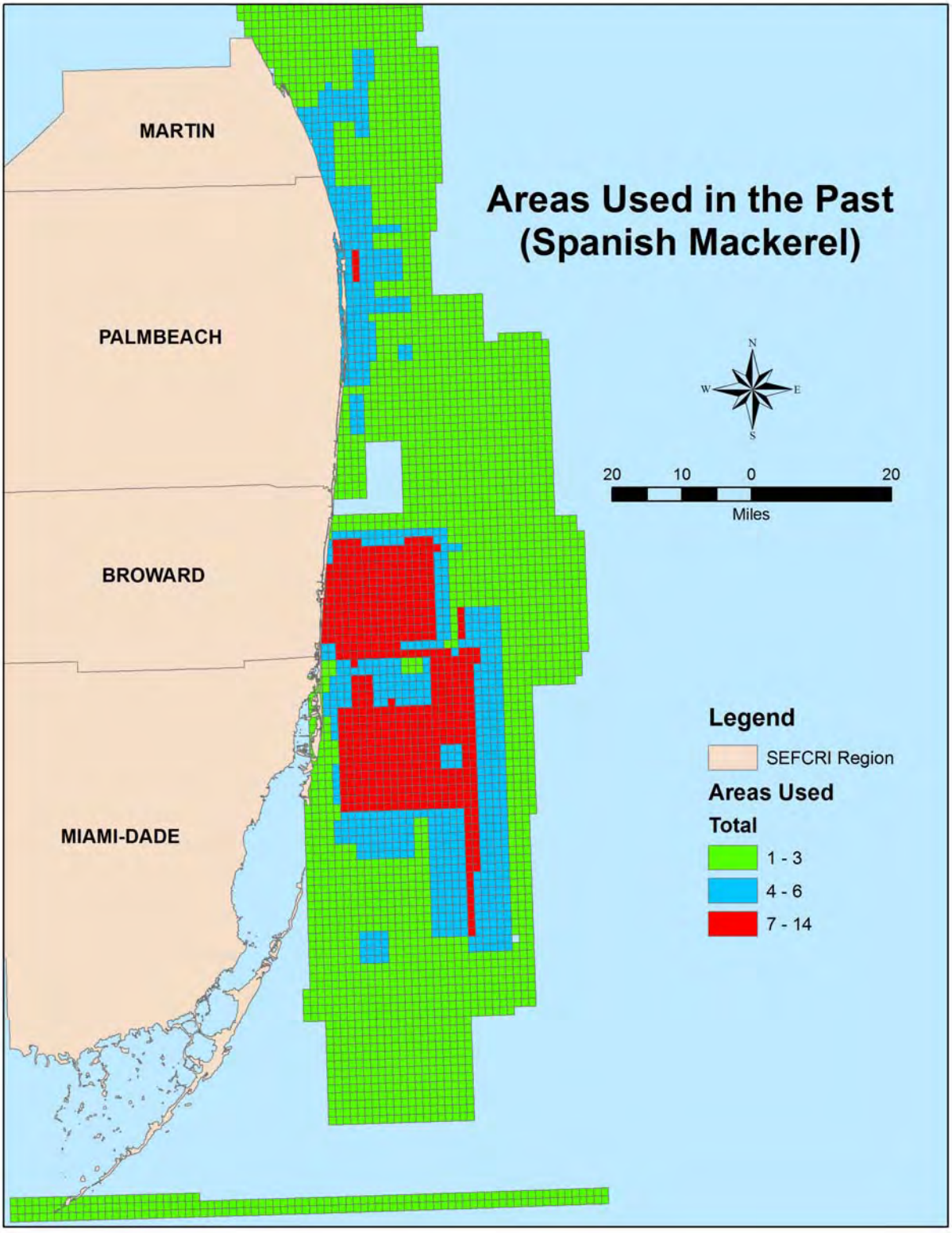

Figure 6: Spanish mackerel fishing trips – past (total refers to number of respondents)

As with king mackerel, charter fishing operations' effort in the Spanish mackerel fishery intensified nearshore in the northern two SEFCRI counties, but it also decreased somewhat in both nearshore and offshore areas of central Broward County. Effort also increased in southern Miami-Dade County.

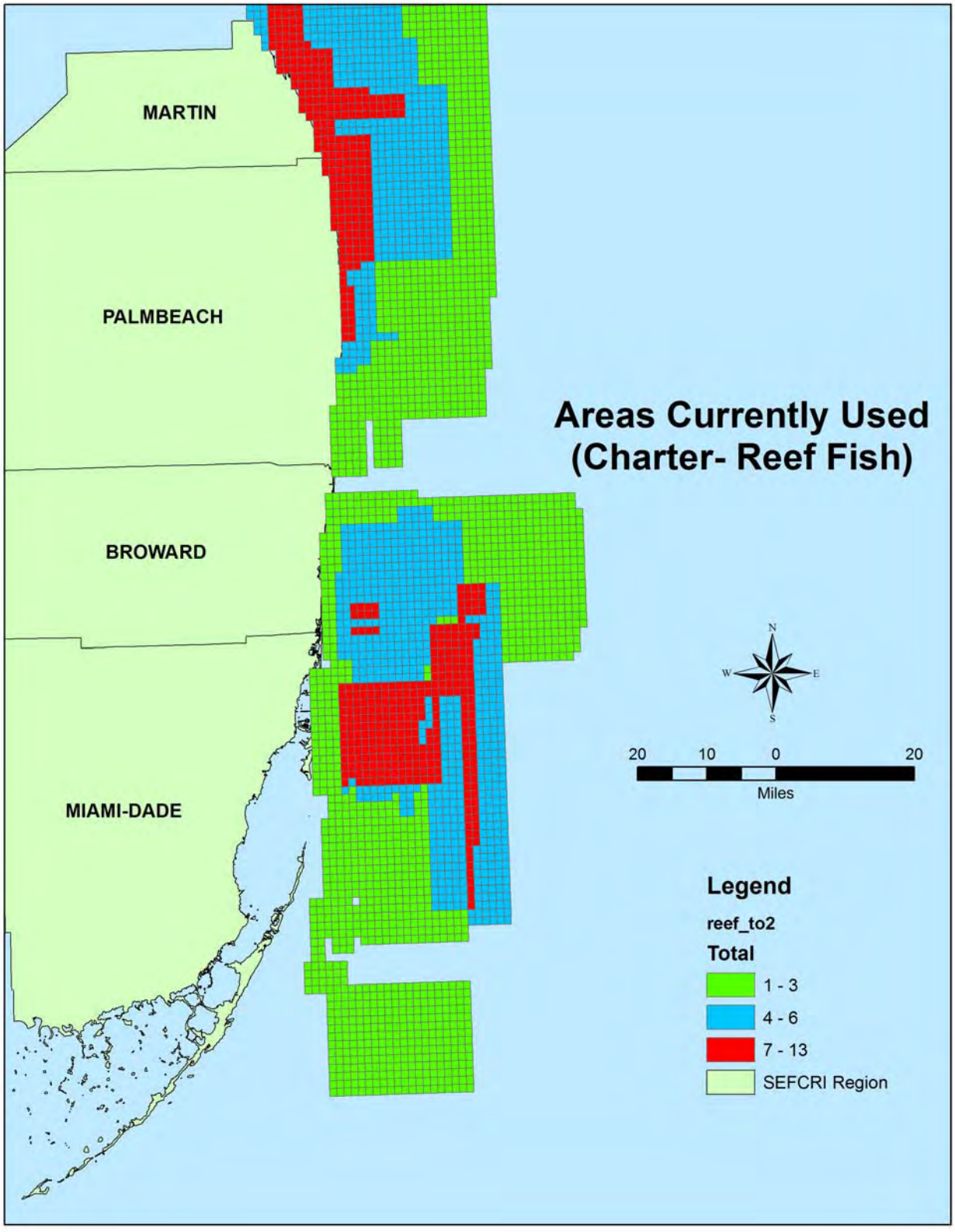

Figure 7: Reef fish fishing trips – present (total refers to number of respondents)

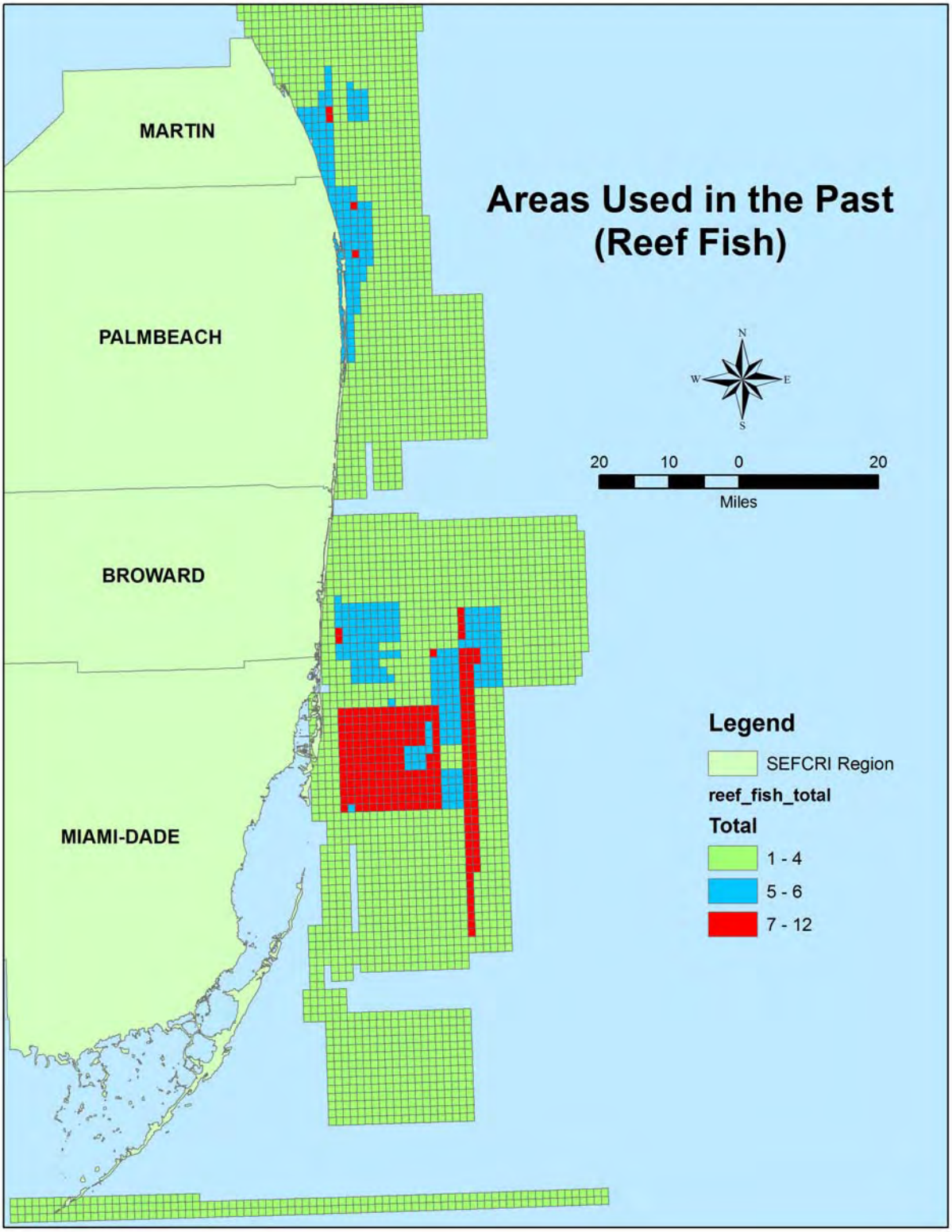

Figure 8: Reef fish fishing trips – past (total refers to number of respondents)

Reef fish effort and fishing areas increased offshore from past to current years in almost all counties, especially off Martin County. Off Broward and Miami-Dade Counties, however, areas fished remained largely unchanged, as did the intensity of fishing effort.

Perceptions

The respondents provided their views on use conflicts, resource trends, threats facing coral reefs and related resources.

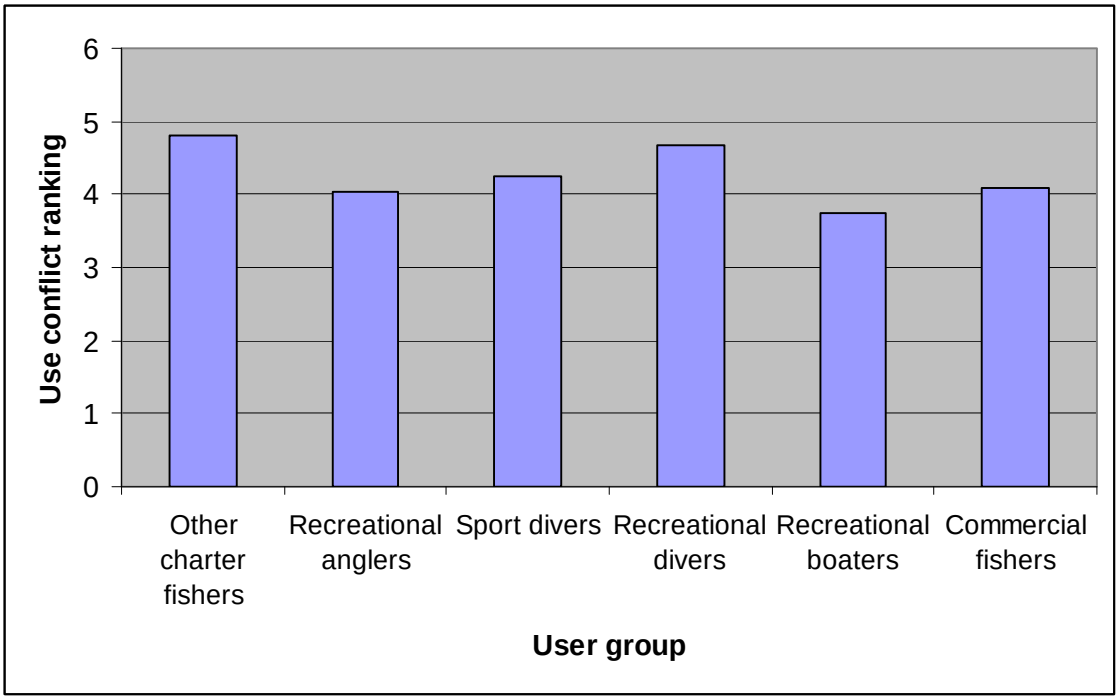

Figure 9: Views on use conflicts (n = 59)

Charter fishing organizations generally did not identify any conflicts with other user groups (mean > 3.0 for all user groups, in a scale from 1 to 6, where 1 represents most conflict and 6 represents least conflict (see Figure 9). The group that ranked lowest and thus represented the most conflict was that of recreational boaters (mean rank = 3.75; SD = 2.17), followed by recreational anglers (mean rank = 4.03; SD = 1.88) and commercial fishers (mean rank = 4.10; SD = 1.89). Respondents reported fewer conflicts with consumptive, or sport, divers (mean rank = 4.24; SD = 1.90) and recreational divers (mean rank = 4.68; SD = 1.84). Finally, charter fishers felt that their own group presented the least conflict (mean rank = 4.80; SD = 1.58).

When asked about their views on individual groups, charter fishing operations believed that commercial fishers (mean = 2.93 out of 5, where 1 is strongly agree and 5 is strongly disagree; SD = 1.35) and recreational anglers (mean = 2.91; SD = 1.49) present the same level of conflict. The respondents also felt that recreational boaters (mean = 3.09; SD = 1.55) presented less of a conflict than commercial or recreational fishers, and that recreational (consumptive and nonconsumptive) divers (mean = 3.38; SD = 1.34) posed the least problem to charter fishers' activities. In terms of percentages, 39.7% and 36.2% of the sample agreed that recreational and commercial fishing negatively affects their activities, respectively. Also, 36% agreed that recreational boaters present a conflict, compared to 31% who perceived consumptive

and nonconsumptive diving as conflicts. Importantly, however, the results demonstrate that while a third or slightly larger percentage of the sample views other groups as conflicting with their use, a majority of dive operators do not believe that other groups interfere with their activities. Finally, charter fishers were asked to identify any other groups that were not listed but which conflict with their use. Most (10.2%) identified specific vessel types, such as personal watercraft and sailboats, and fewer respondents listed environmentalists, government agencies, and shore-based, recreational anglers.

Charter fishers believed that, on average, coral reef conditions had declined (slightly) in the SEFCRI region (n = 57; mean = 3.54 out of 5, where 1 is significantly better, and 5 is significantly worse; SD = 1.27) since when they first started fishing. While over a quarter of the sample, or 26.2%, argued that coral reef conditions had improved over their tenure, a majority (50.8%) felt otherwise. Also, 78.6% of the respondents agreed that coral reef conditions had changed since when they first started fishing in southeast Florida. The main reason for this decline, as agreed upon by 30.5% of the operations, was either land-based (i.e. agricultural and urban runoff, sedimentation, and sewage) or marine pollution. Fewer (13.6%) identified boating (including vessel groundings and anchor damage) as the cause of coral reef decline, and fewer (10% or less) listed overpopulation, algae overgrowth of coral reefs, general mortality, overfishing, and diving as drivers.

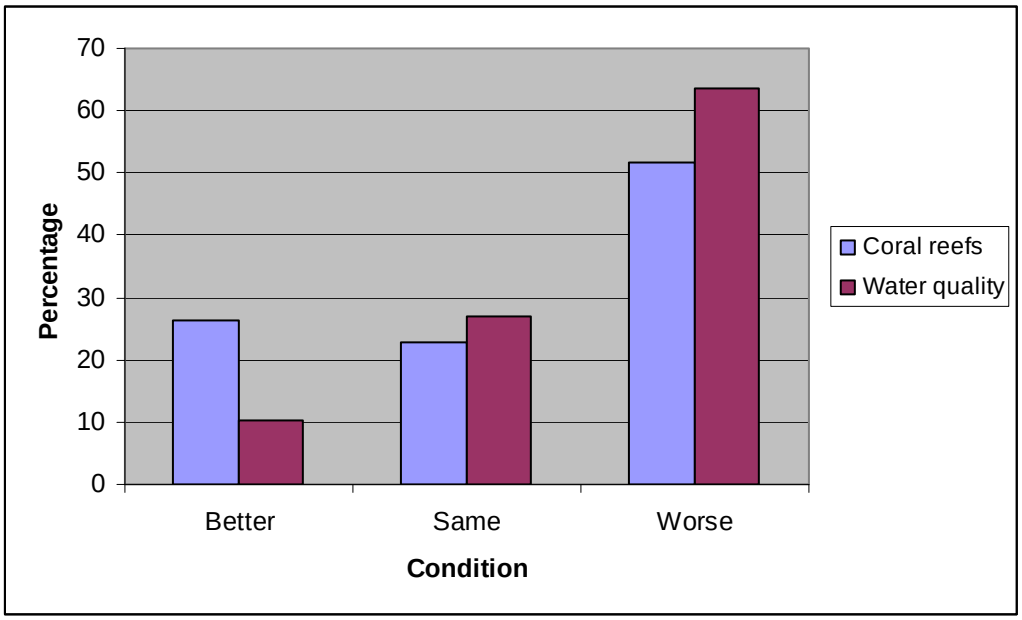

Figure 10: Coral reef and water quality conditions in the SEFCRI region

As shown in Figure 10, charter fishers were more certain that water quality had worsened (n = 59; mean = 3.78 out of 5, where 1 is significantly better and 5 is significantly worse; SD = 0.98) since when they first started fishing than they were about coral reefs (n = 57; mean = 3.54; SD = 1.27). Overall, while 26.2% of the respondents believed that coral reef conditions had improved, only 10.2% felt that

water quality conditions had improved; similarly, almost two thirds of the sample (63.7%) believed the water quality had declined, compared to 50.8% who believed the same for coral reefs. As with other user groups whose interactions with coral reefs tend to be indirect (i.e. the users do not immerse themselves into coral reef environments as part of their activities), charter fishers' views on coral reef conditions are most likely tempered by lack of first-hand knowledge; even so, it is significant that over half of the sample believed that coral reefs in the SEFCRI region are in worse condition than when they first started fishing (a tenure that averages between 11-15 and 15-20 years).

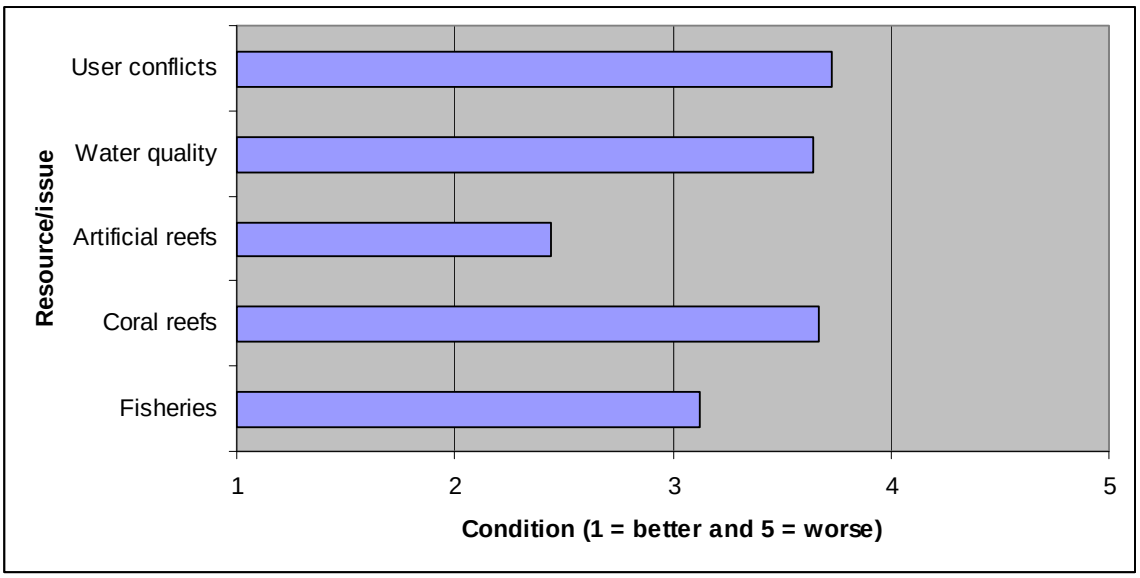

Figure 11: Views on resource conditions

Figure 11 shows that the operators' views on various resources and issues confirmed their opinions on water quality and coral reefs from the previous questions. Water quality (n = 59; mean condition = 3.78 out of 5, where 1 is better and 5 is worse; SD = 0.87) and coral reefs (mean condition = 3.67; SD = 1.06) were both rated as in worse condition than when the respondents first started fishing. Other resources, such as fisheries (n = 58; mean condition = 3.12; SD = 1.15) and artificial reefs (n = 58; mean condition = 2.43; SD = 0.96) were considered to be either stable or improved, respectively. Interestingly, the issue that ranked as having worsened the most was that concerning user conflicts (n = 59; mean condition = 3.73; SD = 0.96), showing that while charter fishing operations did not identify individual group conflicts, they may nevertheless perceived conflicts resulting from increasing numbers of overall users.

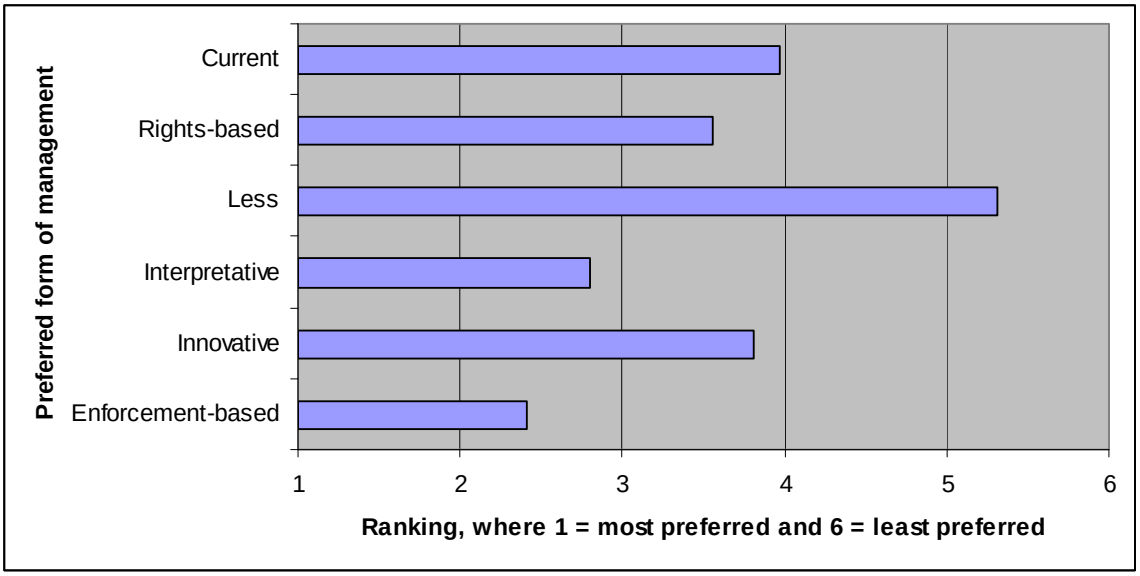

Figure 12: Preferred form of management (n = 59)

When asked about its preferred form of management, the sample selected enforcement-based management (mean rank = 2.14 out of 6, where 1 is most preferred and 6 is least preferred; SD = 1.90) over interpretative management (mean rank = 2.80; SD = 1.89), innovative management (mean rank = 3.81; SD = 1.93), and rights-based management (mean rank = 3.56; SD = 1.95) (see Figure 12). Clearly, respondents were less in favor of zoning and limited entry than they were of increased and/or improved enforcement and outreach and education. Importantly, the results showed that there was even less support for the current form of management (mean rank = 3.97; SD = 1.75) than for the aforementioned alternatives, suggesting that there is considerable dissatisfaction over how resources are presently managed in the SEFCRI region. Finally, the least preferred form of management was that comprising less management (mean rank = 5.31; SD = 1.32), showing that charter fishing operations were in favor of active management (preferably in a form that is improved over the current approach).

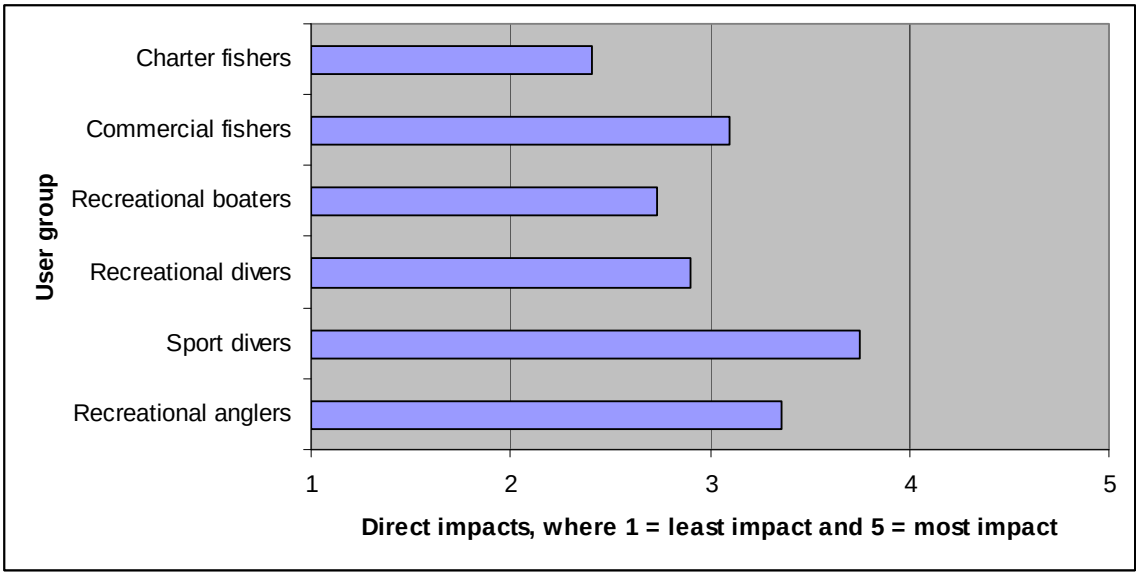

Figure 13: Direct impacts on SEFCRI coral reefs (n = 59)

As shown in Figure 13, charter fishers agreed that their group generated the least impact to coral reefs in the SEFCRI region (mean = 2.14 out of 5, where 1 represents the least impact and 5 represents the most impact; SD = 1.23), an opinion that may be derived from their view that a majority of charter fishers fish offshore areas, practice catch-and-release fishing for several species, and do not directly interact with coral reefs. The latter point is reinforced by the sample's perception on sport, or consumptive divers, which it identified as the group most responsible for direct impacts on coral reefs (mean = 3.75; SD = 1.17); this is to be contrasted with the more positive perception on nonconsumptive divers (mean = 2.90; SD = 1.37), which ranked behind charter fishers and recreational boaters (mean = 2.73; SD = 1.40) in having the least impacts on coral reefs. Other, consumptive groups were also viewed as having impacts (where mean > 3) on coral reefs, including recreational anglers (mean = 3.35; SD – 1.56) and commercial fishers (mean = 3.10; SD = 1.31). As previously stated, the results suggest that charter fishers view other consumptive uses as having much greater impacts on coral reefs than their activities. Importantly, recreational boaters, which charter fishers ranked as presenting the most conflict of any user group, were ranked only behind charter fishers in having the least impact on coral reefs. The result shows that the sample differentiated between the interactions that they have with other user groups and their views on the groups' impacts on coral reefs (and related resources). When requested to list the group most responsible for impacts on coral reefs, 40.7% listed sport, or consumptive, divers, followed by recreational anglers (27.1%), commercial fishers (16.9%), recreational boaters (11.9%), and charter fishers (3.4%)

The indirect impact that is most harmful to SEFCRI region coral reefs, as reported by charter fishers, is land-based sources of pollution (n = 59; mean = 4.61 out of 5, where 1 is least impactful and 5 is most impactful; SD = 0.93). The respondents also ranked development (n = 59; mean = 4.44; SD = 1.24) and dredging (n = 59;

mean = 4.41; SD = 1.07) as having significant impacts, but global warming (n = 39; mean = 3.13; SD = 1.32) was not perceived as harmful. It should be noted, however, that over a third (33.8%) of the sample elected not to rank global warming, suggesting that either it is not considered a threat or that the operators did not understand its potential impacts to be able to answer the question.

Finally, the charter fishers provided information on artificial reefs, in terms of their use of artificial reefs and their views on effects of the structures on fisheries, coral reefs, and use conflicts, among other issues. Overall, 93.2% of the respondents stated that they used artificial reefs, accounting for an average of 32.7% (SD = 23.0) of their total trips.

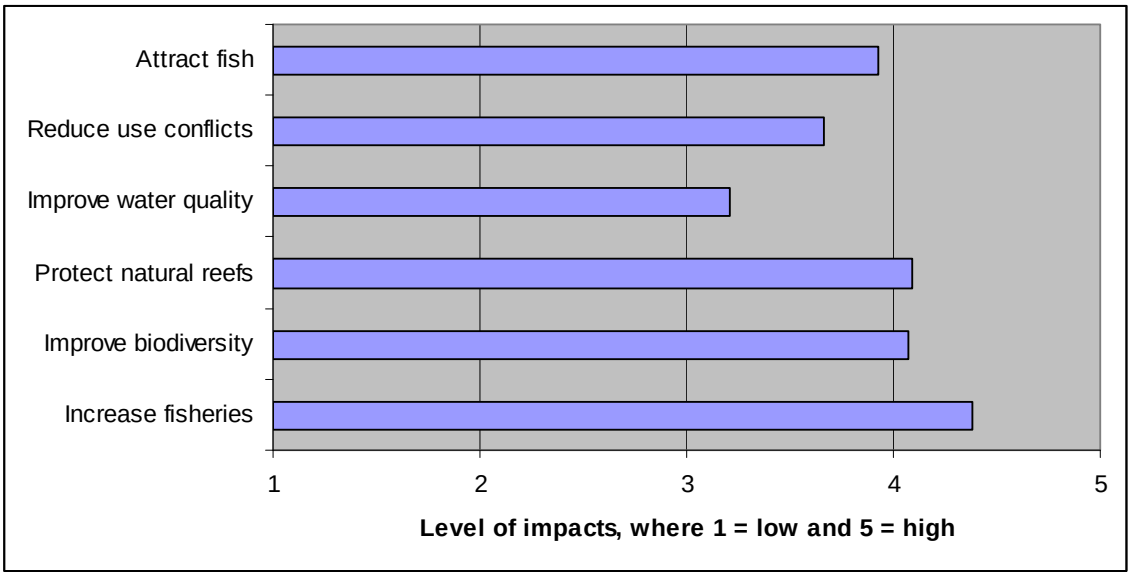

Figure 14: Views on artificial reefs

Charter fishers believed that the most significant impact of artificial reefs was their role in increasing fisheries (n = 56; mean rank = 4.38 out 5, where 1 represents low impact and 5 represents high impact; SD = 1.07) (see Figure 14). They also felt that artificial reefs assist in protecting natural reefs (n = 55; mean = 4.10; SD = 1.29) and improving biodiversity (n = 56; mean = 4.07; SD = 1.20), arguably by reducing pressure on natural reefs and providing more habitat for more species (as well as attracting fish (n = 56; mean = 3.91; SD = 1.51). Charters fishers were less inclined to agree to that artificial reefs reduce use conflicts (n = 53; mean = 3.66; SD = 1.57) or improve water quality (n = 53; mean = 3.21; SD = 1.67). Overall, however, the sample held positive views of artificial reefs, a resource on which the group clearly relies and uses extensively (for an average of a third of all trips).

Discussion

The DEP SEFRCI region charter fishing operations study resulted in a characterization of the southeast Florida charter fishing industry and the industry participants' views on resource trends, impacts on coral reefs, and related resources, and preferences towards management that can effectively address resource trends. The study led to an understanding on the perceptions that charter fishing operations hold on other user groups and on resources and resource trends in the region, and these suggest that charter fishers mostly do not view their activities as natural, coral reef-based, and thus, they do not consider their use as having significant impacts on SEFCRI coral reefs. Moreover, there exists a shared belief among industry participants that, unlike other consumptive user groups, their group has limited impacts on the region's natural resources. Finally, while the operations may not agree on the extent of their impacts on coral reefs, most are in favor of alternate forms of management which they believe will improve the condition of southeast Florida' coral reefs.

The study determined that almost 90% of charter fishing operations interviewed in the region focused on offshore trips, compared to 42% that focused on reef trips. This was further reinforced by the combination of species that operators reported targeting, which was comprised mainly of offshore species, including dolphin, sailfish, marlin, and other, offshore pelagics (also reported by Brinson et al., 2006, in their study of billfish charter fishing operations in the SEFCRI region). Also, while reef fish charters are more common in the Florida Keys (Shivlani et al., in preparation; Waters et al., 2001; Milon et al., 1997), charter fishers in the SEFCRI region tend to advertise offshore trips. In the present study, it was found that operators generally advertised offshore, or deep-sea, fishing trips over reef trips. Thus, even though 8.5% of the sample reported targeting reef fish in its last fishing trip and charter fishers averaged almost 120 reef fish fishing trips, the identity created by the industry in the SEFCRI region is that of an offshore fishing fleet.

Within the context of an industry focused on offshore fishing, it is clear why operators do not perceive their activities as having significant impacts on coral reefs. Instead, they believed that proximity to the resource results in the greatest impact; accordingly, they argued that sport, or consumptive, divers are the group most responsible for coral reef decline in the SEFCRI region. However, they also believed that other consumptive users, including recreational anglers and commercial fishers, were culpable, most likely due to the perceived importance of coral reefs to those user groups. It is unclear how the persistent and widespread use of harvesting bait fish in nearshore environments (many of which are contiguous with coral reefs) was reconciled in the estimation of charter fishers' views on their impacts; baitfish accounted for an average of 219 trips per operator, the highest effort total for all targeted species. It should be noted that it is the purpose of this discussion to demonstrate that charter fishers underestimate their impacts on coral reefs; instead, it is a means by which to determine how an important user group in the SEFCRI region can be engaged to participate in coral reef management efforts if that group perceives its impacts as minimal and identifies its interests as mainly offshore.

This does not mean that charter fishing operations are not concerned over coral reef health and management. Over half of the participants in the study agreed that coral reefs in the region have declined, and most were in favor of adopting alternate forms of management, mainly enforcement-based and interpretative-based management systems; the least preferred form of management was less management, showing that charter fishing operations believed that more active forms of protection are required to conserve SEFCRI coral reefs.

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Appendix 1: Survey instrument

GENERAL INFORMATION

Name_____

Telephone_____

Address_____
_____
_____

1. Which of the following includes your age?

18-30 31-40 41-50 51-60 over 60

2a. Are you Spanish/Hispanic/Latino? YES NO

- if YES: Puerto Rican Mexican Cuban Other_____

2b. What is your race?

White African American Native American Asian

Other (_____)

3. How many family members do you support (including yourself)?

Myself only 2 3 4 5 6 7 greater than 7

4. Are you a member of any of the following groups?

- Charter fishing organization	YES	NO
- Chamber of Commerce	YES	NO
- An environmental group	YES	NO
- Other_____	YES	NO

5. Do you ever sell your catch? YES NO

- If YES, then what percentage?_____

- If YES, then where do you usually sell your catch (ex. restaurants, fish houses, etc.)?
_____

6. What is your primary port? _____

7. Do you have a secondary port, from where you fish part of the year? YES NO

- If YES, then which one? _____

8. How many years have you operated a fishing charter?

< 1 yr 1-5 6-10 11-15 15-20 >20 yrs

ECONOMIC INFORMATION

9. Please provide your best estimate of the replacement value of the following items that you used for charter fishing last season.

____Vessel(s) and electronic equipment:	$_____
Length of vessel	_____feet
Gear (_____)	$_____

10. Please provide your best estimate for the following expenses last last season/year.

Docking fees:	$_____
Interest payments on vessel:	$_____
P&I insurance on vessel, crew	$_____
Maintenance/repair on vessel:	$_____
Maintenance/repair on gear:	$_____
Other_(ex. licenses)_____	$_____

11. What approximate percentage of your personal income is derived from charter fishing?_____%

12. What approximate percentage of your TOTAL household income is derived from charter fishing?_____%

13. How would you describe your primary operation?

Flats/inshore Reef Offshore Other_____

CONFLICTS, TRENDS, AND MANAGEMENT

14. Please rate the following uses in the order of their importance as a conflict to your fishing activities, where 1 is most important and 6 is least important.

Use	Rate
1. Other charter fishers	
2. Recreational anglers	
3. Recreational divers – consumptive	
4. Recreational divers - nonconsumptive	
5. Recreational boaters	
6. Commercial fishers	

For the next three questions, please provide your answer on a 1 to 5 scale, where 1 means **Strongly agree,** 2 means **Moderately agree**, 3 means **Neutral**, 4 means **Moderately disagree**, and 5 means **Strongly disagree**

15. Commercial fishers negatively affect my fishing activities, by either fishing in the same areas, targeting the same species, or by other activities.

1 2 3 4 5 I don't know

16. Recreational anglers negatively affect my fishing activities, by either fishing in the same areas, targeting the same species, or by other activities.

1 2 3 4 5 I don't know

17. Recreational (both consumptive and nonconsumptive) divers negatively affect my fishing activities, by diving on my gear, targeting the same species, anchoring and diving where I am fishing, or by other activities.

1 2 3 4 5 I don't know

18. Recreational boaters negatively affect my fishing activities, by boating over my gear, scaring my targeted species, or by other activities.

1 2 3 4 5 I don't know

Date of interview_____ Location of interview_____

19. Can you identify any OTHER user groups with which you have use conflicts (i.e. those groups that affect your fishing areas and species)?

20. What are the coral reef conditions in southeast Florida and the area(s) where you fish, compared to what they were like when you first started fishing?
    a. Significantly better
    b. Somewhat better
    c. Same
    d. Somewhat worse
    e. Significantly worse

21. Have the coral reefs changed in southeast Florida since you first started fishing?

    YES NO

    - If YES, then what are the main changes that have occurred to reefs since you first started fishing?

    _____

22. What is the condition of water quality since when you first started fishing?
    a. Significantly better
    b. Somewhat better
    c. Same
    d. Somewhat worse
    e. Significantly worse

23. Please identify the general trend in each of the following as they relate to your activities.

	Better ←----------→ Worse
a. Fisheries	1 2 3 4 5
b. Coral reefs	1 2 3 4 5
c. Artificial reefs	1 2 3 4 5
d. Water quality	1 2 3 4 5
e. Use conflicts	1 2 3 4 5

NOTE to data collector: Please follow up on each trend with a question on *why* the trend has occurred.

24. Please rate the following forms of management to determine if management needs to be changed to address resource conditions and trends in southeast Florida, where 1 is the most preferred form of management and 6 is the least preferred form of management.

Management	Rating
1. Restrictive, enforcement-based management - higher penalties, more patrols and monitoring	
2. Innovative management - use separation of activities via zoning - marine protected areas	
3. Interpretative management - more outreach and education	
4. Less management	
5. Rights based management (limited entry, trap limitation, property rights)	
6. Current form of management	

NOTE to data collector: Please collect information on the type of management that the interviewee would prefer, especially if it is not included in the table above or if it is a subset of a type of management.

25. In terms of direct impacts on southeast Florida coral reefs, what is the extent of impacts on these areas by the following groups?

	Low ←------→ High
a. Recreational anglers	1 2 3 4 5
b. Recreational divers (consumptive)	1 2 3 4 5
c. Recreational divers (nonconsumptive)	1 2 3 4 5
d. Recreational boaters	1 2 3 4 5
e. Commercial fishers	1 2 3 4 5
f. Charter fishers	1 2 3 4 5

Which group would you state has the greatest direct impacts on coral reefs and how?

_____

26. In terms of indirect impacts on southeast Florida coral reefs, what is the extent of impacts on these areas by the following activities?

	Low ←------→ High
a. Coastal development	1 2 3 4 5
b. Dredging/filling	1 2 3 4 5
c. Land-based pollution (agriculture, sewage, etc.)	1 2 3 4 5
d. Global warming	1 2 3 4 5

Which activity would you state has the greatest indirect impacts on coral reefs and how?

_____

27. Do you fish artificial reefs in southeast Florida?

    YES NO

    - if YES, then how often do you fish artificial reefs, as a percentage of total trips in a typical year?___%

28. In terms of artificial reefs, what is the extent of impacts of these structures on the following conditions?

	Low ←------→ High
a. Increase fisheries	1 2 3 4 5
b. Protect biodiversity	1 2 3 4 5
c. Protect natural reefs	1 2 3 4 5
d. Improve water quality	1 2 3 4 5
e. Reduce user conflicts	1 2 3 4 5
f. Attract fish from other areas (ex. natural reefs)	1 2 3 4 5

FISHERY INFORMATION

29. Please refer to the table below to write in your best estimate of total trips and amounts per trip last season.

Total Catch/Trips by Species

Fishery	Total trips	Amount per trip
Stone crab		
Lobster		
Shrimp		
Reef fish		
King mackerel		
Spanish mackerel		
Bait fish		
Dolphin		
Sharks		
Marlin		
Sailfish		
Other pelagics		
Nearshore species (bonefish, snook, permit, etc.)		
Marine life		
Others		

30. Please refer to the table below to show how the catch and effort in each species changed since you started fishing.

Change in Catch/Trips by Species

Fishery	Total catch % change (+/-)	Total trips % change (+/-)	Size % change (+/-)
Stone crab			
Lobster			
Shrimp			
Reef fish			
King mackerel			
Spanish mackerel			
Bait fish			
Dolphin			
Sharks			
Marlin			
Sailfish			
Other pelagics			
Nearshore species (bonefish, snook, permit, etc.)			
Marine life			
Others			

31. Please refer to the table below to show the species that you targeted in your last trip and what you caught.

Change in Catch/Trips by Species

Fishery	Targeted	Caught
Stone crab		
Lobster		
Shrimp		
Reef fish		
King mackerel		
Spanish mackerel		
Bait fish		
Dolphin		
Sharks		
Marlin		
Sailfish		
Other pelagics		
Nearshore species (bonefish, snook, permit, etc.)		
Marine life		
Others		

32. Please use the following table to write in your best estimate of costs for a typical trip in each of the fisheries in which you participated in the last season.

Cost by species

Fishery	Fuel/oil	Ice	Bait	Food/Supplies	Other	Crew (#/cost)
Stone crab						
Lobster						
Shrimp						
Reef fish						
King mackerel						
Spanish mackerel						
Bait fish						
Dolphin						
Sharks						
Marlin						
Sailfish						
Other pelagics						
Nearshore species (bonefish, snook, permit, etc.)						
Marine life						
Others						

33. Why do you fish the areas that you do – that is, what is the PRIMARY reason that results in where you fish?

a. Proximity to port
b. Density of target species/correct bottom or water conditions
c. Lack of competition/conflicts from other users
d. Other (please list_____)

34. Have you changed your fishing area since when you first started fishing?

YES NO

- If YES, then how and why?_____
_____

35. Using the following charts for each species, please draw in or point out the following:

a. Areas fished in the past THREE years with percentage for each area, in terms of the percentage of trips taken to each area
b. Areas fished when you started fishing with percentages for each area, in terms of percentage of trips taken to each area
c. Areas of user conflicts

Commercial fisher report

Introduction

The Southeast Florida Coral Reef Initiative Project to *Compile and Compare Scientific Data and Social Perceptions on Reef Conditions and Use* called for identification, assembly, and assessment of existing historical (use) maps, fishery data related to coral reef biodiversity, data on other fishing and diving impacts, the relative importance of reef versus other, offshore fishing (as measured in terms of participation rates and extraction levels), types, quantity, and trends of commercial and recreational extractive and nonconsumptive uses by county, stakeholder concerns on the indirect impacts on reefs, and stakeholder perceptions on artificial reefs. Florida's Local Action Strategy (LAS) developed through the State's membership in the U.S. Coral Reef Task Force, and known as the SEFCRI, identified four focus areas targeting threats to the reefs from Miami-Dade County, through Broward and Palm Beach, to Martin County. This project is a part of the Fishing, Diving, and Other Uses (FDOU) focus area.

The project called for the completion of three tasks: (I) The assemblage of existing information on the resource in the study area from all available sources; (II) the collection of historical and present day social perceptions concerning the resources from various stakeholders; and (III) the completion of a project summary that includes the synthesis of the results form the assemblage of existing information and data collection in a final report with supporting documentation.

As part of the project tasks II and III, the present effort identified and characterized the key, user groups (stakeholders) that utilize and/or rely on the regional coral reefs and associated resources: Commercial fishers; charter, for-hire fishing operations; recreational fishers (consisting of recreational anglers and recreational, consumptive divers); dive operations; researchers and managers; and the surfing community. Stakeholder identification and characterization followed the approach utilized by previous efforts in the region and elsewhere (Shivlani, 2006; Thomas J. Murray and Associates, 2005; Suman et al., 1999).

The region hosts a variety and magnitude of uses, as well as a diversity and density of users; thus the project decided that any study that considers historical and present social perceptions from current and past stakeholders must address the following:

1. What does it mean to be a stakeholder in southeast Florida, and how can that universe be defined (or at least circumscribed) to include all relevant uses?

2. Are there privileged, or dominant, narratives that certain stakeholders (and uses) may present that could undermine the narratives of others; and if so, then how can that be surmounted?

In addressing the first concern, this project worked closely with the FDOU team in bounding the universe of stakeholders, based on all available information, both in terms of information concerning regional stakeholders and theoretical and practical studies on stakeholders in other areas. The second important factor that the project considered was the information it gathered, in that project methodology was refined to reach classes of users to the extent possible. Also, the project focused on the stratification of stakeholder perceptions, where applicable, such that experience and extent of use were considered to provide a more representative opinion.

Commercial fishing industry

Commercial fishing often represents one of the more traditional and widespread uses of the coastal zone, and fishing communities are an important, sociocultural component of maritime culture and history (US Commission on Ocean Policy, 2004; Olson, 2002). The SEFCRI region hosts a diverse set of fisheries, targeting invertebrates such as shrimp, spiny lobster, stone crab, and blue crab, and finfish, including reef fish complexes, migratory coastal species, and offshore pelagics. On average, the four counties comprising southeast Florida accounted for 21.6 million pounds of landings from 1990-2000, of which the commercial fisheries' share was 31% (Johnson et al., 2007). Ethnographic and other directed research with commercial fishers in the region suggests a largely fragmented community along an increasingly urbanized coastline, with limited (and expensive) dock space and few fish houses and processing centers (Shivlani, 2006; Shivlani et al., 2004). However, not much research has been conducted with the commercial fishing industries in the four counties, and most completed studies have mostly characterized or described commercial fisheries as a means of a related effort (for instance, Ault et al., 2000, described the Miami-Dade commercial fishery and its relationship to Biscayne National Park fishery resources; Johns et al., 2001, discussed the socioeconomic uses of southeast Florida reefs; and Shivlani et al., 2005, characterized the Miami-Dade (Miami River) commercial lobster fishery in determining economic performance of that fishery). Thus, very little information on the historical and present conditions on commercial fisheries exists for the SEFCRI region commercial fishing industry.

Information exists on the landings and participation in the commercial fishing industry, as described in Johnson et al. (2007) and as is available via the Florida Fish and Wildlife Conservation Commission's trip-ticket system.

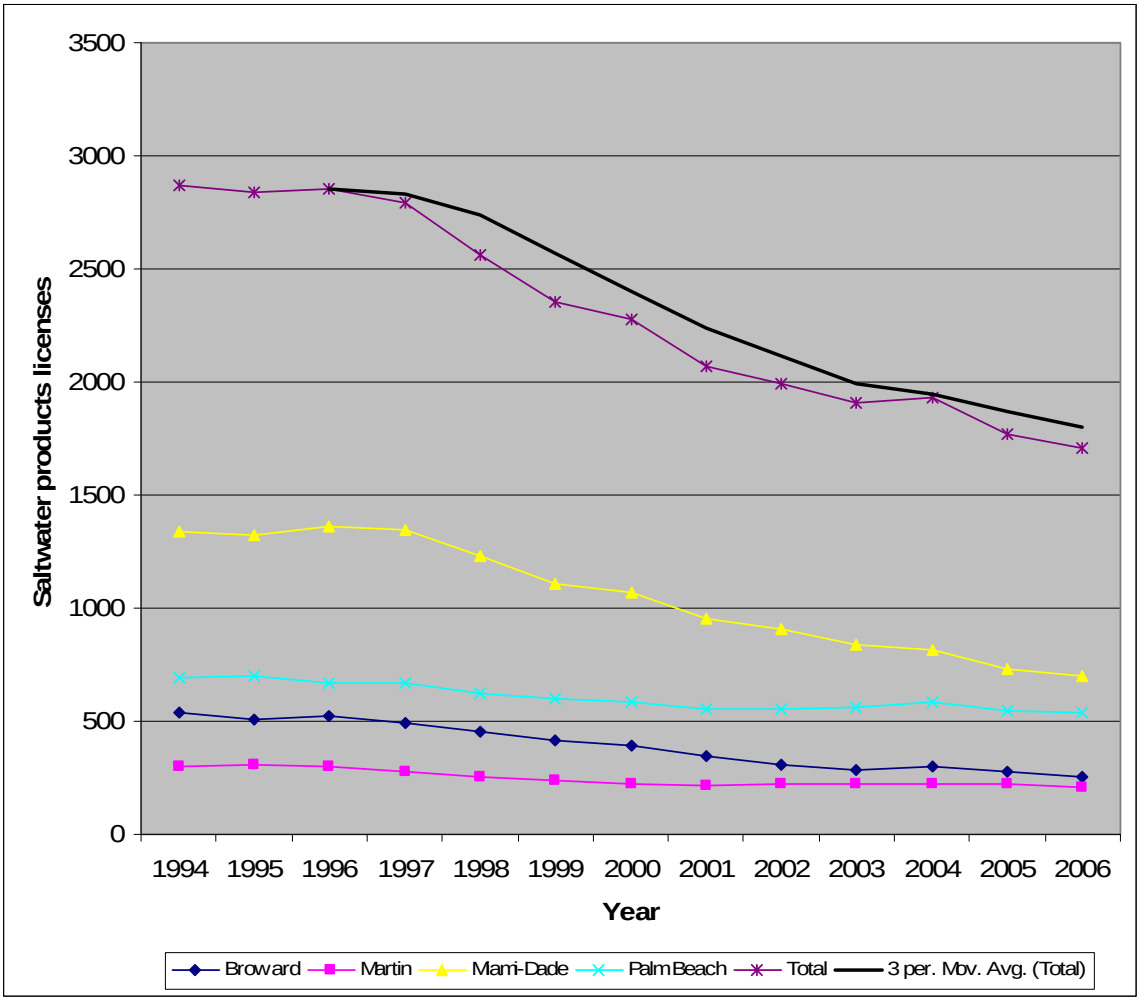

Figure 15: SEFCRI area commercial fishing licenses from 1994 to 2006

Figure 1 shows the overall and county-level changes in commercial fishing licenses (saltwater product licenses) from 1994-95 to 2006-07 (FWRI, 2007). In 1994-95, the state issued a total of 2,871 licenses in the SEFCRI region, and in 2006-07, it issued 1,711 licenses, representing a decline in participation of 40.4%. Commercial fishers declined in each county during the time period, with Broward County (52.1%) and Miami Dade County (47.5%) experiencing the largest losses in participants. Martin County and Palm Beach County lost 30.4% and 22.0% of their commercial fishers, respectively.

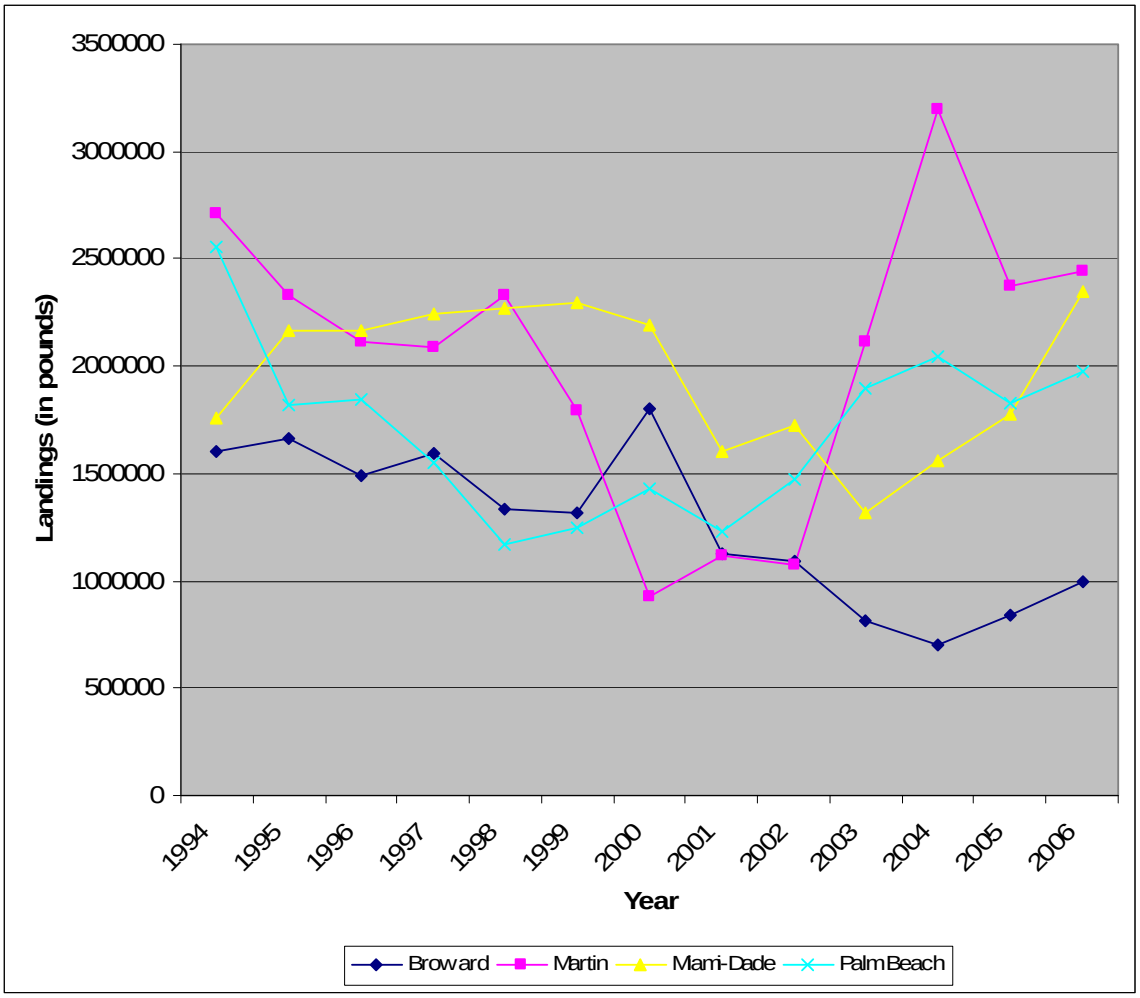

Figure 2: SEFCRI area commercial landings from 1994 to 2006

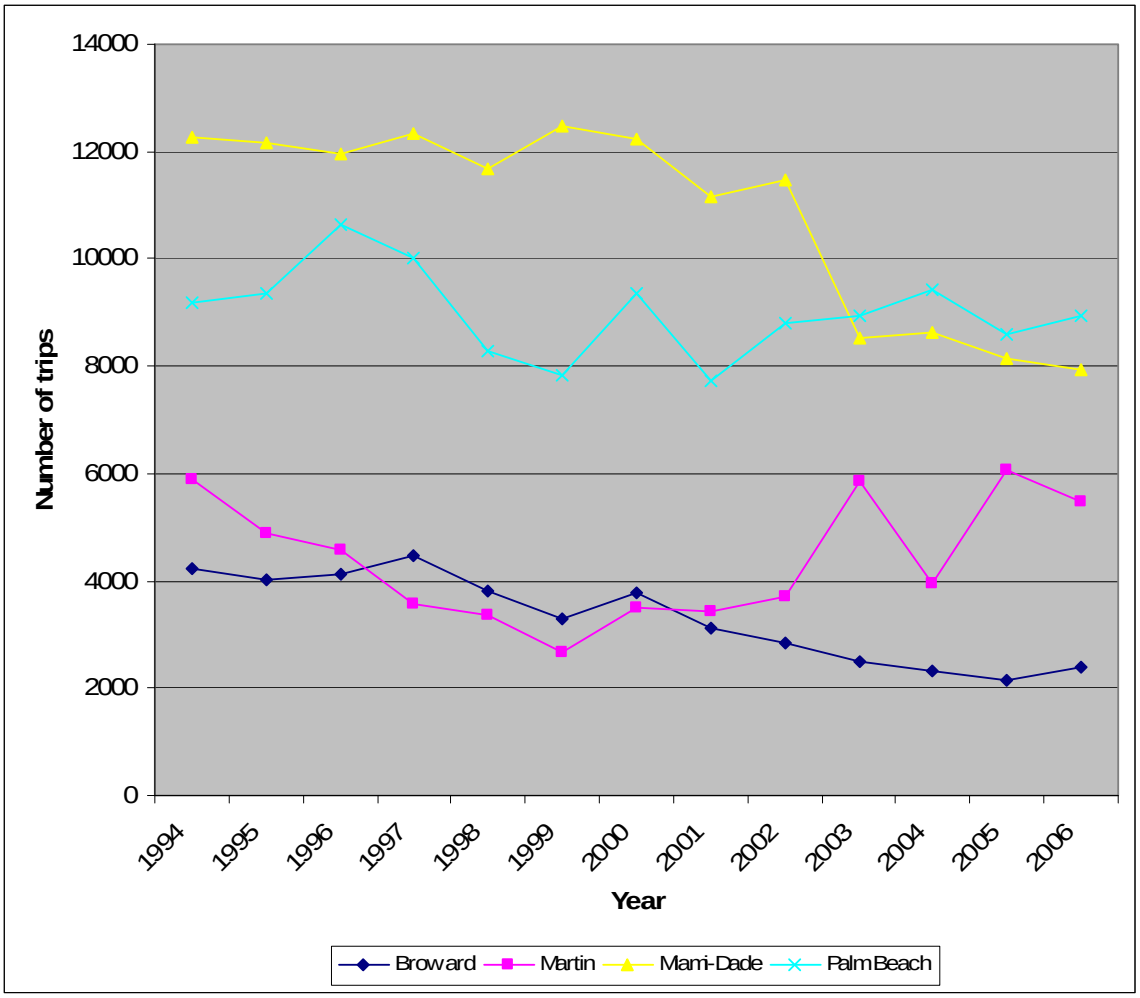

Figure 3: SEFCRI area commercial fishing trips from 1994 to 2006

Figures 2 and 3 show landings and trips in the 1994-2006 period for the four counties and, as might be expected from the license trends, landings and/or trips declined in those counties where participation dropped (FWC, 2007). In Broward County, both landings and trips declined, whereas in Miami-Dade County, landings fluctuated while landings declined. Trips and landings increased in Martin County, especially after 2002. Finally, Palm Beach County experienced a resurgence in catch from 2002 onwards, but trip totals remained stable.

The findings suggest that the commercial fishing industry may have undergone different changes in the SEFCRI region, such that fishery regulations like the Florida Net Ban (Barnes, 1995) and the Spiny Lobster Trap Certificate Program (Shivlani et al., 2004; FS 370.142) may have affected fishing ports differentially. Also, with increasing property values and associated cost of living increases experienced by residents of the four counties in the 2000s, commercial fishing may no longer be the sole source of income and thus a primary occupation for many participants. The research team utilized this information as a starting point from which to develop its methodology and characterize the southeast Florida commercial fishing industry.

Methodology

This SEFCRI commercial fishing study was the first of six study components in FDOU Combined Project 10. The methodology used to identify the study population, develop a survey instrument, and implement the field session served as a model for subsequent studies. Many of the socio-demographic, economic, use, and perceptions questions used in the commercial fisher survey instrument (see Appendix 1) were modified and utilized in the subsequent studies. This approach assured a level of consistency that allowed for inter-group comparisons, as well as the development of a common set of maps that could then be layered to show areas of use and changes in use patterns, as well as use conflict hotspots.

In early June 2006, the research team developed a survey instrument based on the objectives described in the FDOU project request for proposals, and it circulated the draft instrument to the FDOU team members. Following a series of revisions in a comment period that lasted three weeks, the research team finalized the survey instrument by the end of June 2006.

Also in June 2006, the research team sent out introductory letters (Appendix 2) to the entire list of Saltwater Products License (SPL) holders in Martin, Palm Beach, Broward, and Miami-Dade Counties. A total of 1,560 letters were mailed in mid-June 2006 as a means to introduce the study to potential participants and to determine which fishers were still at the addresses provided in the SPL list (provided by the Florida Fish and Wildlife Conservation Commission). The research team received 162 undeliverable letters, which reduced the effective population to 1,398 SPL holders. As per the project budget, the total number of commercial fishers to be surveyed was set at 180 (representing approximately 15% of the SPL holders).

The methodology adopted to implement surveys was to first randomize the updated SPL lists by county, then to contact by phone the individuals in each county list (data collectors called each fisher randomly selected a total of eight times over the period of two weeks before excising the person's name from the list, or if the person declined or was otherwise unavailable [following Agar et al., 2005's methodology]), and finally to set up an interview time and date when to conduct the survey, which was usually (with a few exceptions) conducted in person.

Fieldwork on the study commenced in July 2007, with one lead and two secondary data collectors heading the survey effort. Also, the research team worked on completing surveys by county and only deviated from this approach where commercial fishers called one of the team members and requested to participate. Data collectors also maximized surveys completed by interviewing SPL holders who were available in commercial fishing docks and fish houses but who had not been previously contacted (following Milon et al., 1997). The survey effort ended on the first week of November 2007, and the field session lasted a total of four months.

Response rates were generally low, due to many fishers not being reachable (where they were left various messages but never responded). The overall response rate, including wrong and disconnected numbers, unavailability, and refusals, was 15.5%; that is, 193 fishers participated from a total of 1,247 SPL holders contacted. Overall, data collectors contacted 89.1% of the 1,398 SPL holders in the SEFCRI region. However, despite low response rates, the completion of 193 SPL holder surveys yielded a higher total than projected due to data collectors being able to over-sample counties where fishers requested to participate or where several fishers were surveyed using the field intercept approach.

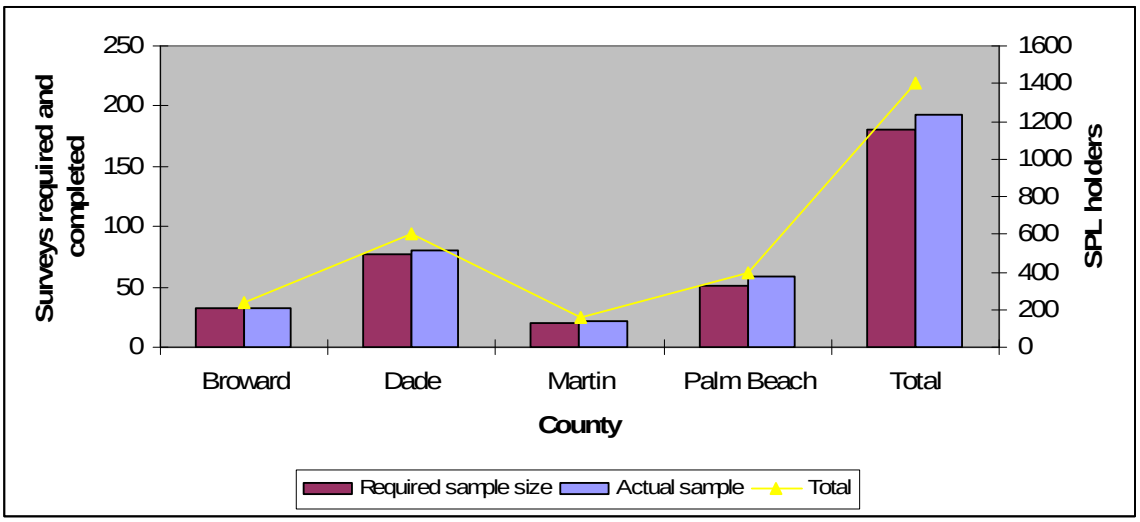

Figure4: Commercial fisher sample size and total population

As shown in Figure 4, Miami-Dade County, which represents 42.8% of the SPL holders in the SEFCRI region, accounted for 81 of the 193 surveys (42.0% of the sample); the projected total for the county was 77 surveys, and the study over-sampled the region by four surveys. Palm Beach County (28.5% of the SPL holders in the region) accounted for 59 surveys (30.6%), and the study over-sampled the region by eight surveys. Broward County contains 17.2% of the region's commercial fishers, and it accounted for 32 surveys (16.5%), which was the projected total. Finally, Martin County accounts for the smallest percentage of commercial fishers in the four-county study area (11.4%), and it accounted for 21 surveys (10.9%) of the total sample, and the study over-sampled the region by one survey.

Results

The results of the survey are presented in the order of the questions as these were provided to the participants (a copy of the survey is available in Appendix I of this report). Also, county-specific results are shown where relevant.

Socio-demographic information

The average response by fishers to their age group was 3.26 (n = 189; SD = 1.21), on a scale from 1 (less than 18 years old) to 5 (over 60 years old), or just over 41-50 years. Only 26.2% of the sample was 40 years or younger, and 40.8% of the commercial fishers were 51 years or older. Overall, 70.2% of the sample was non-Hispanic, 27.7% was of Cuban descent, and 2.1% was non-Cuban Hispanic. In Miami-Dade County, Hispanic fishers (58.6%) outnumbered non-Hispanic (41.4%) fishers; in all other counties, Hispanic fishers represented the minority. Also, 95.3% of the sample identified itself as 'White', with very few, other races being represented. This is consistent with the findings with commercial fishers in the adjacent Florida Keys, where the major differences are observed between ethnicity (Hispanic vs. non-Hispanic) and not race (Milon et al., 1997).

With respect to family members, fishers supported an average of 2.55 (n = 188; SD = 1.35) persons, including themselves. This may be due to the low level of personal income derived from commercial fishing, which accounted for an average of 60.2% (n = 184; SD = 38.9) in the sample.

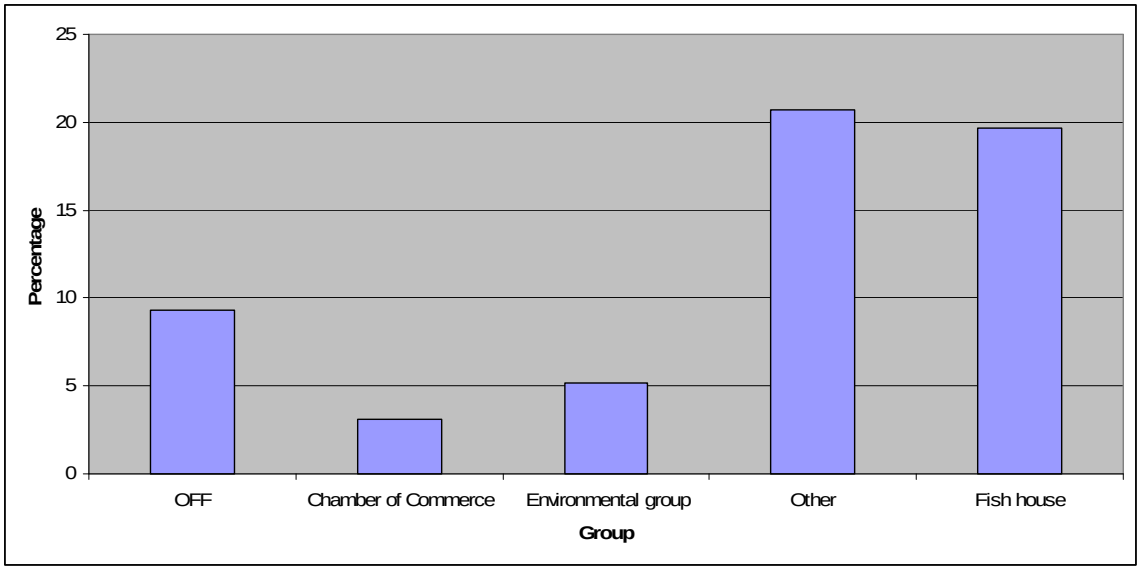

Figure 5: Commercial fisher affiliation in fishery and other organizations and groups (n = 193)

As shown in Figure 5, less than a fifth of the sample reported being affiliated with a particular group; overall, 56.5% of the fishers were not affiliated with any group. Levels of affiliation in traditional, commercial fishery-type organizations or groups were especially low, as shown by the less than 10% of the entire sample who reported being members of the Organized Fishermen of Florida (OFF) and 19.9% who were part of a fish house (rates of fish house affiliation were highest in Miami-Dade County (35%) and did not exceed 10% in any of the other counties). Compared to the Florida Keys, where such group affiliation rates are much higher (Shivlani et al., 2004; Milon et al., 1997), the results suggest a less cohesive commercial fishery network in the SEFCRI region. This

may be in part due to the lower number of fish houses in the region, especially north of the Miami River in Miami-Dade county, but it may also result from the diversified nature of the fishery participants, where less than half of the respondents (49.0%) identified themselves as full-time, commercial fishers. Another 28.9% identified themselves as part-time, commercial fishers. Over 14% (14.2%) were charter fishers who hold SPLs to be able to sell their part of their landings. Finally, another 7.9% were recreational fishers who have SPLs to catch certain species over their recreational limits.

Respondents listed various ports per county that they utilize as primary ports, but the most popular ports were Miami (13%), Fort Lauderdale (11%), Miami River (10.9%), Jupiter (10.4%), Port Salerno (8.8%), and Dinner Key (5.7%). Clearly, the frequency at which ports were identified was directly related to the number of fishers interviewed within the county in which the ports are located. Also, 37.3% of the sample listed a secondary port, showing that over a third of the fishers changed ports during a fishing year. Secondary port use was highest in Broward County (59%), followed by Martin County (52%) and Palm Beach County (43%); by contrast, only over 21% of Miami-Dade County fishers used a secondary port. While most of the respondents identified secondary ports within the same county, 20% of these fishers listed ports in the Florida Keys (including Key Largo, Islamorada, and Key West). Also, 16% of the sample, predominantly from Broward County, listed Miami as a secondary port.

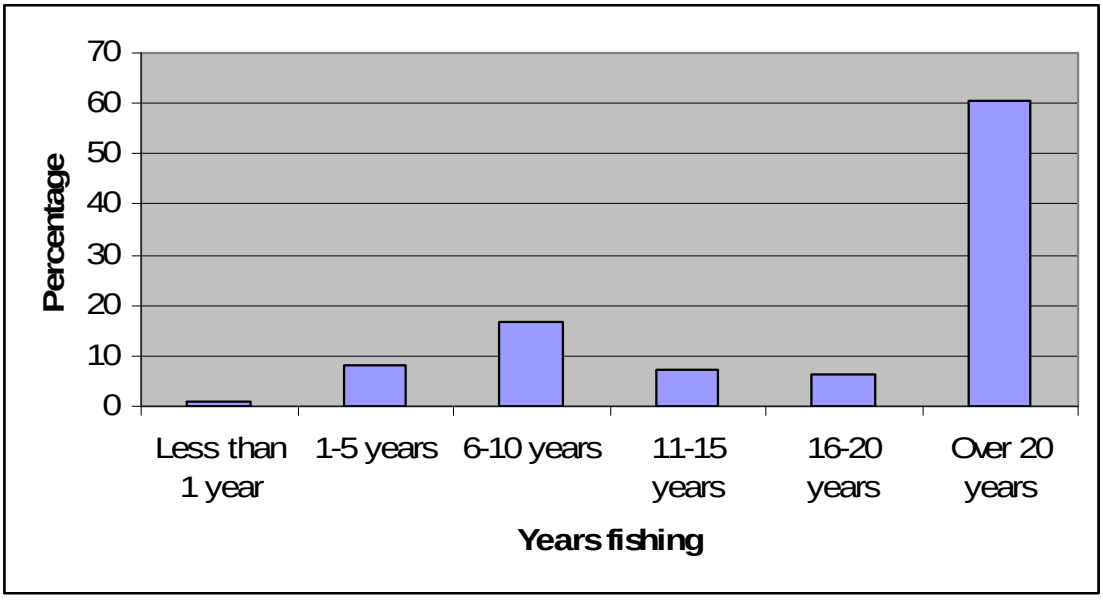

Figure 6: Years fishing in the SEFCRI region (n = 189)

Finally, fishers stated how long they had been fishing commercially in southeast Florida, as shown in Figure 6. The mean score for tenure in the industry was 4.91 (SD = 1.50), on a scale where 1 is less than one year and 6 is greater than 20 years, or between 16-20 years. However, a majority of the respondents, or 61%, had been fishing commercial in the region for over 20 years, and only 9% had five years or less of experience. As with other, established fisheries in the region (Shivlani et al., 2004; Leeworthy and Wiley, 2000), the participants in the southeast Florida fishing industry

appear to choose fishing as a profession at an early age and are generally experienced (and thus knowledgeable about fishery resources and related issues explored in the study).

Economic and catch information

Fishers were asked to provide basic economic information on their operations, including the costs of their primary investments (i.e. vessels, gear) and annual operating costs. Table 1 below presents the average costs across the fisheries in the region.

Table 1: Economic investments and costs per operation among SEFCRI area commercial fishers

Item	*Average number (standard deviation in parenthesis)*	*Average cost in 2005 (standard deviation in parenthesis)*
INVESTMENTS		
1. Vessel	1.25 (0.67) n = 161	$83,605.70 (131,581.40) n = 32
2. Traps	1,789.30 (2,719.7) n = 32	$79,936.70 (261,064.21) n = 32
3. Other gear		$10,933.44 (19,874.18) n = 80
OPERATING COSTS		
4. Docking fees		$4,140.22 (4540.25) n = 102
5. Interest payments		$6,600.00 (6,627.22) n = 8
6. P&I insurance on vessel/crew		$4,703.98 (7,146.60) n = 60
7. Vessel maintenance/repair		$6,234.89 (10,266.19) n = 141
8. Gear maintenance/repair		$2,840.34 (3,421.60) n = 95
9. Other costs		$825.63 (1,306.76) n = 135
INCOME		
10. Personal income derived from fishing		60.2% (38.9) n = 184
11. Household income derived from fishing		57.1% (38.6) n = 183

As shown in Table 1, the principal investment for the fishers was their vessel, with an average replacement cost of $83,600; however, there was considerable variation across the fishery, which included roller shrimp trawlers, offshore charter vessels, small

nearshore vessels, and recreational watercraft. Just over 16% of the fishers reported having traps (spiny lobster, stone crab, or blue crab traps), and the average number held was 1,789. The average number of traps held also showed a high variation across respondents, with some fishers holding less than 10 traps and others fishing several thousand traps. Finally, the sample identified various types of other gear, including nets, rods and reels, and hydraulic lines, among others. As with costs across the fishery in other investments, other gear costs varied, with the average approximating $11,000.

In terms of operating expenses, the most common cost in 2005 was that reported for vessel maintenance and repair (average = $6,235). Fewer fishers listed docking fees (as several fishers, including those that use more than one port, trailer their vessels), gear maintenance and repair costs, and interest payments, and insurance fees. Among the other costs, the most common of these listed across the sample was that of licenses, trap certificates, and other endorsements' fees.

Finally, as described previously, fishers' annual personal incomes from commercial fishing averaged just over 60% of their total income. Thus, for many respondents, commercial fishing did not represent the only means of income, and that percentage decreased to an average of 57.1% when it related to total household income. Thus, unlike in other fisheries where fishing communities strongly rely on commercial fishing as a primary income generator[2], the SEFCRI commercial fishery is one where economic gains from commercial fishing for a majority of its exponents may represent supplementary income.

[2] For example, Thomas J. Murray & Associates (2005b) reported an average personal income of 91.8% derived from commercial fishing in the Tortugas fishery in the western Florida Keys. Similar, Agar et al. (2005) found that US Caribbean trap fishers are highly dependent on commercial fishing for most of their household income.

Table 2: SEFRCI area commercial fishery landings and effort and changes in landings and effort over time

Species	Landings	Trips	Change in landings	Change in trips	Change in size	Targeted (%)
1. Stone crab	1,673.4 (1716) n = 16	30.5 (20.3) n = 17	-13.6 (23.1) n = 22	20.6 (96.8) n = 22	-2.8 (12.3) n = 23	5.2/5.2
2. Spiny lobster	4,954.7 (6,710.9 n = 43	121.7 (236.3) n = 47	-19.7 (33.6) n = 49	21.9 (159.5) n = 53	-0.3 (19.9) n = 52	14.4/14.0
3. Shrimp		194.9 (141.2) n = 31	-13.4 (32.6) n = 31	2.9 (24.1) n = 31	-5.8 (18.2) n = 30	10.9/10.9
4. Reef fish	3,395.3 (5,614.5 n = 47	43.4 (49.3) n = 48	-12.1 (34.6) n = 51	-5.7 (33.6) n = 54	-1.8 (12.7) n = 55	15.0/15.5
5. King mackerel	10,587.0 (19893.2) n = 70	73.7 (86.2) n = 68	9.1 (46.6) n = 69	-5.1 (31.5) n = 73	-1.1 (11.5) n = 73	11.4/10.4
6. Spanish mackerel	19,191.2 (32,949.1) n = 61	56.9 (66.3) n = 59	8.2 (37.3) n = 61	-0.5 (33.3) n = 59	2.1 (324.3) n = 60	2.6/2.1
7. Baitfish		85.2 (90.0) n = 42	2.7 (27.2) n = 42	-2.4 (25.1) n = 44	0.0 (0.0) n = 45	6.7/7.8
8. Dolphin	1,787.7 (2,887.7) n = 56	31.4 (39.8) n = 56	-11.4 (37.2) n = 57	-1.7 (31.9) n = 62	-1.6 (13.2) n = 62	4.7/5.2
9. Wahoo	235.6 (298.4) n = 28	14.5 (23.1) n = 28	-5.6 (39.6) n = 29	-3.1 (30.7) n = 31	-2.1 (10.5) n = 31	0.5/0.5
10. Tuna	530.8 (1,341.4) n = 20	10.2 (10.3) n = 20	-12.5 (33.6) n = 16	-5.0 (31.1) n = 18	0.0 (3.4) n = 18	1.6/1.6
11. Sharks	9494.0 (23,200.0) n = 18	42.1 (48.6) n = 18	-0.8 (21.0) n = 18	-1.2 (12.6) n = 21	3.0 (11.3) n = 20	0.5/0.5
12. Swordfish	950.9 (1706.7) n = 11	12.9 (13.9) n = 12	16.7 (20.6) n = 9	2.5 (9.7) n = 12	3.3 (4.9) n = 12	2.6/1.6
13. Marlin		18.4 (18.0) n = 5	-11.3 (7.7) n = 8	-11.3 (24.7) n = 8	-1.4 (3.8) n = 7	0.5/0.5
14. Sailfish		57.9 (63.4) n = 16	13.5 (36.6) n = 20	-2.8 (21.1) n = 20	0.5 (5.1) n = 20	0.0/0.0

- all statistics represent mean totals, and standard deviations are provided in parentheses.

Table 2 above shows landings, trips, and changes in species sizes and fishing patterns, as reported by the sample. The species most often listed by the respondents that they fished in 2005 (according to the fishers reporting trips) was king mackerel, followed by Spanish mackerel, dolphin, reef fish, spiny lobster, bait fish, and shrimp. Less than 15% listed any other species, showing the importance of the above listed commercial fisheries.

Also, it is important to note that almost all the species listed have undergone a decline in landings, as perceived by the fishers. The only species whose stocks were perceived to have improved since the respondents started fishing are king mackerel, Spanish mackerel, swordfish, and sailfish. Interestingly, the only species for which effort increased as a result of lowered landings were invertebrates (stone crab, spiny lobster, and shrimp). For fin fish, fishers generally reported decreasing effort as landings shifted (with the exception of swordfish, for which effort increased with higher landings). This may be a result of the nature of the invertebrate fisheries, which may not afford substitutability, and due to the high, fixed gear costs (e.g. traps and trap certificates) in the stone crab and spiny lobster fisheries. Finally, the results suggest that fishers generally perceive declines in the sizes of target species since they first started fishing, suggesting that along with a general decline in most species' landings, there is agreement that most species are also now smaller than they used to be.

Table 3: SEFCRI area commercial fishing trip costs

Species	Fuel/oil	Ice	Bait	Food/supplies	Other	Crew
1. Stone crab (n = 26)	101.5 (47.2)	6.53 (11.20)	68.84 (73.56)	16.15 (20.57)	2.69 (10.41)	1.96 (0.45)
2. Spiny lobster (n = 56)	103.75 (93.73)	10.85 (13.18)	30.0 (48.04)	21.25 (21.37)	4.82 (30.03)	1.79 (0.62)
3. Shrimp (n = 36)	84.58 (42.40)	7.64 (10.07)	4.86 (13.17)	27.64 (43.10)	1.39 (8.33)	1.58 (0.50)
4. Reef fish (n = 56)	115.35 (115.01)	13.26 (40.16)	28.44 (40.89)	41.61 (62.09)	4.12 (29.17)	1.33 (0.66)
5. King mackerel (n = 84)	118.81 (105.28)	7.31 (11.91)	18.52 (29.43)	35.71 (47.63)	3.57 (24.61)	1.50 (0.69)
6. Spanish mackerel (n = 74)	114.64 (112.19)	7.81 (11.57)	15.09 (29.16)	36.42 (49.52	50.61 (28.50)	1.62 (0.82)
7. Baitfish (n = 52)	110.44 (123.02)	16.62 (45.66)	14.04 (26.64)	28.94 (36.43)	4.33 (30.50)	1.67 (0.81)
8. Dolphin (n = 70)	163.07 (249.52)	10.06 (25.39)	48.11 (238.47)	50.43 (103.04)	3.71 (26.45)	1.46 (0.76)
9. Wahoo (n = 33)	210.15 (342.60)	13.36 (35.21)	86.36 (345.69)	78.64 (144.23)	1.21 (5.00)	1.33 (0.82)
10. Tuna (n = 20)	245.25 (440.00)	23.05 (47.76)	125.60 (442.94)	84.10 (175.58)	0.0 (0.0)	1.20 (0.95)
11. Sharks (n = 24)	198.75 (404.08)	16.71 (40.68)	105.42 (404.95)	62.50 (158.68)	0.83 (4.08)	1.67 (1.05)
12. Swordfish (n = 13)	337.69 (519.91)	35.38 (53.17)	198.46 (542.15)	103.46 (211.21)	0.0 (0.0)	1.77 (0.93)
13. Marlin (n = 8)	211.25 (191.72)	13.13 (13.87)	20.00 (22.04)	30.63 (34.27)	27.5 (77.78)	1.63 (0.52)
14. Sailfish (n = 21)	128.1 (134.6)	9.52 (11.61)	20.71 (21.52)	27.38 (24.22)	10.48 (48.01)	1.67 (0.48)

- all statistics represent mean totals, and standard deviations are provided in parentheses.

Fishers also provided cost information by species. As shown in the Table 3 above, costs were highest for pelagic species (although the costs in these trips varied considerably due to differences in costs by vessel, as many of these respondents were charter fishers holding an SPL) and invertebrate trap fisheries (namely spiny lobster and stone crab). Also, trap fisheries had the highest average number of crew; that is, stone crab trips included an average of 1.96 persons (or a captain and a mate), compared to 1.79 persons per trip on a spiny lobster trip, 1.77 persons per trip on a swordfish trip, and 1.33 persons per trip on a reef fish trip. Generally, operations other than trap or offshore fishing involved fewer crew members; this was in part due to the need for more crew members to pull fixed gear such as traps or to have on board as mates for a charter trip. With other finfish trips involving species that were landed mainly for commercial sale purposes, costs were minimized by reducing (or eliminating) crew members.

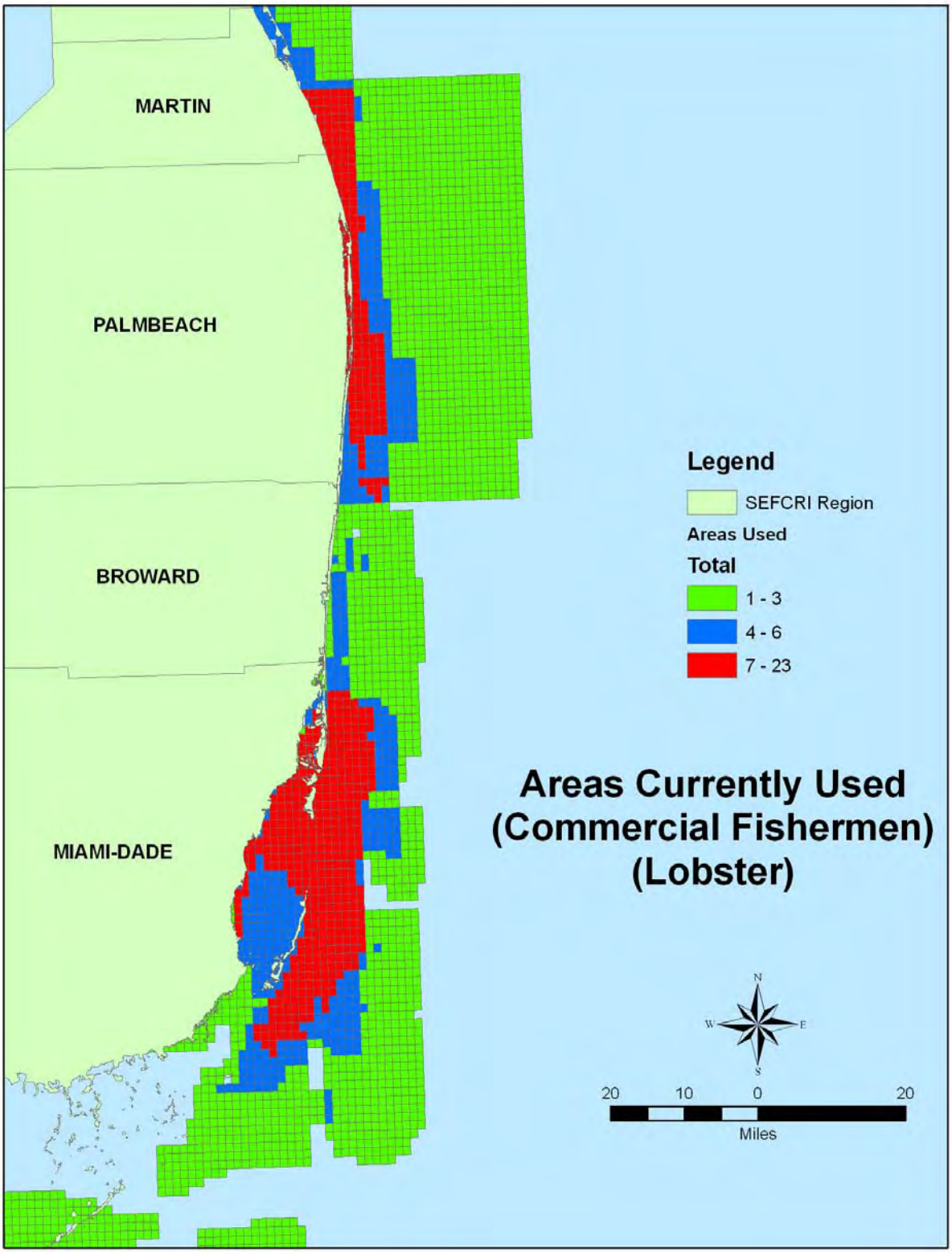

Figure 7: Lobster fishing trips – present (total refers to number of respondents)

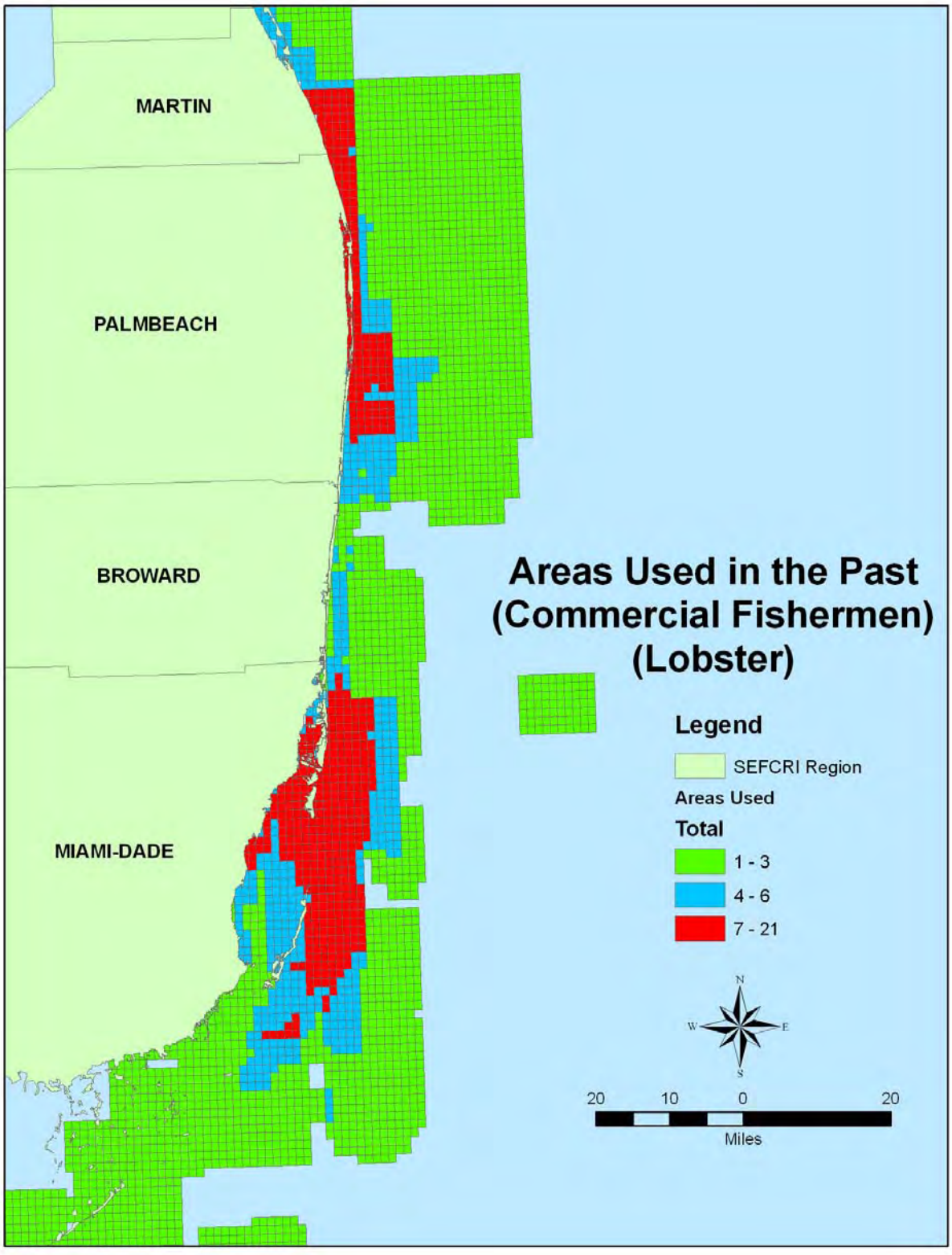

Figure 8: Lobster fishing trips – past (total refers to number of respondents)

As shown in Figures 7 and 8, spiny lobster fishing is focused mainly close to the shore in all counties and effort is highest in the southern section of the SEFCRI area, extending into Biscayne Bay and southeast towards the Florida Keys. Spiny lobster fishing utilizes traps as a primary gear, with lobster diving becoming more popular since the passage of the Spiny Lobster Trap Certificate Program in the early 1990s (Shivlani et al., 2005). Thus, the maps show a distribution of effort where both trap and dive gear are used in the south with dive gear dominating effort in the north. In fact, 87.5% of the 32 fishers who owned traps were located in Miami-Dade County (the remainder were in Broward County), and these fishers accounted for 99.8% of all traps reported by the sample. Landings have not shifted much since the past, most likely due to the abundance profiles of spiny lobster in the region, which prefer the shallow habitats off the SEFCRI counties. Finally, it must be noted that a few respondents erroneously identified the Biscayne Bay Lobster Sanctuary as a fishing area (please refer to the map of the sanctuary provided in the Biscayne National Park website, available on the Internet via: www.nps.gov/archive/bisc/lobster.htm); this does not mean that fishers used and continue to use the closed area and is more likely a result of their not correctly identifying the area.

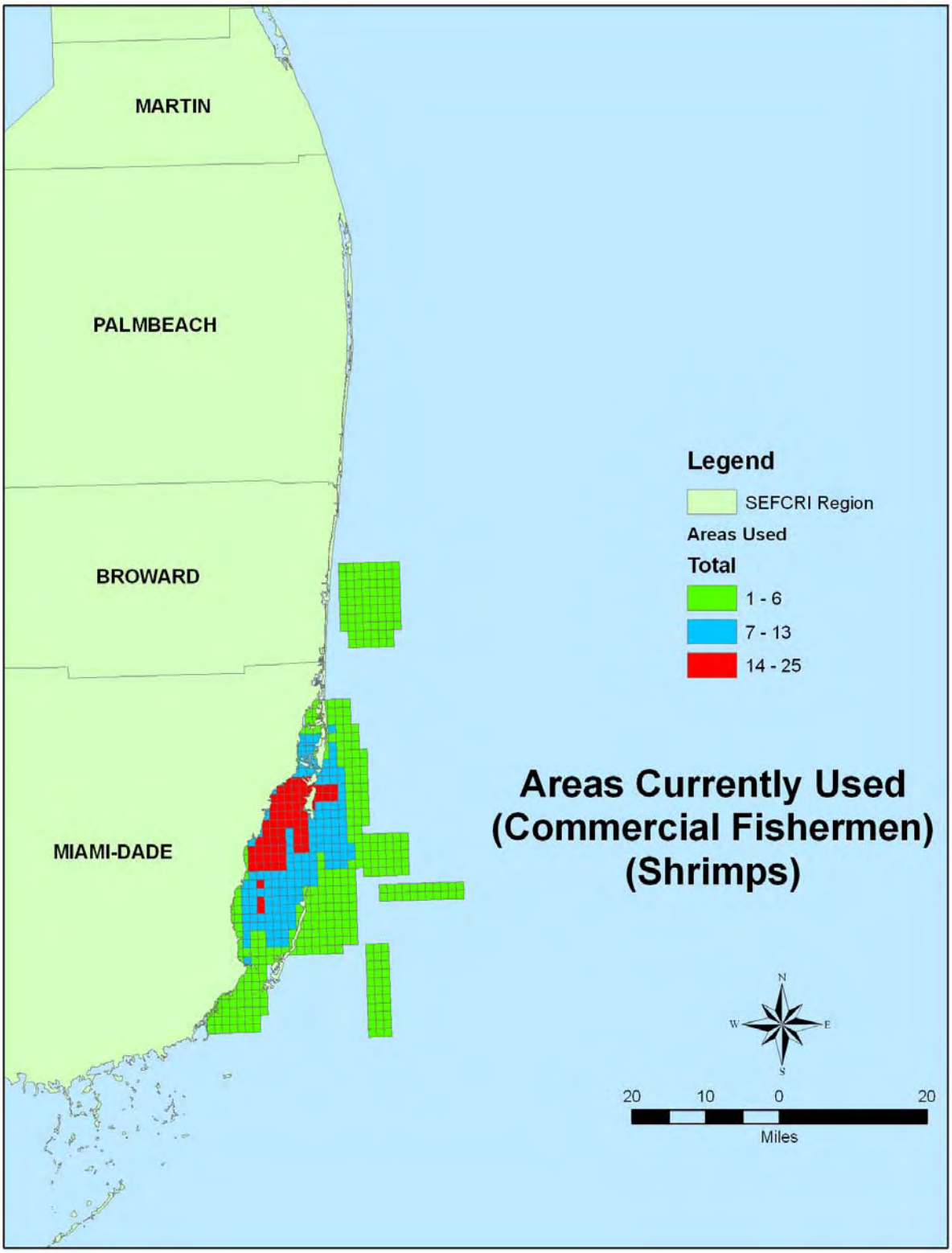

Figure 9: Shrimp fishing trips – present (total refers to number of respondents)

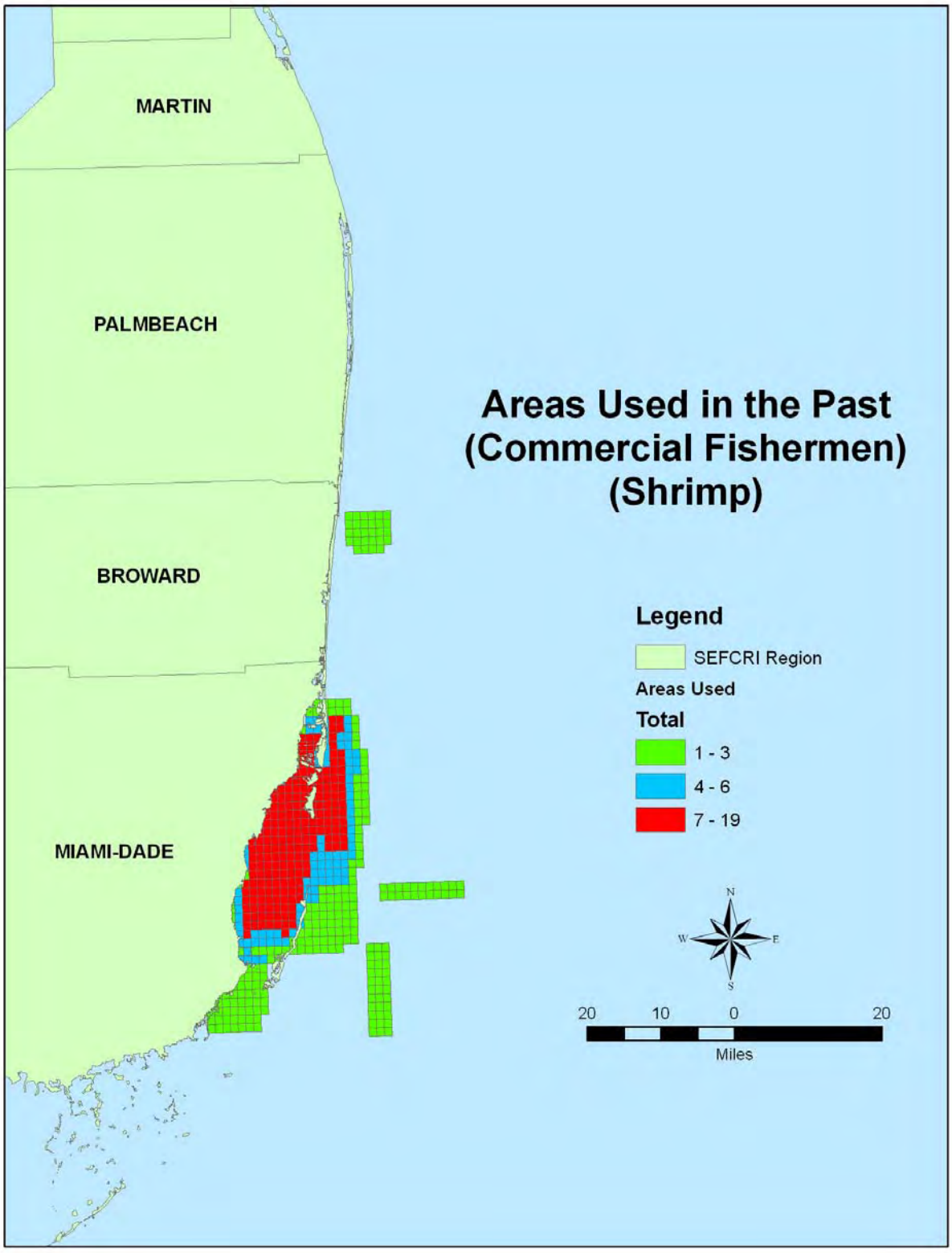

Figure 10: Shrimp fishing trips – past (total refers to number of respondents)

The shrimp fishing maps (Figures 9 and 10) show little difference in fishing effort form the past to the present. Also, 83.4% of the effort originated from Miami-Dade County, where fishers accounted for 97.7% of all reported shrimp trips. There are two main shrimp fisheries in the southeast Florida and both are located mainly in Miami-Dade County: a roller-frame bait shrimp fishery and a wingnet food shrimp fishery (EDAW, 2005; Ault et al., 1997). Fishing effort from both fisheries is highly localized, with a majority of trips being taken within southern Biscayne Bay, and it is consistent between years, as shown in the past and present use maps for the species.

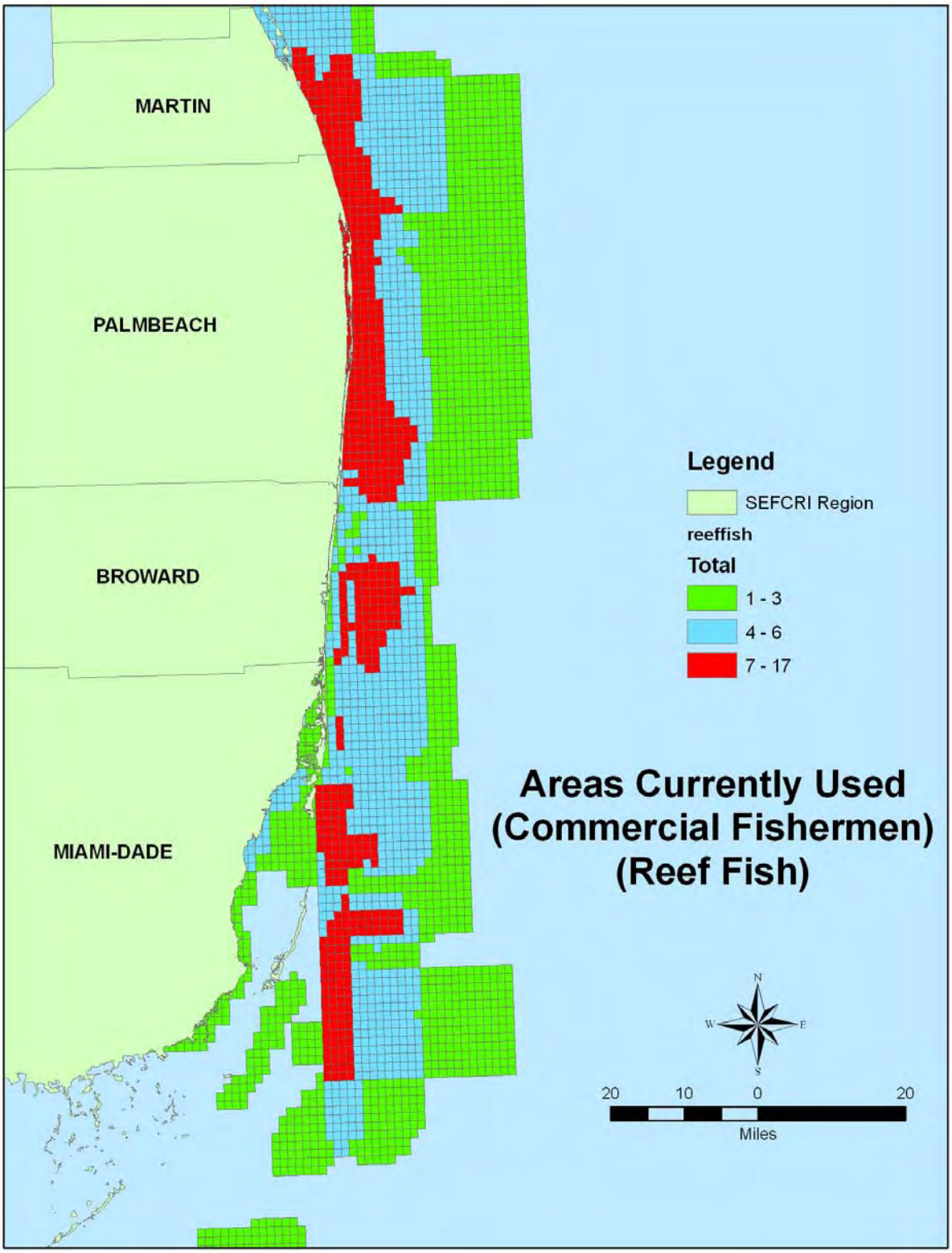

Figure 11: Reef fish fishing trips – present (total refers to number of respondents)

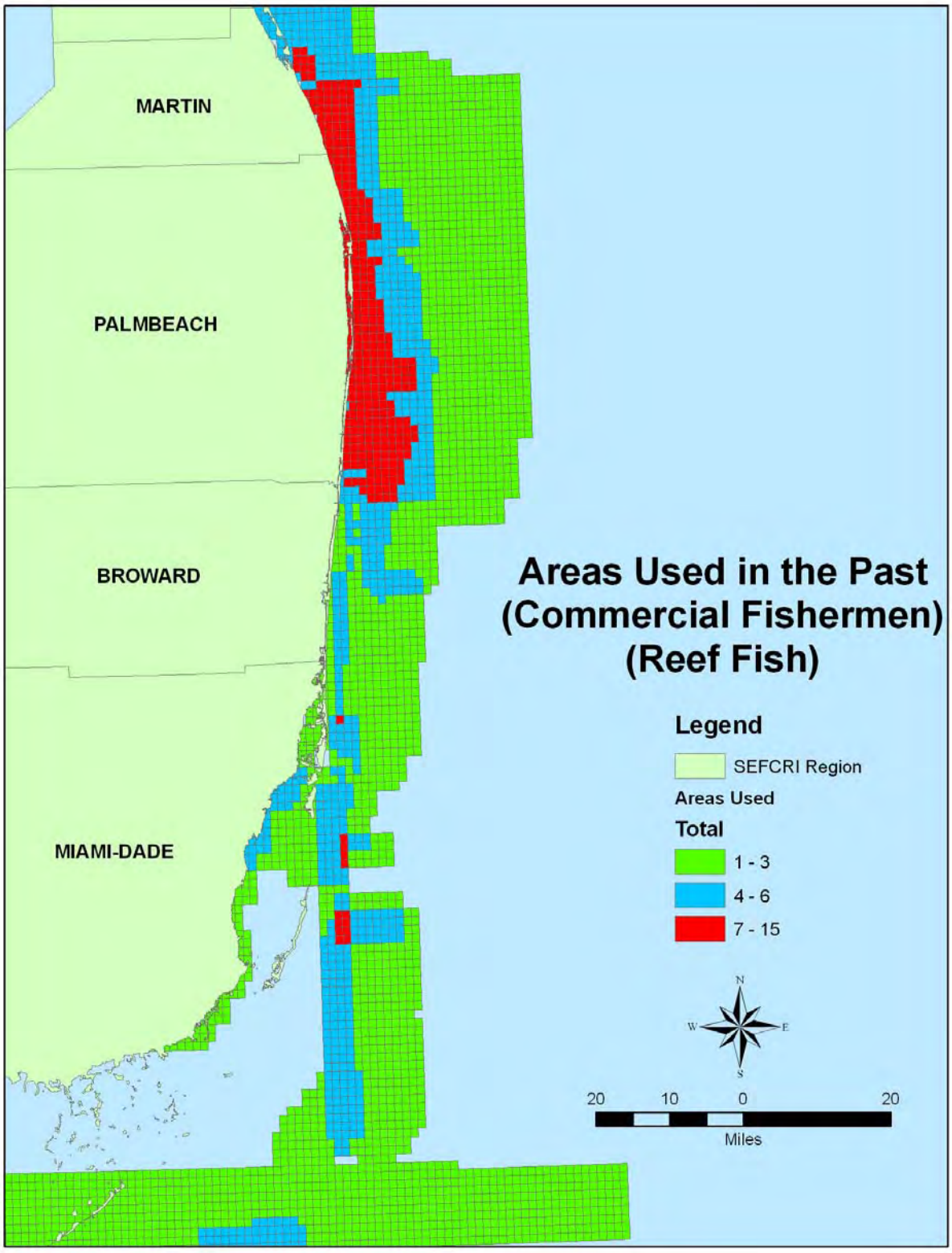

Figure 12: Reef fish fishing trips – past (total refers to number of respondents)

As shown in Figures 11 and 12, reef fish fishing trips were and continue to be taken across the SEFCRI region, with effort concentrated close to the shore, especially off the northern counties. It also appears the reef fishing trips have increased off Broward County and in parts of Miami-Dade County, with fewer trips taken in the Florida Keys. However, the maps do not show effort being shifted further from shore, suggesting that commercial fishers have perhaps been limited by reef fish habitats and have thus concentrated effort in the same areas throughout their tenure. In terms of participation, most of the fishers reporting trips were from Miami-Dade (39.6%) and Palm Beach Counties (35.4%). Fewer fishers were from Broward (18.8%) and Martin Counties (6.3%). Reef fish fishers made up less than 30% of the total fisher sample in all four counties, with participation being highest in Palm Beach County (28.8% of the total sample), followed by Broward County (28.1% of the total sample), Miami-Dade County (23.5% of the total sample), and Martin County (14.3% of the total sample). Thus, unlike species such as spiny lobster or

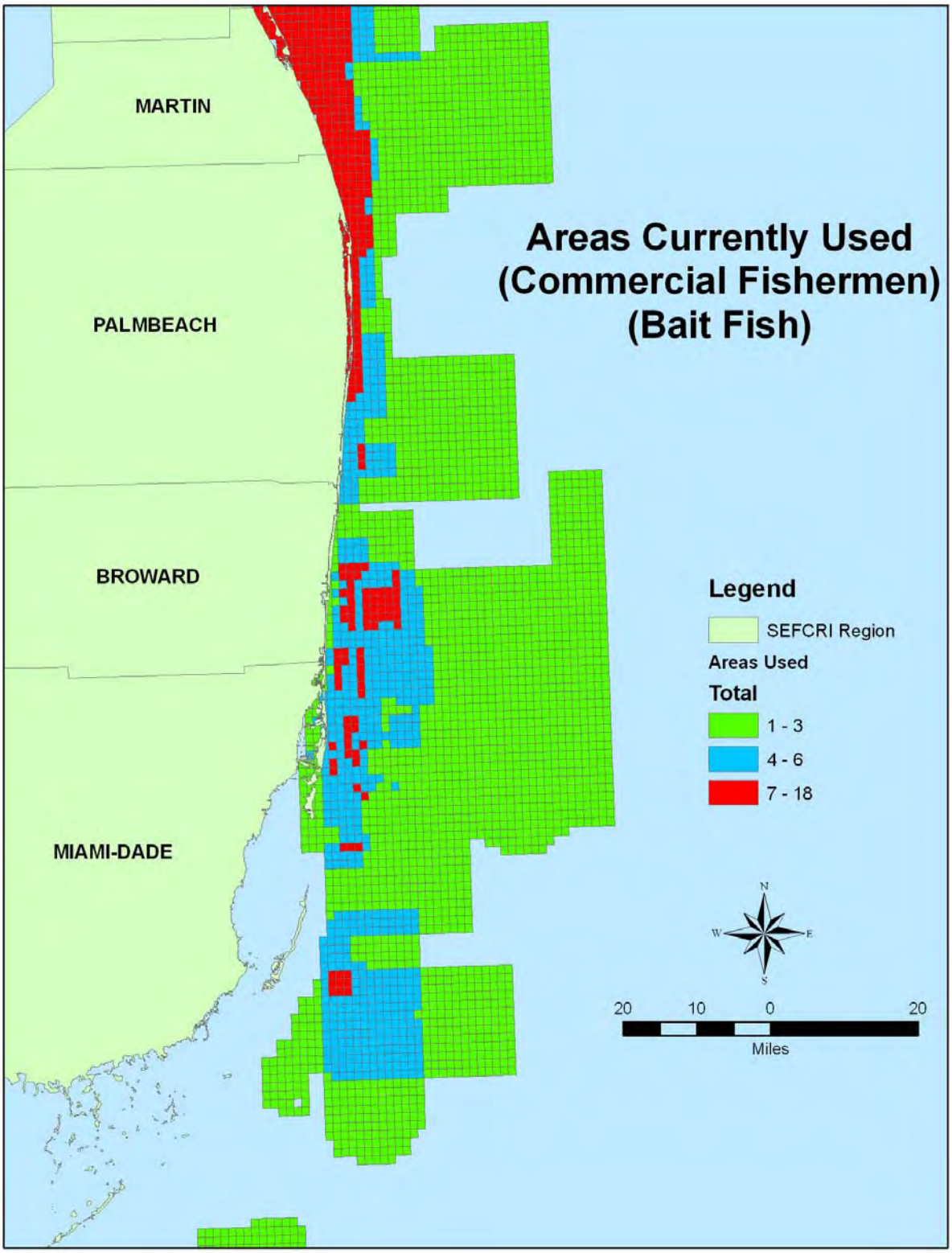

Figure 13: Bait fish fishing trips – present (total refers to number of respondents)

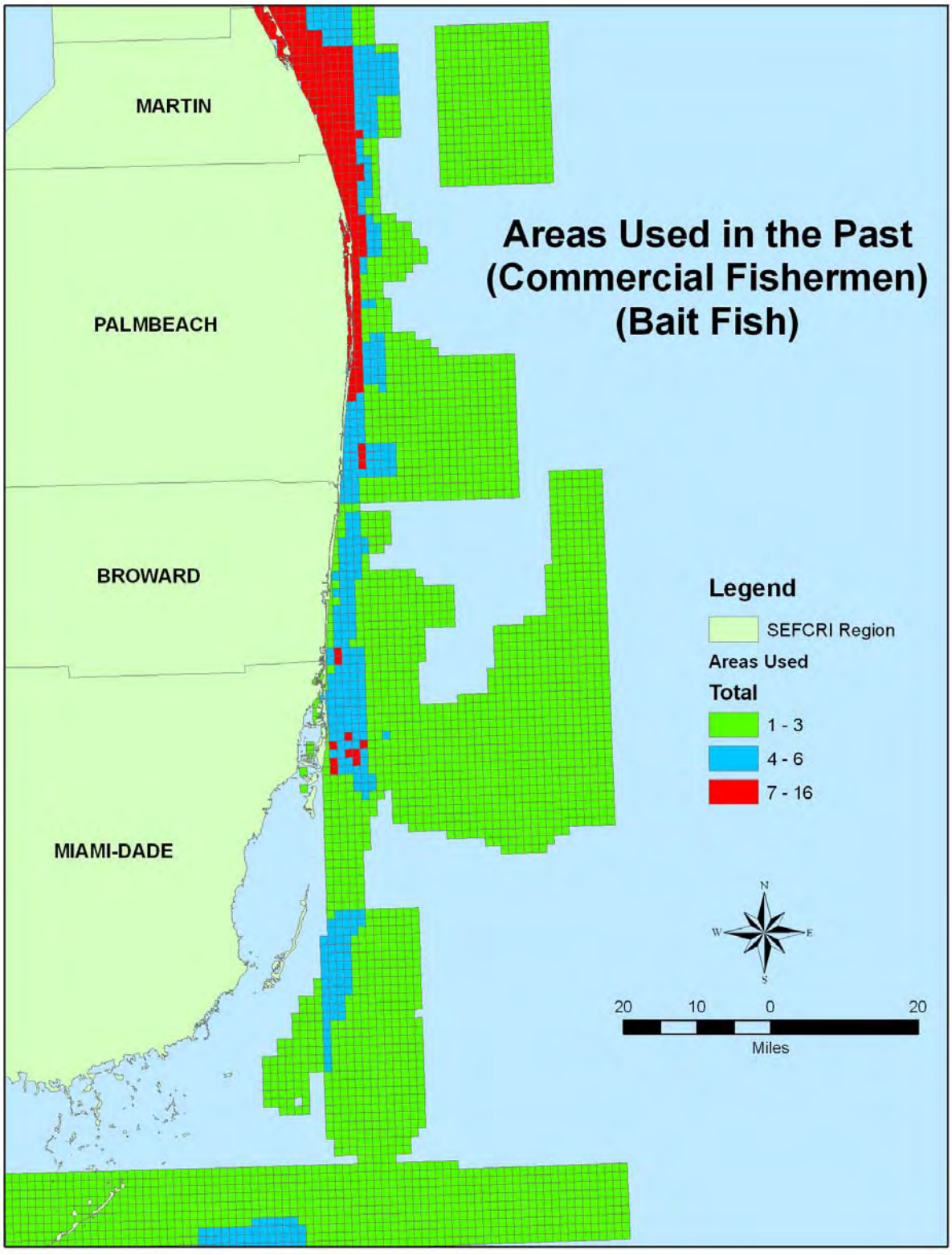

Figure 14: Bait fish fishing trips – past (total refers to number of respondents)

In terms of bait fish effort in the SEFCRI region, Figures 13 and 14 show that trips have focused in both the past and present in discrete areas in Miami-Dade and Broward Counties and more generally from the shoreline in shallow water in Palm Beach and Marine Counties. There has been a slight shift in that certain fishers reported targeting bait fish in the Upper Florida Keys in the past but no longer do so. Also, effort appears to have increased in parts off Broward County. However, as is the case with many of the other species, the results suggest that commercial fishers have focused on habitats important to bait fish and therefore not significantly changed their fishing areas. Overall, most of the respondents who reported bait fishing trips were from Palm Beach County (40.5%), with both Broward and Miami-Dade Counties contributing 21.4% each, and 16.7% from Martin County. Few fishers from Miami-Dade County, or 11.1%, were bait fish fishers, compared to 28.1% of Broward County fishers, 28.8% of Palm Beach County fishers, and 33.3% of Martin County fishers.

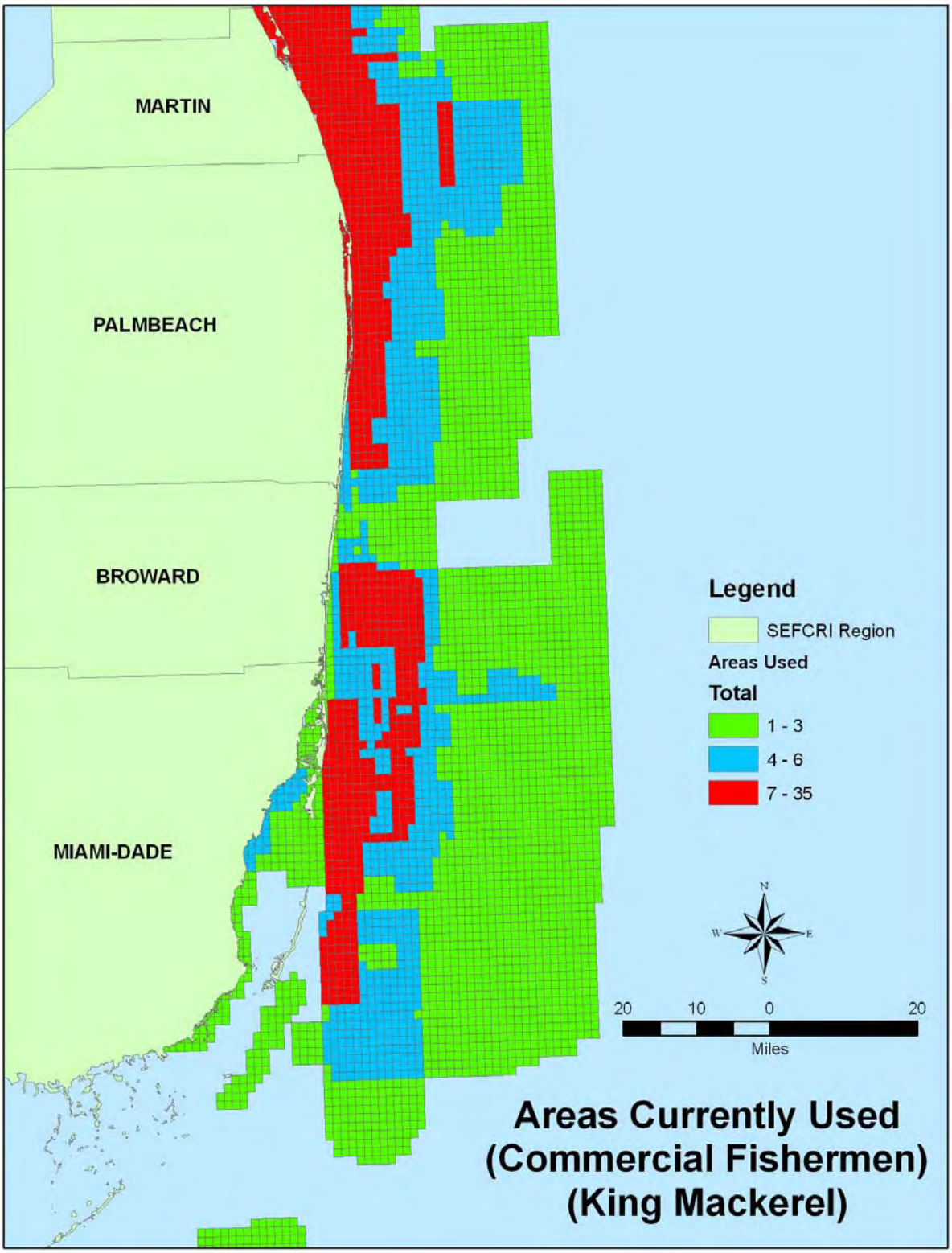

Figure 15: King mackerel fishing trips – present (total refers to number of respondents)

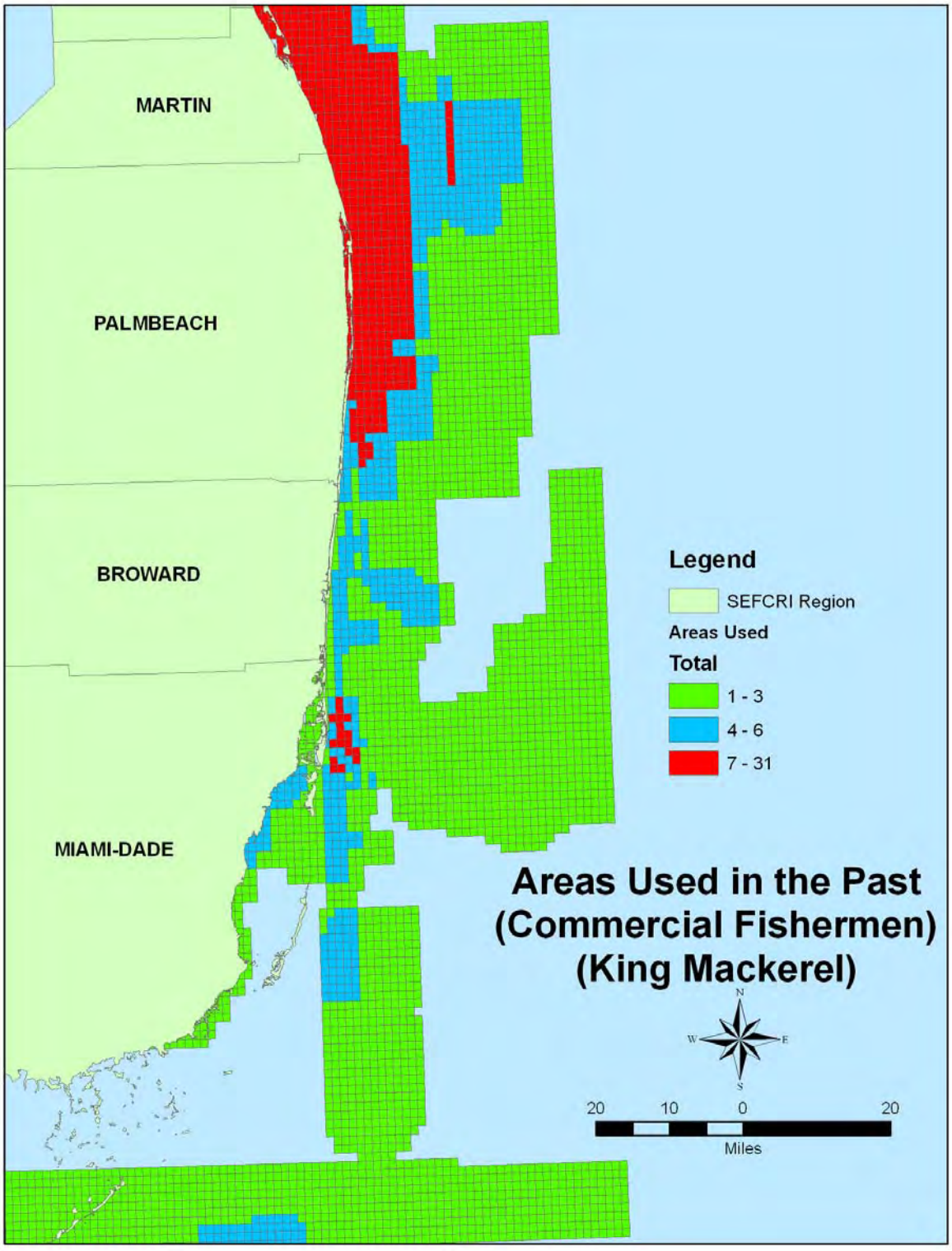

Figure 16: King mackerel fishing trips – past (total refers to number of respondents)

King mackerel fishing effort, as shown in Figures 15 and 16, increased considerably within the Miami-Dade and southern Broward Counties from the past to present, creating an almost continuous band of effort paralleling the SEFCRI counties' shoreline. Effort for king mackerel was located close to shore in both past and present maps for Palm Beach and Martin Counties, whereas such effort increased in the southern counties in the present map. The overall distribution of effort in both maps shows the overall importance of the coastal pelagic species. Over half (52.4%) of Martin County fishers interviewed reported king mackerel landings, followed by 47.6% of Palm Beach County fishers, and 31.3% of Broward County fishers. While the species was least important in Miami-Dade County, as measured by the number of participants, over a fifth of that county's sample (23.5%) targeted king mackerel.

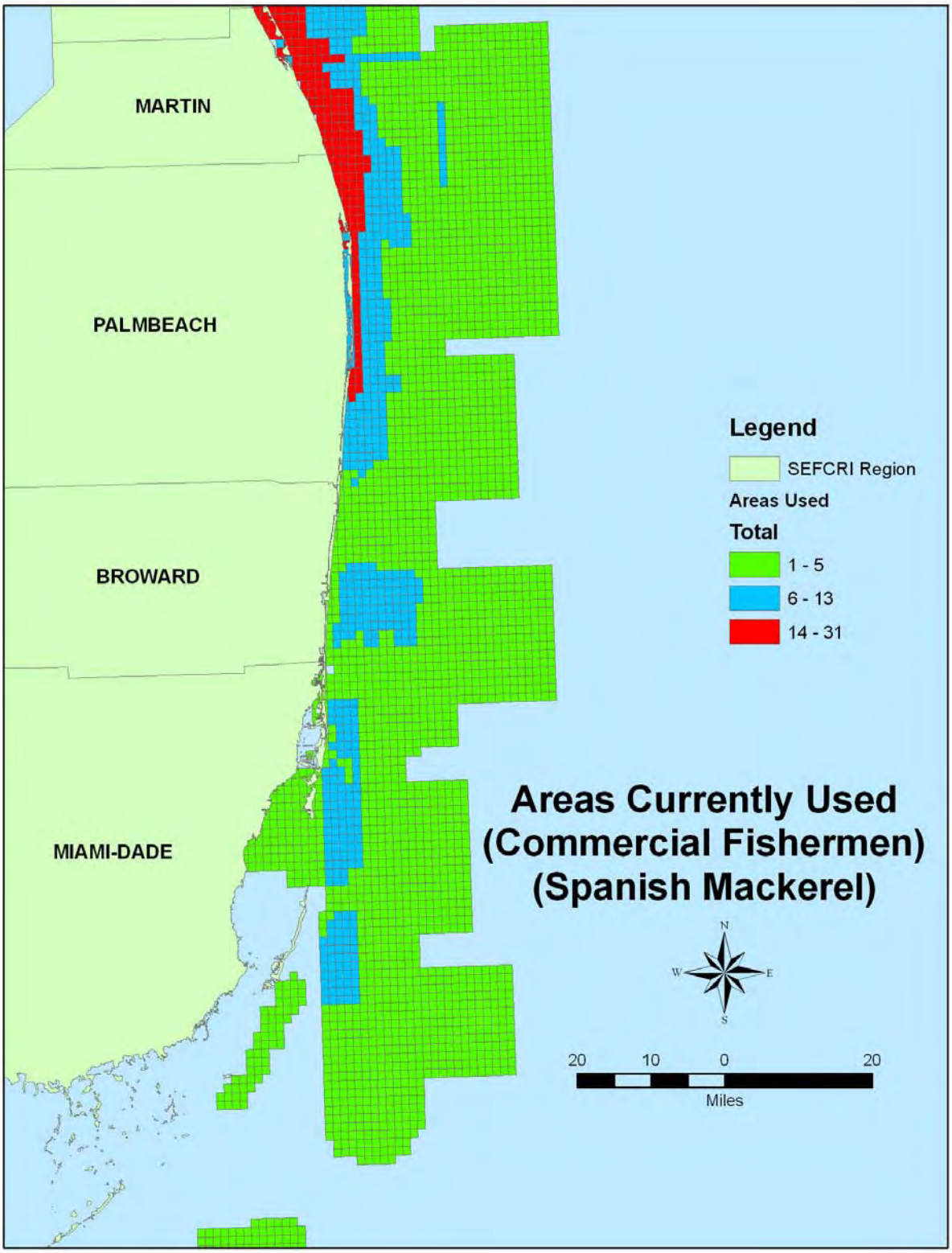

Figure 17: Spanish mackerel fishing trips – present (total refers to number of respondents)

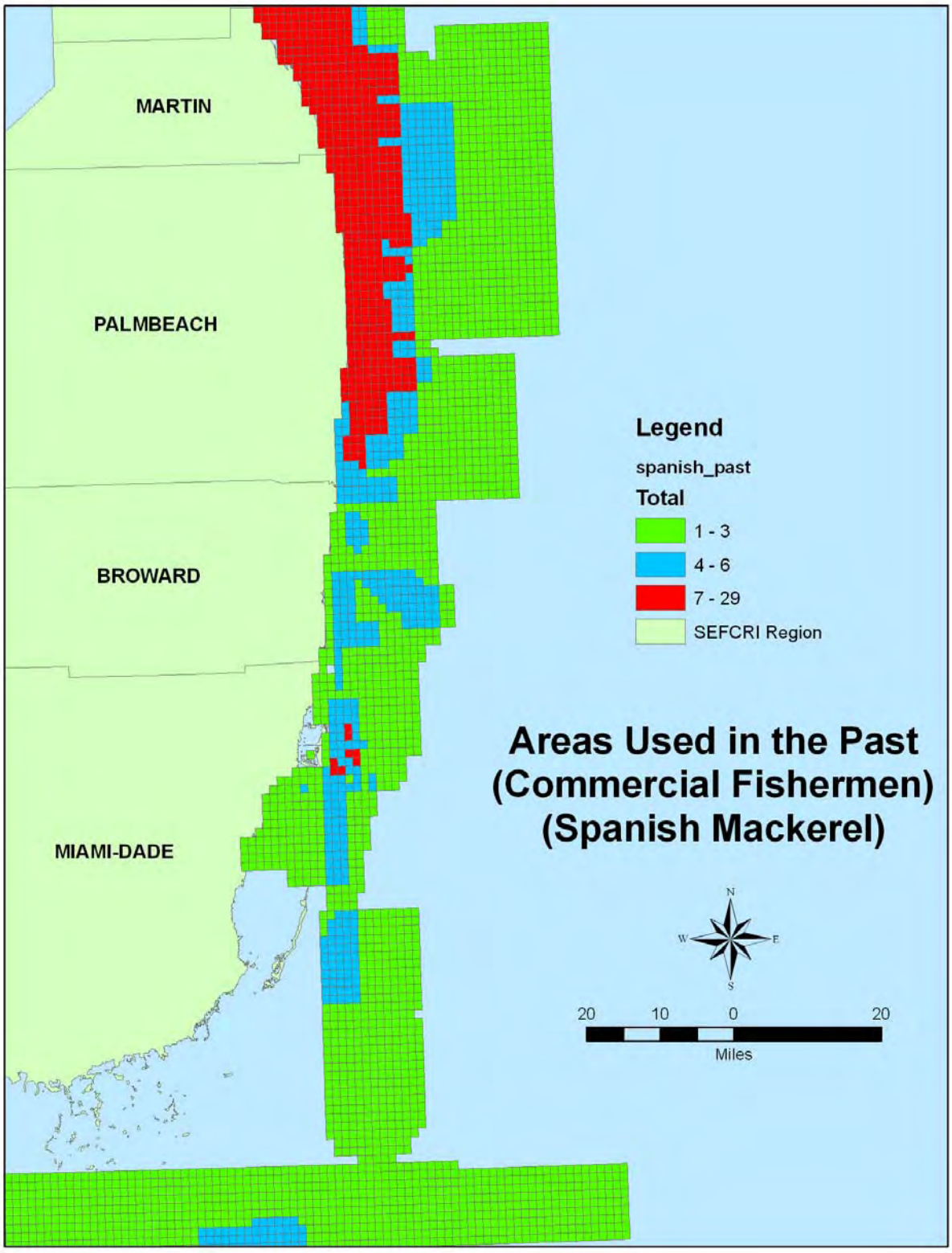

Figure 18: Spanish mackerel fishing trips – past (total refers to number of respondents)

Spanish mackerel and king mackerel comprise an important coastal pelagic species complex that has been targeted across the SEFCRI region and namely in the northern counties. The maps in Figures 17 and 18 show the importance of Spanish mackerel to Palm Beach County and Martin County fishers, who accounted for 39% and 23.7% of the total participants in the sample. More importantly, however, 71.4% of Martin County fishers interviewed reported landing Spanish mackerel, compared 39% of Palm Beach County fishers, 21.9% of Broward County fishers, and only 17.3% of Miami-Dade County fishers. The maps also show that the fishery has moved closer to shore in Palm Beach and Martin Counties but has remained largely unchanged off Broward and Miami-Dade Counties.

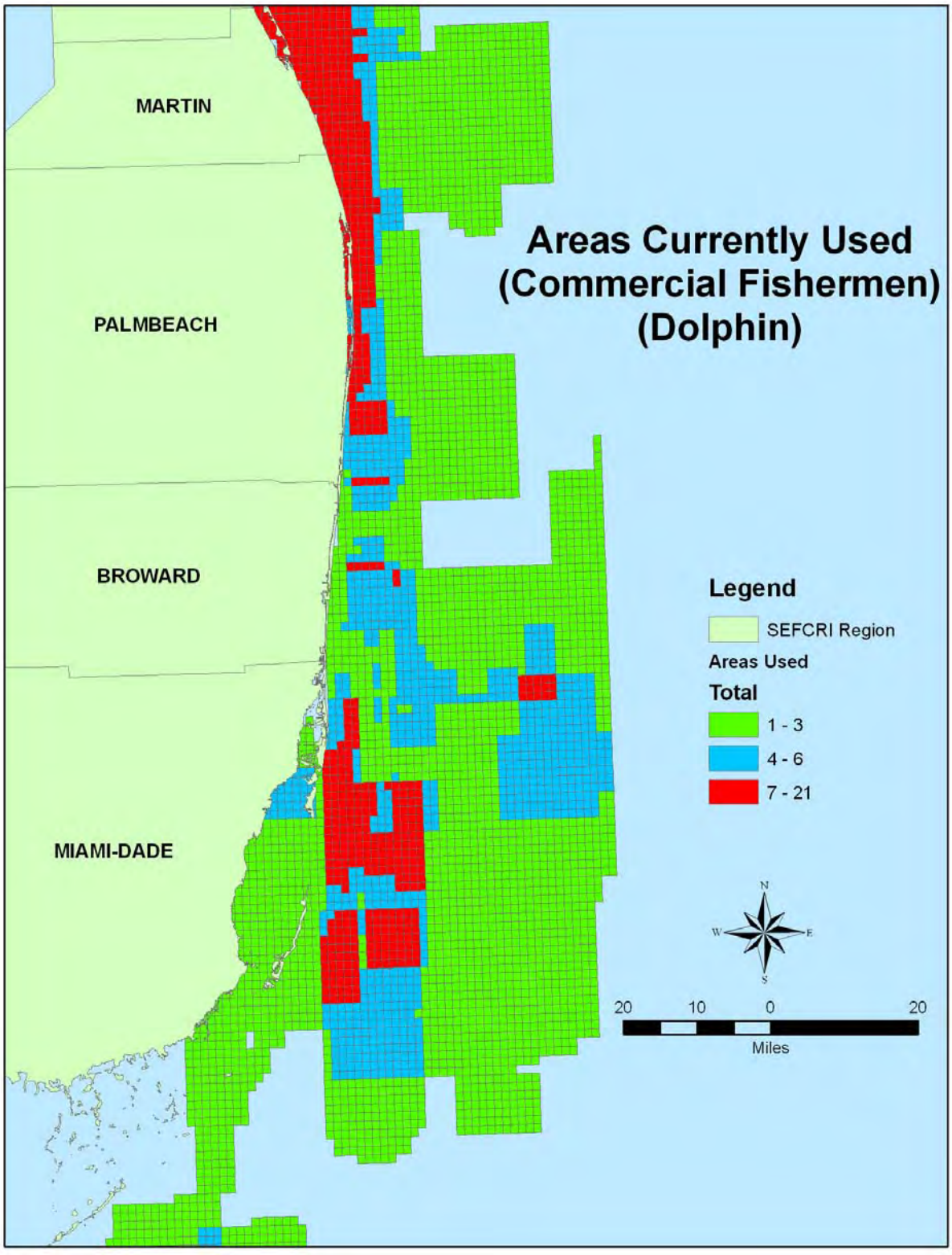

Figure 19: Dolphin fishing trips – present (total refers to number of respondents)

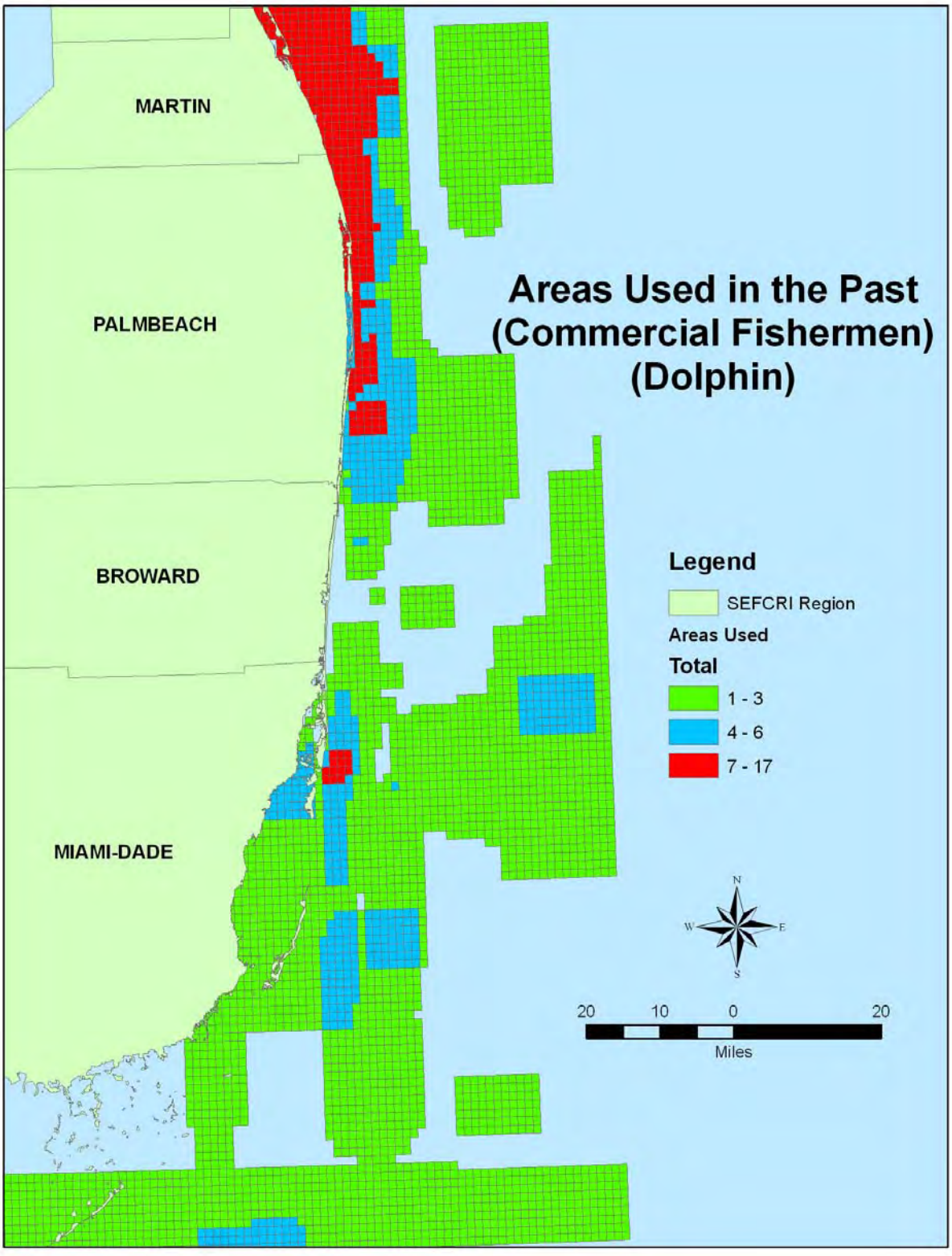

Figure 20: Dolphin fishing trips – past (total refers to number of respondents)

Dolphin fishing trips represented the most important pelagic species trips taken by the fishers interviewed, as measured by the number of participants in the fishery. Figures 19 and 20 show that while effort remained mostly unchanged in the northern counties, Miami-Dade fishers increased effort in the offshore areas off Biscayne Bay south towards the Upper Florida Keys. In terms of county-level participation, 39.3% of the dolphin fishers were from Palm Beach County, 28.6% from Miami Dade County, 17.9% from Broward County, and 14.3% from Martin County. When viewed in terms of relative importance of the fishery to the county, dolphin accounted for less than a fifth of the Miami-Dade County fisher sample (19.8%), becoming more important in Broward (31.3% of the fisher sample), Palm Beach (37.3% of the fisher sample), and Martin Counties (38.1% of the fisher sample). These results emphasize the relative importance of finfish species in the northern three counties compared to Miami-Dade County, which shares key target species in common with the southern Monroe County, especially the invertebrate fisheries of shrimp, spiny lobster, and stone crab.

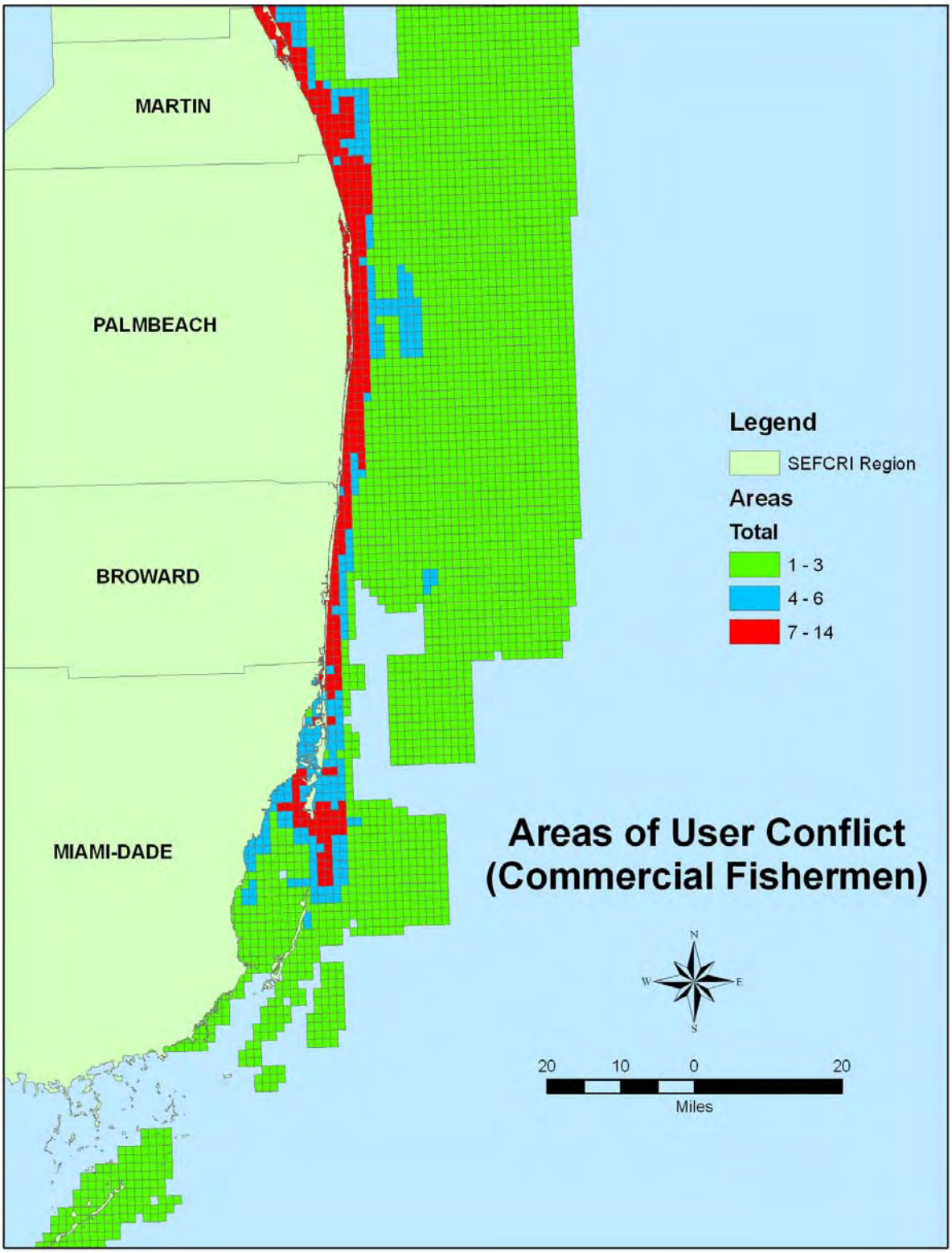

Figure 21: Commercial fishers' areas of use conflict (total refers to number of respondents)

As shown in Figure 21, commercial fishers identified nearshore areas as the areas the present the highest amount of conflict. This pattern was consistent across all four counties, with the number of respondents reporting conflicts dissipating as a function of distance from the shoreline.

Perceptions

The respondents provided their views on use conflicts, resource trends, threats facing coral reefs and related resources.

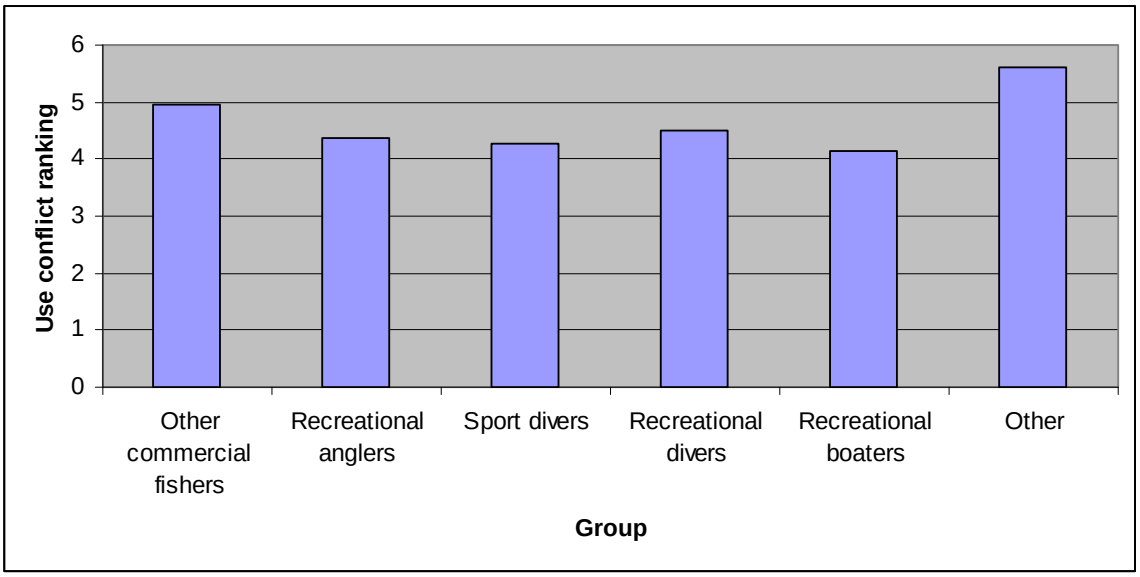

Figure 22: Views on use conflicts (n = 191)

In terms of use conflicts, commercial fishers ranked recreational boaters as presenting the greatest conflict (mean rank = 4.15 out of 6.0, where 1 represents the greatest conflict and 6 represents the least conflict; SD = 2.04), followed by sport, or consumptive, divers (mean rank = 4.27; SD = 2.06), recreational anglers (4.37; SD = 1.98), and recreational, nonconsumptive divers (mean rank = 4.49; SD = 2.00) (see Figure 22). Other user groups, which mainly consisted of personal watercraft, part-time commercial fishers, and charter fishing operations, did not represent a significant conflict, ranking last at 5.62 (SD = 1.32). Finally, commercial fishers did not consider their own group posing a conflict, as other commercial fishers ranked 4.97 (SD = 1.72); thus, while respondents argued that recreational uses all presented approximately the same amount of conflict, their own group presented a significantly lower use conflict compared to the recreational uses (Kruskal Wallis test: $H = 15.03$; $p < 0.005$).

The rankings were further enforced by fishers' views on the level of conflict presented by recreational anglers, divers, and boaters. On average, commercial fishers were neutral in their views on recreational anglers (mean = 3.26 out of 5.0, where 1 represents strong agreement that the group poses a conflict, and 5 represents strong disagreement that the group poses a conflict; SD = 1.51), recreational divers (mean = 3.21; SD = 1.59), and recreational boaters (mean = 3.16; SD = 1.65). An average of 36.5% of the respondents agreed that the three recreational groups posed a conflict, and 42.5% disagreed.

Finally, commercial fishers were asked to identify any other groups that were not listed but which conflict with their use. Most identified personal watercraft and charter or part-time fishers; respondents believed that the former group often does not respect their activities by riding at high velocities near their fishing areas, whereas the latter group competes with commercial fishers in the marketplace by selling fishery products at the same locations (but having the added economic advantage of being able to take out clients).

When asked about coral reef conditions, commercial fishers tended to lean towards a mean perception that coral reef ecosystems in southeast Florida had declined (mean = 3.51 out of 5, where 1 is significantly better, and 5 is significantly worse). Moreover, only 18.7% believed that coral reef conditions had improved, compared to 47.1% who believed that such conditions had worsened. Also, 63.2% of the total sample agreed that coral reef conditions had changed since when they first started fishing in southeast Florida.

Table 4: Commercial fishers' perceptions on coral reef decline in the SEFCRI region

Reason for coral reef decline	% identifying (n = 193)
1. Algae	9.09
2. Anchoring/boating	8.26
3. Dredging	4.96
4. Fisheries	12.4
5. Freshwater input	10.7
6. General mortality	4.96
7. Hurricanes	13.2
8. Overpopulation	7.44
9. Pollution	18.2
10. Sedimentation	7.44
11. Sewage	3.31

When asked to identify the reason for coral reef decline, commercial fishers listed a variety of factors that are condensed into the 11 factors listed in Table 4. It should be noted that several of these factors are inter-related, and most respondents did understand and convey that. Over 18% of the commercial fishers identified pollution as the primary cause for coral reef decline. If pollution-related factors, such as freshwater input (which several fishers stated was contaminated with land-based sources of pollution,) and sewage, as well as overpopulation which may exacerbate local inputs, are considered, then almost 40% blamed some form of pollution for the decline of coral reefs in southeast Florida. Interestingly, the second most frequent reason given for coral reef decline was a natural stressor, hurricanes, which 13.2% stated was most responsible for present coral reef conditions. This was followed by overfishing occurring in various fisheries in the region (12.4%), and freshwater input (10.7%). Importantly, less than 2% of the respondents listed coral bleaching (which a few fishers attributed to "warm waters" and which is subsumed under "General mortality" in the table) as a reason for coral reef decline; otherwise, it is clear that according to the commercial fishing industry, the malaise affecting coral reefs in the

region is that which has been identified in recent, scientific literature (Bellwood et al., 2004; Pandolfi et al., 2003).

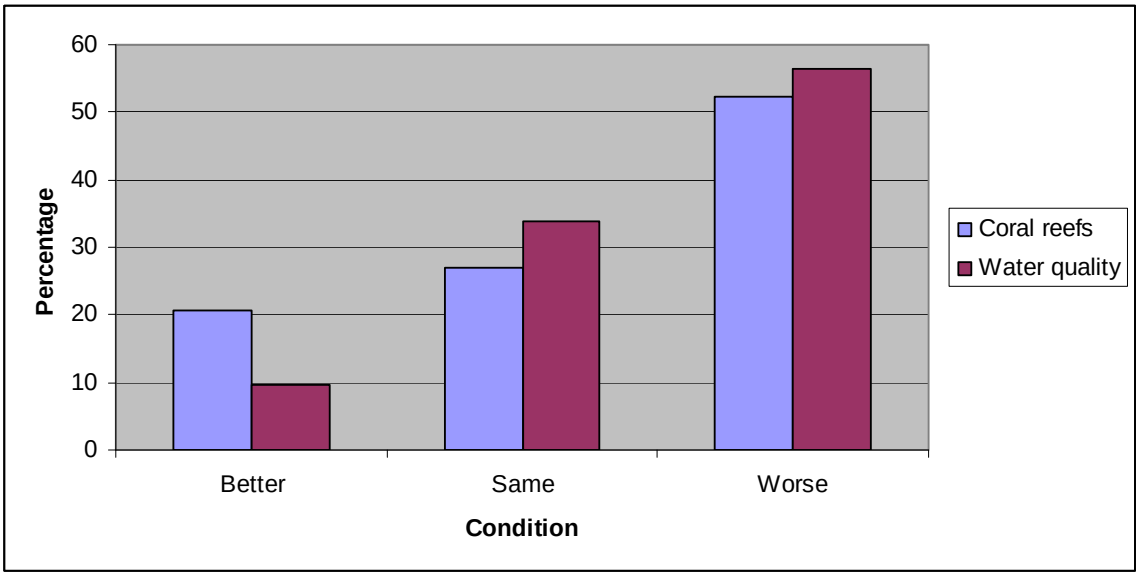

Figure 23: Condition of coral reefs and water quality

While their views on coral reef conditions were somewhat more tempered, in that the mean response was 3.51 (n = 174; SD = 1.17), showing a tendency towards coral reef decline, commercial fishers were less unsure about water quality conditions (Chi-square = 8.93; p = 0.01) (see Figure 23). On average, respondents believed that water quality conditions had become somewhat worse (n = 187; mean = 3.73; SD = 0.99), and 54.4% felt that conditions were either somewhat or significantly worse (and only 9.3% felt otherwise). But, as shown in the figure above, a majority of respondents felt that both coral reefs and water quality have declined since they first started fishing.

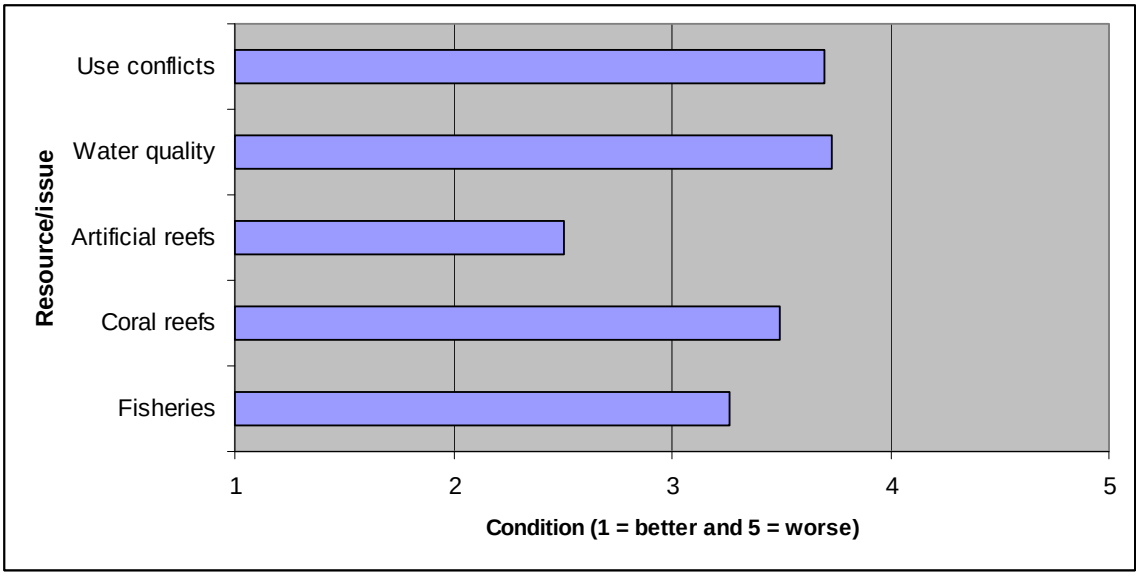

Figure 24: Resource/issue conditions

When asked about trends in resources and issues, which included the previously discussed coral reefs and water quality, the respondents re-stated their previous views, in that water quality (n = 182; mean = 3.73, out of 5, where 1 is better and 5 is worse; SD = 1.05) and coral reefs (n = 167; mean = 3.49; SD = 1.11) both were considered to be in worse condition than previously (see Figure 24). Interestingly, use conflicts (n = 165; mean = 3.70; SD = 1.04) were also perceived as having worsened, which many respondents blamed on the increase in the number of users (and especially uneducated users) in the marine environment. Similarly, the sample believed that, on average, fisheries had slightly worsened (n = 187; mean = 3.28; SD = 1.23), which is significant in that it demonstrates an acknowledgement among the user group that their resources have declined during their tenure; however, it should be noted that respondents rated fisheries as being in a significantly better condition than coral reefs or artificial reefs (Kruskal Wallis test: $H = 12.7$; $p < 0{,}005$). Finally, fishers were generally in favor of artificial reefs, which they ranked significantly higher than all other resources (Kruskal Wallis test: $H = 99.6$; $p = 0.0$) as having improved marine resource conditions, especially fisheries (n = 134; mean = 2.51; SD = 1.02).

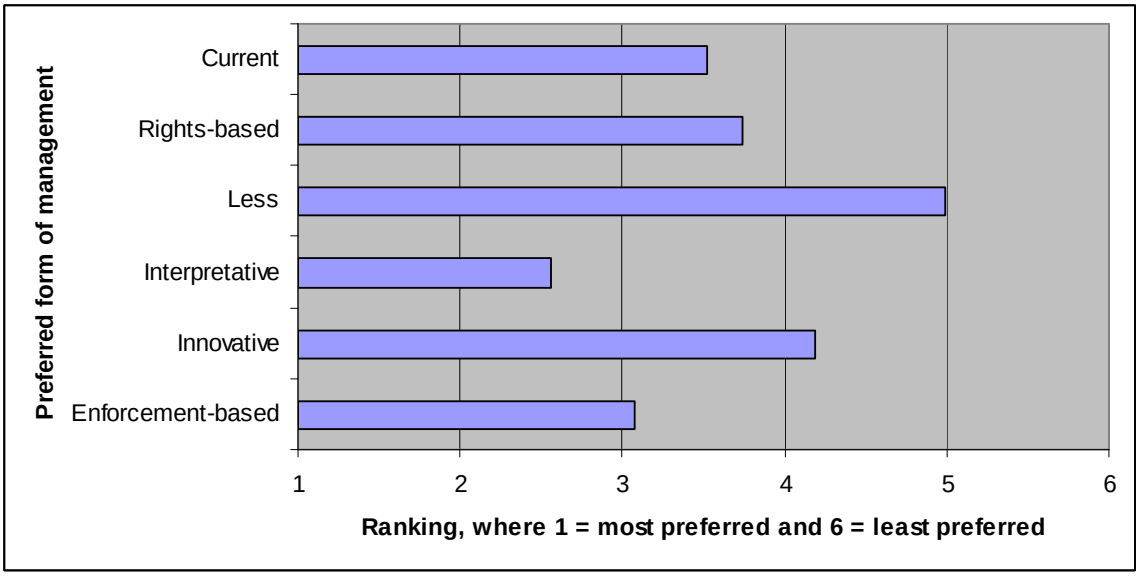

Figure 25: Preferred forms of management

As shown in Figure 25, respondents believed that the best way to remedy resource conditions in the region was by implementing interpretative management (n = 187; mean = 2.56 out of 6, where 1 is the most preferred form of management and 6 is the least preferred form of management; SD = 1.95); no other management type ranked below 3, although enforcement-based management (n = 187; mean = 3.08; SD = 2.07) was also popular among respondents. Fishers were not in favor of having a more open system with less enforcement (n = 187; mean = 4.99; SD = 1.55), and the sample also did not rank innovative forms of management, as exemplified by zoning and marine protected areas, highly (n = 187; mean = 4.19; SD 2.02). In fact, fishers preferred the current form of management (n = 186; mean = 3.52; SD = 1.96) above several other types of management approaches, including rights-based management (n = 185; mean = 3.74; SD = 2.03). Overall, commercial fishers believed that infractions, especially as these relate to the recreational fishing sector, remain a largely unresolved issue in the industry, and that enforcement and interpretation should play strong, dual roles in clamping down on illegal activities and educating novice users. Commercial fishers did not, however, believe that fisheries management should be changed, particularly if that were to include zoning, marine protected areas, or right-based fishing. But, as is clearly shown by the rejection of less management as an alternative management option, commercial fishers are in favor of managing marine resources in southeast Florida.

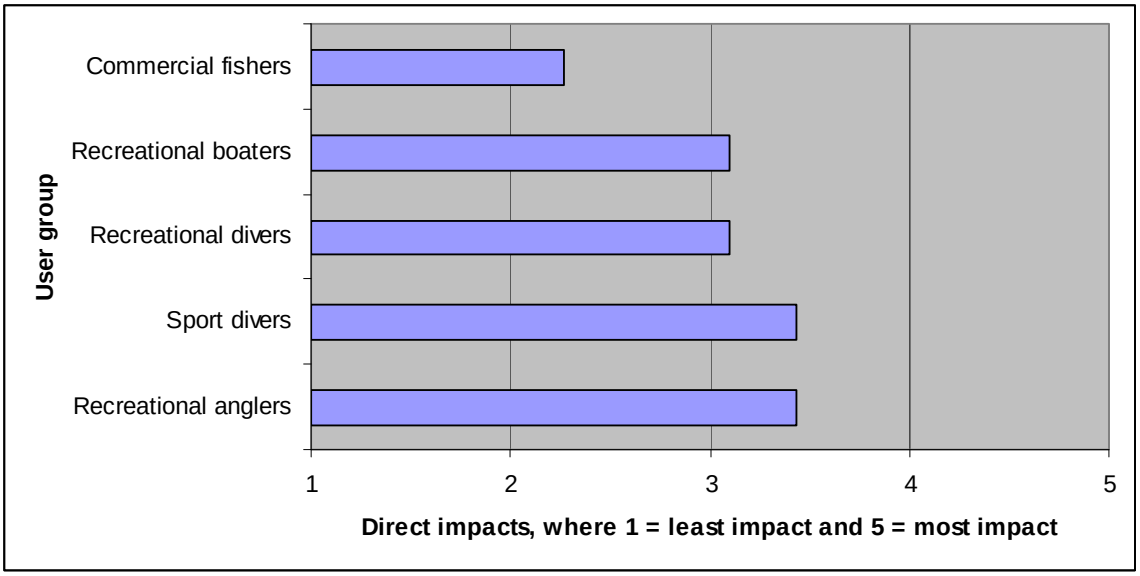

Figure 26: Views on direct impacts by user groups on SEFCRI region coral reefs

When asked about which group has the greatest impact on the region's coral reefs, commercial fishers stated that recreational anglers (n = 175; mean = 3.43, where 1 represents the least impact and 5 represents the most impact; SD = 1.57) and sport divers (n = 174; mean = 3.43; SD = 1.46) were more damaging than were recreational boaters (n = 175; mean = 3.10; SD = 1.55) and recreational divers (n = 174; mean = 3.10; SD = 1.46) (see Figure 26). By contrast, commercial fishers believed that their group had the least impact on coral reefs (n = 177; mean = 2.27; SD = 1.33). These results suggest two major trends in commercial fishers' views on their relationship with coral reef resources: The first is that many fishers perceive not impacting the reef due to the fact that they do not participate in diving and anchoring, both activities that they believe are harmful to coral reefs (even nonconsumptive diving, which many fishers believe leads to anchor-related impacts, damage to corals by touching, and related, recreational effects); the second trend in respondents' views is that commercial fishing is a mostly sustainable activity and as such, coral reef fishes taken from coral reefs via commercial fishing do not adversely impact the coral reef ecosystem.

The indirect impact that are most harmful to SEFCRI region coral reefs, as reported by commercial fishers, is land-based sources of pollution (n = 176; mean = 4.60 out of 5, where 1 is least impactful and 5 is most impactful; SD = 0.93). It should be noted, however, that commercial fishers also identified dredging (n = 175; mean = 4.29; SD = 1.18) and development (n = 170; mean = 4.14; SD = 1.45) as having significant impacts on coral reefs in southeast Florida; but, land-based sources of pollution were considered significantly more impactful than either dredging or development (Kruskal-Wallis test: $H = 6.28$; $p < 0.05$). The only indirect source that respondents did not believe was as threatening as the aforementioned factors is global warming (n = 130; mean = 3.45; SD = 1.56) (Kruskal-Wallis test: $H = 39.6$; $p = 0.0$); also, up to a quarter more fishers ranked threats other than global warming,

suggesting that many fishers either did not consider it a threat or did not understand its potential impacts to be able to answer the question.

Finally, the sample provided information on artificial reefs, in terms of commercial fishers' use of artificial reefs and their views on effects of the structures on fisheries, coral reefs, and use conflicts, among other issues. Overall, over half of the fishers interviewed, or 50.3%, reported using artificial reefs. The average percentage of total trips taken to artificial reefs was 24.2% (n = 85; SD = 21.3), with artificial reef use being highest among Broward County respondents and lowest among Martin County fishers.

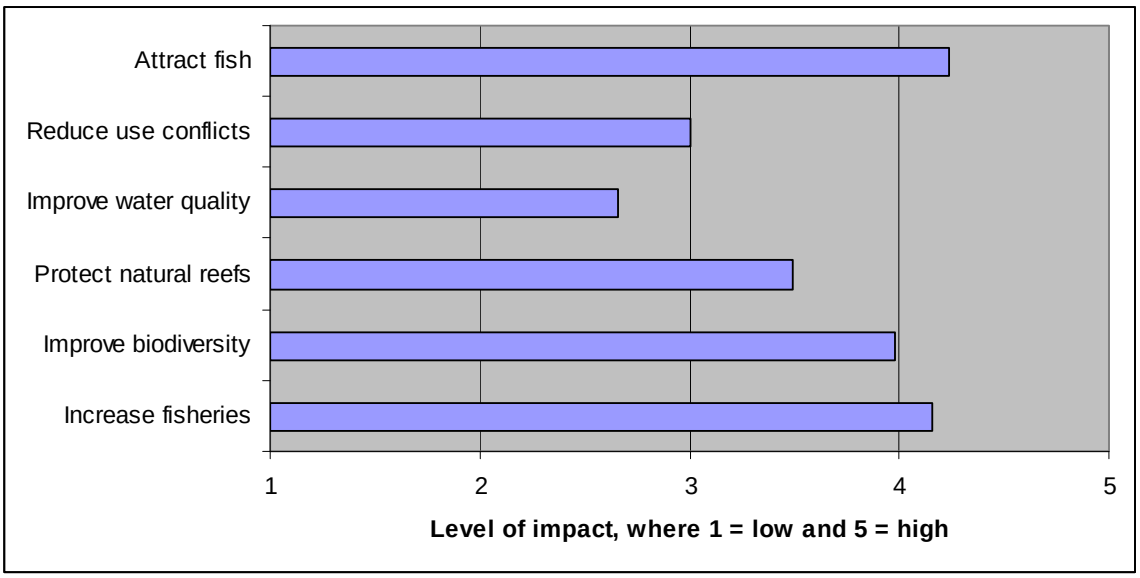

Figure 27: Views on indirect impacts on SEFCRI region coral reefs

The most significant impacts of artificial reefs, as according to the sample, are those that relate to fisheries (see Figure 27). The role of artificial reefs in attracting fish (n = 127; mean = 4.24 out of 6; SD = 1.11) and increasing fisheries (n = 126; mean = 4.16; SD 1.35) were perceived as significantly more important than artificial reefs serving as tools to protect natural reefs (n = 118; mean = 3.49; SD = 1.45), reduce user conflicts (n = 122; mean = 3.00; SD = 1.59), or improve water quality (n = 111; mean = 2.66; SD = 1.65) (Kruskal Wallis test: H = 80.3; p = 0.0). Fishers generally did not consider improvements in water quality as a benefit derived from artificial reefs, pointing instead to the aforementioned increasing in landings and the ability of artificial reefs to attract fish from natural areas, as well as a means by which to improve biodiversity (n = 120; mean = 3.98; SD = 1.41). These findings show the importance of artificial reefs as areas of production and fisheries enhancement rather than management mechanisms by which to protect natural reefs or reduce user conflicts, as reported by the sample.

Discussion

The DEP SEFRCI region commercial fisher study resulted in a characterization of the southeast Florida commercial fishing industry and the industry participants' views on resource trends, impacts on coral reefs, and related resources, and preferences towards management that can effectively address resource trends. There are four, main themes identified through the study and which are important to better understand fisher opinions and on how to engage the user group in management decision-making:

1. The commercial fishing industry is a diverse sector, comprised of fishers operating at different economic scales, targeting a large variety of finfish and invertebrates, and fishing distinct water depths and bottoms.
2. Commercial fishers acknowledge an overall decline in marine resource conditions, including coral reef decline, in the SEFCRI region over their tenure, as well as increase in use conflicts.
3. Commercial fishers do not perceive their group as having significant impacts on coral reefs and tend instead to identify recreational uses (which are often the most visible use type) as one of the main causes for coral reef decline.
4. The commercial fishing industry is generally in favor of changing management to address resource trends (which they perceive as declining), but the preferred forms of management are related mainly to other groups and thus do not emphasize either innovative forms of management (ex. zoning) or rights-based fishing.

1. The commercial fishing industry as a diverse sector

The commercial fishing industry identified via the study is comprised of a variety of fishing operations, both in terms of investment and costs and the species fished and areas targeted. Generally, invertebrate fisheries such as spiny lobster, stone crab, and shrimp, are targeted mainly in Miami-Dade County, whereas finfish (including reef fish) use is more diffuse across the region. This generally agrees with previous work (Johnson et al., 2007). Also, as the sample includes several charter fishing operations, which tend to have high operating costs (see, for instance, Brinson et al., 2006, for a characterization of the SEFCRI region charter fishing fleet), as well as trap fishers who have high fixed costs (see, for instance, Shivlani et al., 2004, for a description of the Miami River spiny lobster fishery), expenditures tend to vary considerably across the fishery.

Also, it is important to highlight the socio-demographic characteristics and diversity in the fishery. As could be expected due to US Census data for Miami-Dade County (see Shivlani, 2004), Hispanic fishers are the dominant ethnic group in that county but are minorities in all other counties. Otherwise, fishers are largely homogenous or display similar characteristics, including being skewed in their age group towards being an older, more experienced group which is largely connected to each other only via the fact that each has a Saltwater Products License (SPL), rather than other industry (ex. commercial fishing organization, fish house, etc.) or social networks. Indeed, it could be argued that the fishing community in the SEFCRI region, with the exception of ports

such as the Miami River and Port Salerno, consists of a "virtual" community of commercial fishers, who are increasingly less dependent on commercial fishing as a primary means of income generation, and many of whom have diversified into other fishery (ex. charter fishing) or non-fishery interests.

2. Overall decline in marine resource conditions

Commercial fishers can often provide anecdotal information (which can be highly objective and thus useful) on resource conditions and trends (DeMaria, 1996). In this study, respondents generally acknowledged that there has been a decline in coral reef and related resource conditions since their tenure (which averaged between 16-20 years). Due perhaps to their interaction with marine resources (in that commercial fishers generally do not directly observe coral reefs and other benthic resources), commercial fishers are more in agreement over the decline in water quality than in coral reefs. Moreover, the industry also believes that use conflicts have increased as coastal populations and, more importantly, recreational users have swelled. Impacts such as pollution, vessel groundings, anchor damage, and overpopulation are thus often listed as the causes for coral reef decline.

3. Uses responsible for significant impacts on coral reefs

Commercial fishers do not perceive their activities as impacting coral reefs and instead blame other user groups for the decline. That is, in part, due to their perception that because their activities (mostly, as determined by the species targeted) occur off or over coral reefs, they do not affect the resource; this view is reinforced by the fishers reporting increasing numbers of water-based, recreational users, including anglers, boaters, and divers.

Interestingly, fishers do not differentiate as much between consumptive and nonconsumptive, recreational users. In the study, both sport and nonconsumptive divers were perceived as having above average (i.e. in the scale, greater than 3 out of 5) impacts on coral reefs, as were anglers and boaters. Also, 77% of those who identified a group that has the highest direct impact on coral reefs stated that a combination of recreational users (anglers, boaters, and divers) are most responsible for coral reef decline.

4. Changing management to address resource trends

The commercial fishing industry in the SEFCRI region is in favor of changing management, but it prefers that management address enforcement and interpretation, aspects that the group believes are needed for the recreational users. This is enforced by the low ranking that commercial fishers assign to the forms of management that would most likely affect commercial fishing activities, namely zoning (including marine protected areas) and effort limitation and rights-based fishing. Because the group does not accept the premise that it may be in part responsible for coral reef decline, its

recommendations do not include internal reform. Instead, by better enforcing recreational bag limits and vessel groundings and by educating novice boaters and divers, the commercial fishing industry believes that coral reef declines can be reversed. Commercial fishers in the Florida Keys have similar views on management (Suman et al., 1999); there, they argue that commercial fisheries are among the most regulated of all marine-based activities, and that zoning and other innovative forms of management should not extend to the commercial fishing industry.

Altogether, these opinions suggest an industry that understands that there is a need to address coral reef (and other resource) trends, which it agrees are in decline. Whereas commercial fishers may not agree that their activities are as harmful as those of the recreational sector (which does, after all, outnumber the commercial fishing sector by several orders of magnitude), the respondents from this study believe that management should be changed to protect coral reefs.

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Appendix 1: Survey instrument

GENERAL INFORMATION

Name_____

Telephone_____

Address_____
_____
_____

1. Which of the following includes your age?

18-30 31-40 41-50 51-60 over 60

2a. Are you Spanish/Hispanic/Latino? YES NO

- if YES: Puerto Rican Mexican Cuban Other_____

2b. What is your race?

White African American Native American Asian

Other (_____)

3. How many family members do you support (including yourself)?

Myself only 2 3 4 5 6 7 greater than 7

4. Are you a member of any of the following groups?

- OFF	YES	NO
- Chamber of Commerce	YES	NO
- An environmental group	YES	NO
- Other_____	YES	NO

5. Do you belong to a fish house? YES NO

- If YES, then which one?_____

- If NO, to which fish houses do you usually sell your catch?_____

6. What is your primary port? _____

7. Do you have a secondary port, from where you fish part of the year? YES NO

- If YES, then which one? _____

8. How many years have you been a commercial fisher?

< 1 yr 1-5 6-10 11-15 15-20 >20 yrs

ECONOMIC INFORMATION

9. Please provide your best estimate of the replacement value of the following items that you used for commercial fishing last season.

____Vessel(s) and electronic equipment:	$_____
Trap gear (Number of traps_____)	$_____
Trap certificates (Number_____)	$_____
Other gear (_____)	$_____

10. Please provide your best estimate for the following expenses last last season/year.

Docking fees:	$_____
Interest payments on vessel:	$_____
P&I insurance on vessel, crew	$_____
Maintenance/repair on vessel:	$_____
Maintenance/repair on gear:	$_____
Other_(ex. licenses)_____	$_____

11. What approximate percentage of your personal income is derived from commercial fishing?_____%

12. What approximate percentage of your TOTAL household income is derived from commercial fishing?_____%

13. How would you describe your fishing occupation?

Full-time Part-time Charterboat Recreational

CONFLICTS, TRENDS, AND MANAGEMENT

14. Please rate the following uses in the order of their importance as a conflict to your fishing activities, where 1 is most important and 6 is least important.

Use	Rate
1. Other commercial fishers	
2. Recreational anglers	
3. Recreational divers – consumptive	
4. Recreational divers - nonconsumptive	
5. Recreational boaters	
6. Other (_____)	

For the next three questions, please provide your answer on a 1 to 5 scale, where 1 means **Strongly agree,** 2 means **Moderately agree**, 3 means **Neutral**, 4 means **Moderately disagree**, and 5 means **Strongly disagree**

15. Recreational anglers negatively affect my fishing activities, by either fishing in the same areas, targeting the same species, or by other activities.

1 2 3 4 5 I don't know

16. Recreational (both consumptive and nonconsumptive) divers negatively affect my fishing activities, by diving on my gear, targeting the same species, anchoring and diving where I am fishing, or by other activities.

1 2 3 4 5 I don't know

17. Recreational boaters negatively affect my fishing activities, by boating over my gear, scaring my targeted species, or by other activities.

1 2 3 4 5 I don't know

18. Can you identify any user groups with which you have use conflicts (i.e. those groups that affect your fishing areas and species)?

Date of interview_____ SPL number_____ Location of interview_____

FISHERY INFORMATION

28. Please refer to the table below to write in your best estimate of total catch in pounds last year/season.

Total Catch/Trips by Species

Fishery	Total catch	Total trips
Stone crab		
Lobster		
Shrimp		
Reef fish		
King mackerel		
Spanish mackerel		
Bait fish		
Dolphin		
Wahoo		
Tuna		
Sharks		
Swordfish		
Marlin		
Sailfish		
Other pelagics		
Marine life		
Others		

29. Please refer to the table below to show how the catch and effort in each species changed since you started fishing.

Change in Catch/Trips by Species

Fishery	Total catch % change (+/-)	Total trips % change (+/-)	Size % change (+/-)
Stone crab			
Lobster			
Shrimp			
Reef fish			
King mackerel			
Spanish mackerel			
Bait fish			
Dolphin			
Wahoo			
Tuna			
Sharks			
Swordfish			
Marlin			
Sailfish			
Other pelagics			
Marine life			
Others			

30. Please refer to the table below to show the species that you targeted in your last trip and what you landed.

Change in Catch/Trips by Species

Fishery	Targeted	Landed
Stone crab		
Lobster		
Shrimp		
Reef fish		
King mackerel		
Spanish mackerel		
Bait fish		
Dolphin		
Wahoo		
Tuna		
Sharks		
Swordfish		
Marlin		
Sailfish		
Other pelagics		
Marine life		
Others		

31. Please use the following table to write in your best estimate of costs for a typical trip in each of the fisheries in which you participated in the last season.

Cost by species

Fishery	Fuel/oil	Ice	Bait	Food/Supplies	Other	Crew (#/cost)
Stone crab						
Lobster						
Shrimp						
Reef fish						
King mackerel						
Spanish mackerel						
Bait fish						
Dolphin						
Wahoo						
Tuna						
Sharks						
Swordfish						
Marlin						
Sailfish						
Other pelagics						
Marine life						
Others						

32. Why do you fish the areas that you do – that is, what is the PRIMARY reason that results in where you fish?

a. Proximity to port
b. Density of target species/correct bottom or water conditions
c. Lack of competition/conflicts from other users
d. Other (please list_____)

33. Have you changed your fishing area since when you first started fishing?

YES NO

- If YES, then how and why?_____
_____

34. Using the following charts t for each species, please draw in or point out the following:

a. Areas fished in the past THREE years with percentage for each area, in terms of the percentage of trips taken to each area
b. Areas fished when you started fishing with percentages fore each area, in terms of percentage of trips taken to each area
c. Areas of user conflicts

Appendix 2: Letter of introduction to commercial fishers

Department of Environmental Protection

Coral Reef Conservation Program
Biscayne Bay Environmental Center
1277 NE 79th Street
Miami, Florida 33138

Jeb Bush
Governor

Colleen M. Castille
Secretary

June 16, 2006

Dear Saltwater Products License (SPL) holder:

This letter serves as an introduction to an important study being conducted as part of a Florida Department of Environmental Protection (DEP) project, as determined by a field survey conducted with members of the commercial fishing industry in southeast Florida.

The study concerns the condition of coastal and marine resources in southeast Florida and especially coral reefs and associated ecosystems, and your knowledge of these resources. As an important stakeholder group, commercial fishers' knowledge of resource conditions, stressors, and trends is essential to a better understanding of coral reefs and associated ecosystems. Towards that end, our team has developed a short questionnaire, consisting of questions concerning background information, use patterns, and knowledge and perceptions which we plan to administer shortly.

Your participation is essential to the success of this study, and we use this letter as a means by which to inform you of a field-based effort that we expect to commence soon. As part of the effort, a member of the study research team may contact you to conduct a short, in-person survey at a time of your convenience. Please keep in mind that we make every effort to conduct this fieldwork at your convenience.

Finally, we wish to thank you for having taken the time to read this letter. You may contact our Mr. Manoj Shivlani of the research team directly at 305-968-7136 with any questions or suggestions.

Sincerely,

Chantal Collier
Coral Reef Program Manager

Dive operations report

Introduction

The Southeast Florida Coral Reef Initiative Project to *Compile and Compare Scientific Data and Social Perceptions on Reef Conditions and Use* called for identification, assembly, and assessment of existing historical (use) maps, fishery data related to coral reef biodiversity, data on other fishing and diving impacts, the relative importance of reef versus other, offshore fishing (as measured in terms of participation rates and extraction levels), types, quantity, and trends of commercial and recreational extractive and nonconsumptive uses by county, stakeholder concerns on the indirect impacts on reefs, and stakeholder perceptions on artificial reefs. Florida's Local Action Strategy (LAS) developed through the State's membership in the U.S. Coral Reef Task Force, and known as the SEFCRI, identified four focus areas targeting threats to the reefs from Miami-Dade County, through Broward and Palm Beach, to Martin County. This project is a part of the Fishing, Diving, and Other Uses (FDOU) focus area.

The project called for the completion of three tasks: (I) The assemblage of existing information on the resource in the study area from all available sources; (II) the collection of historical and present day social perceptions concerning the resources from various stakeholders; and (III) the completion of a project summary that includes the synthesis of the results form the assemblage of existing information and data collection in a final report with supporting documentation.

As part of the project tasks II and III, the present effort identified and characterized the key, user groups (stakeholders) that utilize and/or rely on the regional coral reefs and associated resources: Commercial fishers; charter, for-hire fishing operations; recreational fishers (consisting of recreational anglers and recreational, consumptive divers); dive operations; researchers and managers; and the surfing community. Stakeholder identification and characterization followed the approach utilized by previous efforts in the region and elsewhere (Shivlani, 2006; Thomas J. Murray and Associates, 2005; Suman et al., 1999).

The region hosts a variety and magnitude of uses, as well as a diversity and density of users; thus the project decided that any study that considers historical and present social perceptions from current and past stakeholders must address the following:

1. What does it mean to be a stakeholder in southeast Florida, and how can that universe be defined (or at least circumscribed) to include all relevant uses?

2. Are there privileged, or dominant, narratives that certain stakeholders (and uses) may present that could undermine the narratives of others; and if so, then how can that be surmounted?

In addressing the first concern, this project worked closely with the FDOU team in bounding the universe of stakeholders, based on all available information, both in terms

of information concerning regional stakeholders and theoretical and practical studies on stakeholders in other areas. The second important factor that the project considered was the information it gathered, in that project methodology was refined to reach classes of users to the extent possible. Also, the project focused on the stratification of stakeholder perceptions, where applicable, such that experience and extent of use were considered to provide a more representative opinion.

Dive operations

Dive operations comprise an important industry in many coastal areas providing the means by which visitors can access dive sites and their associated flora and fauna (Green and Donnelly, 2003; Orams, 1999; Davis and Tisdell, 1995). The visitor base has grown considerably in the few decades since the advent of SCUBA, and diving and snorkeling activities have emerged as an important (and integrated) component of the coastal tourism economy.

In south Florida, Johns et al. (2001) conducted a comprehensive diver study, determining the use value of natural and artificial reef use from Palm Beach to Monroe Counties. Of the estimated total of 27.95 million person-days spent on reefs in the region, the study calculated that 13.24 million of those person-days were spent snorkeling or diving, as well as an additional 0.15 million on glass-bottom boats. Thus, just under half of the person-days spent on reefs in the region consisted of diving or snorkeling activities. An earlier study by Leeworthy and Wiley (1996) determined that over a third of over three million visitors that traveled to the Florida Keys in 1995-96 took a water-based trip. Both the Florida Keys National Marine Sanctuary (1996) and Shivlani and Suman (2000) reported that over 90% of all use (inclusive of dive operators) is highly concentrated on only 1% of the most popular reefs located throughout the 2,900 square mile Sanctuary.

While the socioeconomic characteristics of the dive industry and diving have been well studied in the Florida Keys (Shivlani et al., forthcoming; Leeworthy et al., 2006; Shivlani and Suman, 2000; Suman et al., 1999; and Suman and Shivlani, 1998, among others), fewer such studies have focused on the SEFCRI region (Shivlani, 2006; Johns et al., 2000). Thus, apart from resource based studies that have focused on the impacts of diver (Tilmant and Schmahl, 1981) or vessel-related damage (Lutz, 2006; Ginsburg et al., 2001), almost no information exists on the socioeconomic characteristics of the SEFCRI region's dive operations industry. As a user group that accesses the coastal and marine resources of the region on almost a daily basis (depending on the size of the operation), dive operators possess considerable current and, in many cases, historical information on changes in coral reef and related resource conditions. They are well exposed to areas where use conflicts and user-based impacts are occurring, and dive operations can provide useful information on the efficacy of current management efforts, as well as elaborate on how the operator activities can or should be modified to improve coral reef management.

Thus, one component of the DEP SEFCRI project 10 study effort consisted of a census survey of the region's dive operations to assess the socioeconomic and use characteristics of dive operations in the SEFCRI region, and obtain their views on resource conditions and perceptions on other user groups and management.

Methodology

The dive operator study followed the methodology developed for the commercial fishing study. It used a field-based approach to survey dive operators, whose population was determined using a variety of sources. A survey instrument was developed and modeled after the commercial fishing study survey instrument[3], and initial contact with each operation via telephone to describe the study and a field session to complete the surveys was conducted.

In August 2006, the research team developed a database list of dive (and snorkel) operators that represented the population for the SEFCRI region. The operators were selected from the following sources: Web-based dive shop lists; telephone yellow pages; brochures; and industry contacts. The approach adopted the population estimation methodology used by Shivlani et al. (2003) and Suman and Shivlani (1998) for dive operations in the Florida Keys.

The research team completed a draft survey instrument that included sections on socio-demographic information, economic investments and operating costs, use patterns, and attitudes, perceptions, and beliefs. The survey instrument was circulated among the FDOU member team and, following revisions, the survey was finalized by mid-September 2006 (see Appendix I for a copy of the questionnaire).

The methodology adopted to implement surveys was to randomize the database list of dive operators in the four counties and to contact and survey the appropriate number of operations until the survey totals per county had been reached. The initial population estimation led to the identification of 166 dive operations, of which 65 (44.5%) were located in Broward County, 46 (31.5%) in Miami-Dade County, 45 (30.8%) in Palm Beach County, and 10 (6.8%) in Martin County. The number of operators for each county was reduced, however, after it was determined that only a third of the operations initially identified actually take out divers and snorkelers on a regular basis to dive sites in the region. The rest of the operations were either technical dive instruction centers, dive supply shops, and operations offering commercial diver services, among others. Thus, implementation of the survey shifted from random sampling to a census survey. Each potential operator was contacted to determine whether (a) the operation qualified to participate and (b) the operation elected to participate.

[3] This approach assured a level of consistency that allowed for inter-group comparisons, as well as the development of a common set of maps that could then be layered to show areas of use and changes in use patterns, as well as use conflict hotspots.

The dive operator study led to the completion of 46 surveys during the three month field session (August – October 2006), of which 19 (41.3%) were completed in Broward County, 11 (23.9%) each in Miami-Dade and Palm Beach Counties, and five (10.9%) in Martin County.

Results

The results of the survey are presented in the order of the questions as these were provided to the participants (a copy of the survey is available in Appendix I of this report). Also, county-specific results are shown where relevant.

Socio-demographic information

The research team targeted either captains or dive shop owners or managers to complete the surveys. The average age of the respondents was between 31-40 years old and 41-50 years old (mean = 2.39 on a scale where 1 is 18-30 years old and 5 is over 60 years old; SD = 1.08). Over 78% of the sample was 40 years or younger. In terms of ethnicity and race, 87% of the persons interviewed were non-Hispanic and almost all (98%) were Caucasian. These results are consistent with socio-demographic results obtained for Florida Keys dive operations (Suman and Shivlani, 1998).

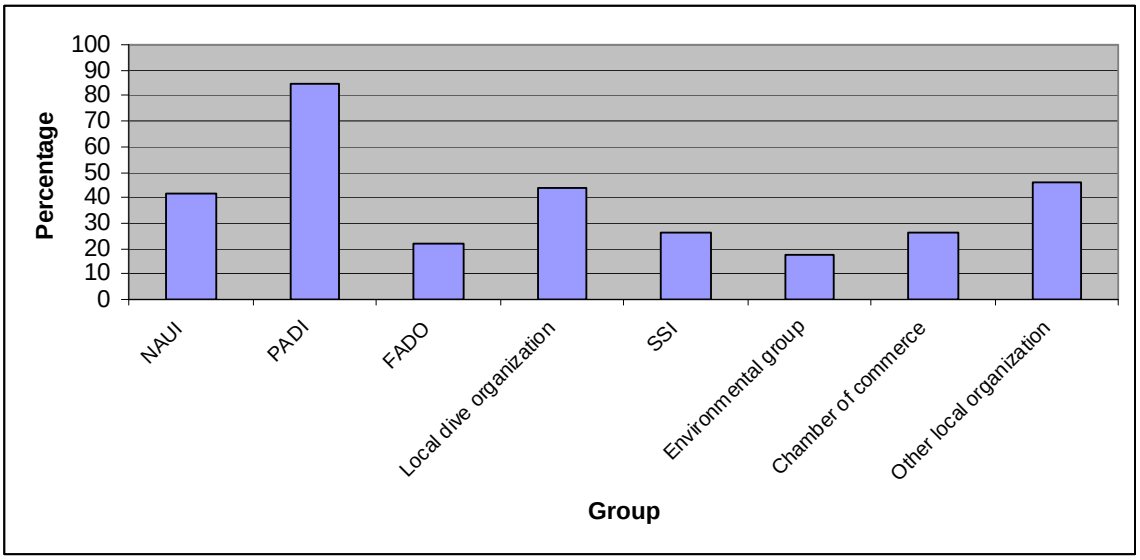

Figure 1: Affiliation in dive and community groups and organizations (n = 46)

As shown in Figure 1, dive operators showed high rates of affiliation, both between national and local dive organizations. The most frequently listed dive certification organization was PADI, with which almost 85% of the sample was affiliated (contrasted by 41.3% affiliated with NAUI). Dive operators were twice as likely to be part of a local dive organization (43.5%) than as part of the Florida Association of Dive Operators (FADO) (21.7%). Several dive operators also listed other, local affiliations, such as local organizations (45.7%) and chambers of commerce (26.1%). Altogether, these

high rates of local group affiliations show the linkage between dive operations and local tourism and conservation groups and identify potential institutions and groups through which to engage dive operations in management strategies.

Most operations (65%) had been in existence for 11-20 years, with the average tenure in the industry being 11-20 years (mean = 3.00; SD = 1.07). Only 10.9% had been operating for 1-5 years, suggesting an experienced sample.

The respondents listed various ports across the SEFCRI region, of which the most popular locations were Hillsboro (19.6%), Port Everglades (17.4%), Miami Beach (10.9%), and Boynton Inlet (10.9%). Over a third (37%) of the dive operators reported using secondary ports, of which Palm Beach County accounted for 47.1%, followed by Broward (17.6%) and Miami Dade Counties (17.6%). Part of the secondary port use in Palm Beach County was a result of most Martin County dive operators (75%) using Palm Beach County ports for some of their trips.

Economic and use information

Dive operators were asked to provide basic economic information on their operations, including the costs of their primary investments (i.e. vessels, gear) and operating expenses. They also provided information on the number of trips they organized and/or took in 2005, as well as areas visited.

Table 1: Economic investments and costs per operation among SEFCRI area dive operations

Item	*Average number (standard deviation in parenthesis)*	*Average cost in 2005 (standard deviation in parenthesis)*
INVESTMENTS		
1. Vessel	1.76 (1.19) n = 42	$198,250.12 (135,309.76) n = 20
2. Dive equipment		$16,203.45 (20,479.44) n = 29
3. Compressors		$22,720.00 (19,466.90) n = 25
OPERATING COSTS		
4. Docking fees		$11,761.54 (8481.00) n = 13
5. Interest payments		$3,225.00 (3,347.01) n = 4
6. P&I insurance on vessel/crew		$7,885.71 (5,004.44) n = 14
7. Vessel maintenance/repair		$13,285.71 (14,504.26) n = 14
8. Gear maintenance/repair		$1,297.23 (5,944.65) n = 21
9. Dive shop rental		$38,978.95 (51,653.84) n = 19
10. Advertising		$10,497.50 (13,307.72) n = 16
INCOME		
11. Personal income		80.1% (30.5) n = 35

As shown in Table 1, dive operator costs varied considerably, due in part to the investments held by operations, as well as differences in operating costs. Also, half of the dive operations interviewed did not own their own vessels and used charters instead; because several dive shops used more than one charter for their trips, the average number of vessels reported was 1.76 vessels per operation. Within dive equipment, the most expensive item identified was compressors, which over half (54.3%) of the sample owned. This was followed by dive equipment, which cost an average of $16,203 per operation.

Within annual operating costs, only a minority of respondents listed any particular cost, with gear maintenance being the most commonly reported cost. Just over a third of the sample (34.8%) reported expenditures related to advertising, and 41.3% paid dive shop rental fees (most of the others either did not operate a dive shop, running trips directly

from a marina, and a few had dive shops but did not pay rent). Overall, respondents relied considerably on the dive operation as part of their total income, stating that an average 80.1% of their personal income was derived from the dive operation.

Approximately two thirds of the operations (65.2%) reported hiring an average of 3.1 full-time employees (SD = 2.28); fewer operations (5.65%) also hired an average of 3.27 (SD = 2.05) part-time employees.

Average vessel size of the operation was18.6 divers (SD = 10.1) or 29.7 snorkelers (SD = 15.7) per trip; generally, trips consisted either of divers or snorkelers, as most operators did not organize mixed trips. The range of clients per trip was less than six divers or snorkelers on some vessels to a maximum of 50 (median divers per vessel = 19; median snorkelers per vessel = 25).

In terms of trips taken in 2005, 80.4% of the respondents reported taking an average of 263.3 trips (SD = 180.01) to dive sites in the SEFCRI region. The range in the number of trips taken varied considerably, with 20 representing the minimum number of trips and 750 the maximum number of trips. The average number of divers taken per trip was 9.6 (SD = 6.14; range = 1 – 25 divers), and the average number of snorkelers per trip was 6.3 (SD = 6.12; range = 0 – 20). Costs per trip averaged $91.61 (SD = 72.86) in fuel and $23.88 (SD = 16.28) in supplies, and $104.67 (SD = 49.98) in crew costs. Finally, 92.7% reported taking consumptive trips (which allow spear fishing or lobster diving). On average, the percentage of consumptive trips taken by dive operations that reported allowing consumptive diving was 27.3% (n = 38; SD = 26.9).

Asked about why they take the trips to the sites that they visit, most dive operators (45.2%) stated ‘proximity to port’ as the most important reason. Another 28.6% and 26.2% identified ‘habitat quality’ and ‘abundance of wildlife’, respectively. Interestingly, no dive operator was motivated by ‘lack of competition/conflict from other users’ as a reason to select dive sites. Finally, under a quarter (23.4%) of the sample agreed that the dive sites that they targeted had changed since when they first started diving, but few respondents provided a reason for that change. Some of those that did stated they wanted to give the reefs a rest, that they had purchased a larger vessel, and that they were targeting newer artificial reefs, among others.

The respondents identified a total of 105 sites that represented their top seven sites visited in 2005. Only a few of these sites, such as Breakers Reef (4%), Pompano Drop Off (3.4%) and Sea Emperor (3.4%), were listed by several operators. Also, several operators identified areas by location (ex. distance from port). Thus, the results presented focus mainly on natural and artificial reefs.

Table 2: Natural and artificial dive site conditions

Dive site	Corals or coral reef present	Percentage of total trips	Condition (1= excellent; 5 = poor)	Crowding (1= excellent; 5 = poor)	Consumptive
1. Artificial	89.6%	19.7 (15.3) n = 73	2.50 (1.18) n = 72	2.59 (1.17) n = 72	33.8%
2. Natural	100%	28.2 (24.2) n = 88	2.48 (1.05) n = 97	2.85 (1.33) n = 97	49.5%

- Standard deviation in parentheses

As shown in Table 2 above, natural reefs were more popular than artificial reefs, as they attracted almost 10% more trips. Generally, however, natural reefs were perceived as being slightly more crowded, although overall conditions suggest that both the conditions of the dive sites and the crowding that they attract are acceptable (that is, the means are near the midpoints between 'excellent' and 'poor'). Natural dive sites attracted considerably more consumptive trips than did artificial sites, and this is most likely due to the nature of the dives (ex. where artificial sites attract technical, deeper dives whereas natural sites attract greater multiple use, including lobster diving and spear fishing).

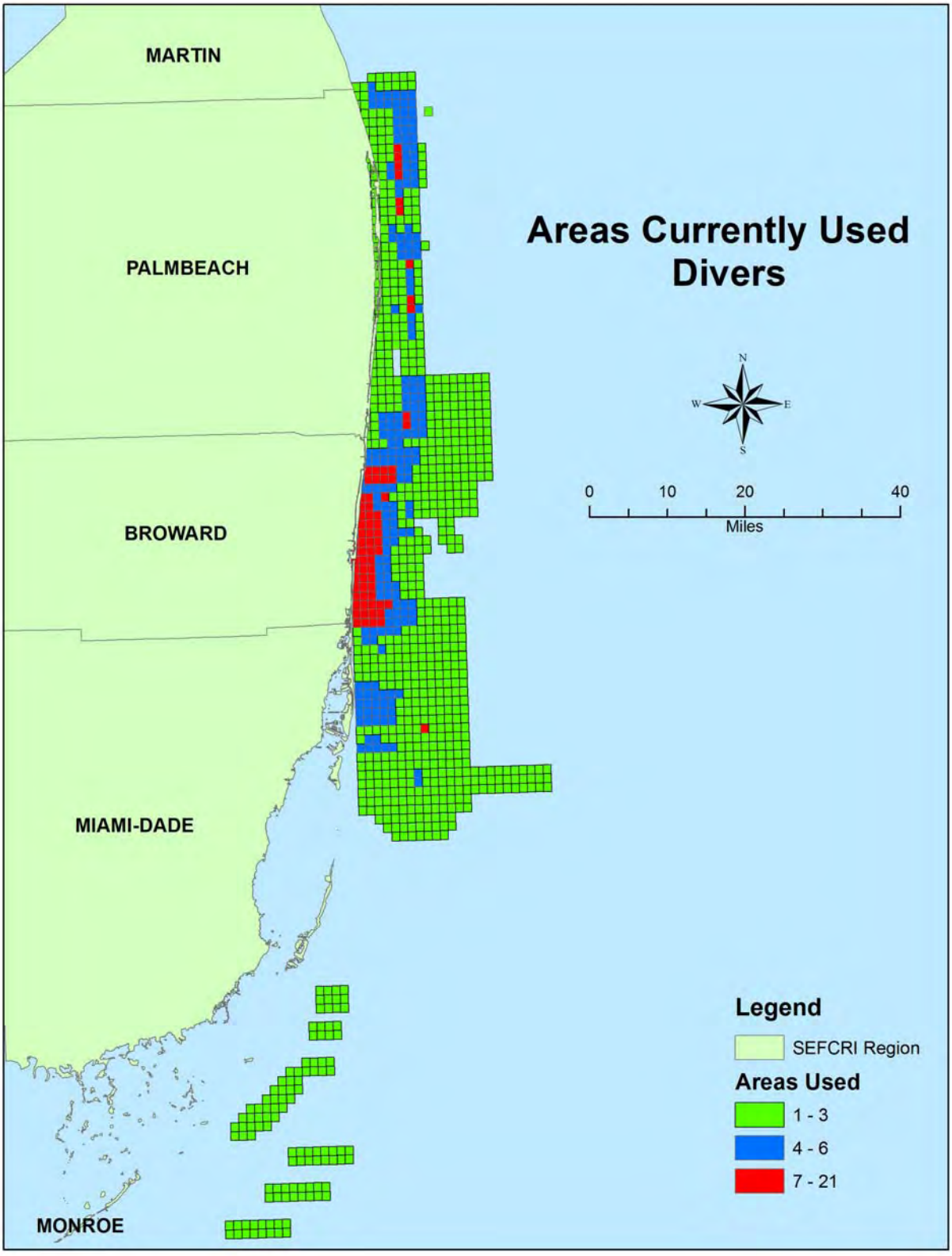

Figure 2: Current dive use areas in the SEFCRI region (total refers to number of respondents)

The map in Figure 2 demonstrates the nearshore aspect of dive operations, as well as the focus within Broward County, a function of the highest concentration of dive operations in that county. Also, the map shows that most use in 2005 originating from Martin County ended up in Palm Beach County. Finally, there is some indication that charters booked in the SEFCRI region are taken in the Upper Florida Keys (at least two operators reported organizing Florida Keys dive trips).

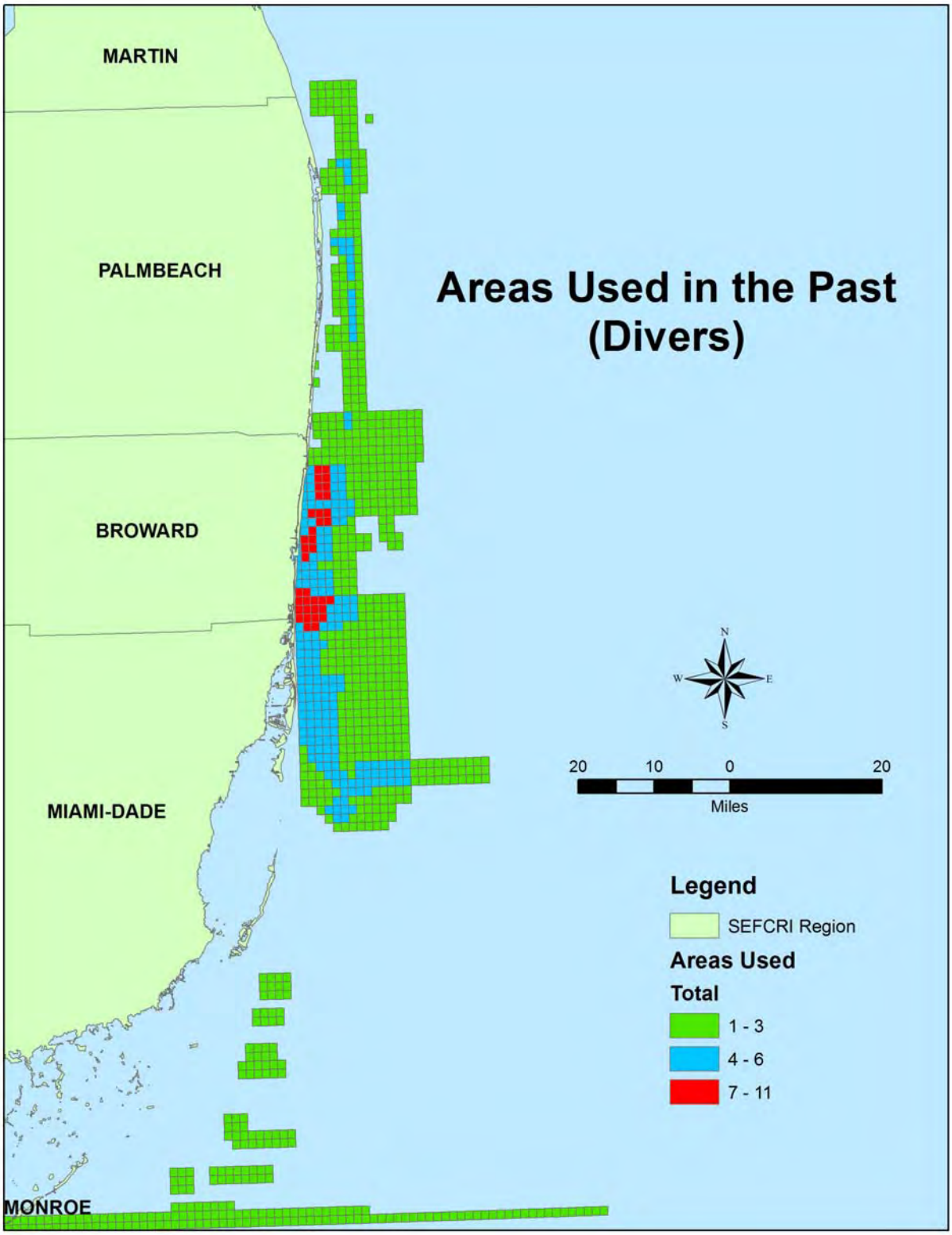

Figure 3: Past dive use areas in the SEFCRI region (total refers to number of respondents)

Figure 3, depicting past dive use areas in the SEFCRI region, shows that trips were more diffuse across Broward County, extending into Miami-Dade County; however, the general profile remains generally unchanged from the past to present use. Dive use in Broward County may have increased as a result of more artificial reefs, which dive operators in that county targeted more frequently than operators in any other county.

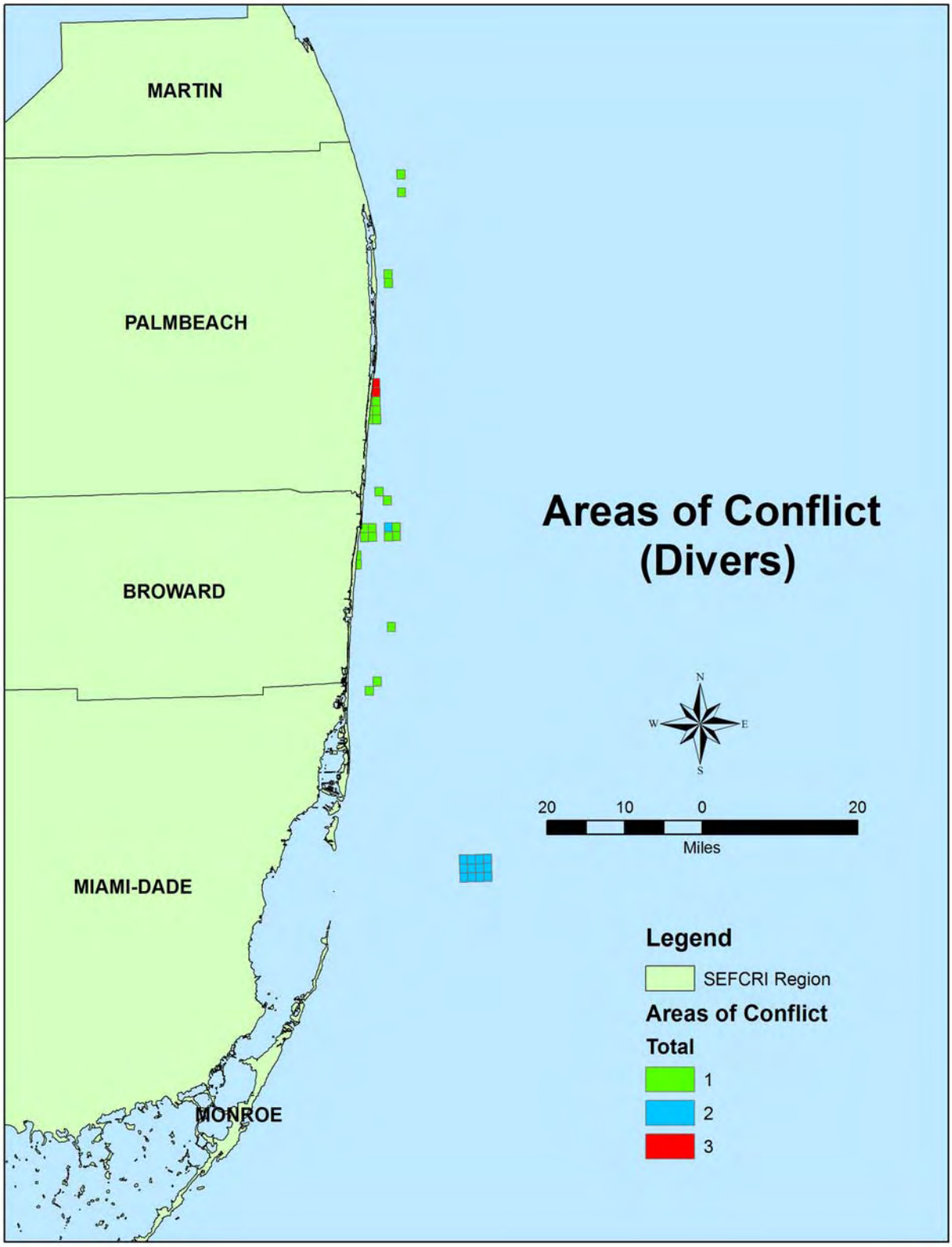

Figure 4: Areas of use conflicts (total refers to number of respondents)

Generally, dive operations did not identify many use conflicts (see Figure 4). The only areas that were identified tended to nearshore dive sites that operators described as having too many users. Otherwise, most dive operations believed that their activities were not affected by other users, with the exception of recreational boaters (see the following section).

Perceptions

The respondents provided their views on use conflicts, resource trends, threats facing coral reefs and related resources.

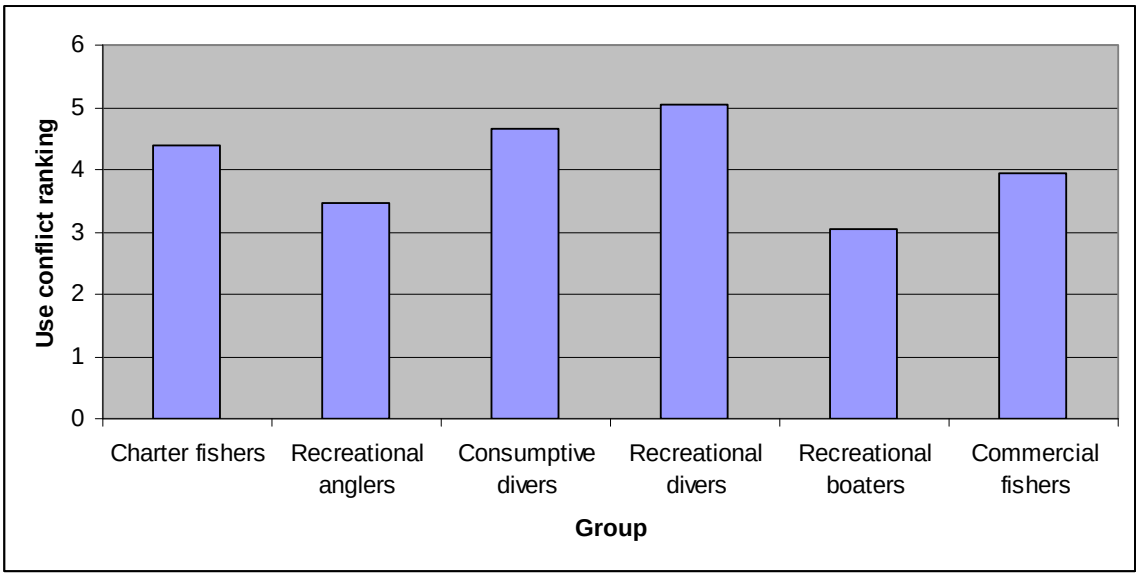

Figure 5: Perceptions on use conflicts (n = 46)

As shown in Figure 5, dive operations ranked recreational boaters as presenting the greatest conflict to their activities (mean rank = 3.04 out of 6, where 1 represents the greatest conflict and 6 the least conflict; SD = 1.84), followed by recreational anglers (mean rank = 3.46; SD = 1.75), commercial fishers (mean rank = 3.93; SD = 1.96), and charter fishers (mean rank = 4.39; SD = 1.74). By contrast, both consumptive (mean rank = 4.65; SD = 1.75) and recreational (mean rank = 5.04; SD = 1.56) divers did not present much of a conflict, as these groups participate in the same (and thus, complementary) activities as do dive operators. This may also be the result of a majority of the dive operators reporting consumptive dive trips and other consumptive divers may be perceived as presenting a low conflict.

The rankings provided by dive operators on use conflicts were reinforced by their views on specific groups. Respondents slightly disagreed (in a 1-5 scale, where 1 is strongly agree and 5 is strongly disagree) that either commercial fishers (mean = 2.89; SD = 1.37) or recreational anglers (mean = 2.51; SD = 1.29) negative affect their activities. However, respondents were more willing to agree that recreational boaters (mean = 2.09; SD = 0.91) present a greater conflict than commercial fishers or recreational anglers (Kruskal-Wallis test: $H = 7.83$; $p < 0.05$). Similarly, consumptive and recreational divers presented the least conflict (mean = 3.84; SD = 1.26) among all user groups (Kruskal-Wallis test: $H = 36.6$; $p = 0.0$).

A majority of dive operators (63.9%) believed that SEFRCI region coral reef conditions were either somewhat or significantly worse than when they first started diving, and 93.5% believed that coral reef conditions during that time period had changed. The main changes the operators identified were increased amounts of algae on the reef (23.9%), land-based sources of pollution (19.6%), and overfishing (15.2%). A similar percentage of respondents (60.9%) believed that water quality conditions are somewhat or significantly worse than when they first started diving. The overwhelmingly negative perceptions on both resource quality conditions represents an important result, in that it shows that dive operators, the group that tends to access coral reefs and gauge water quality on an almost daily basis, perceive a significant (and long-term) decline in both parameters.

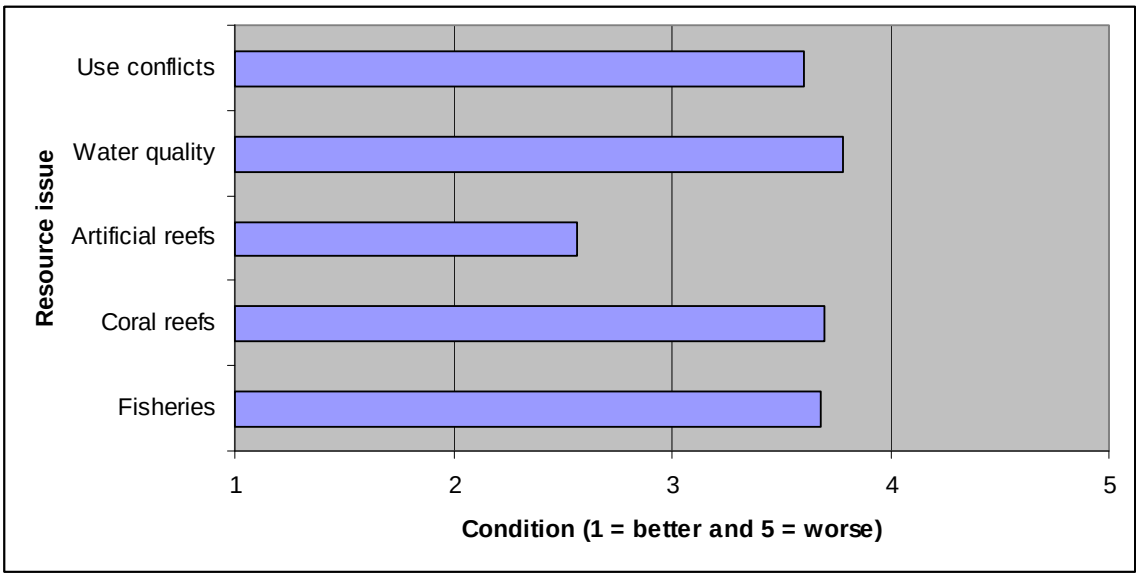

Figure 6: Views on resource conditions (n = 46)

Dive operators felt that the condition of all resources had declined (see Figure 6). The ones that had worsened the most were water quality (mean rank = 3.78 out of 5, where 1 is better and 5 is worse; SD = 0.87), coral reefs (mean rank = 3.70; SD = 0.99), fisheries (mean rank = 3.68; SD = 1.01), and use conflict (mean rank = 3.60; SD = 0.81). The only resource that dive operators believed was in significantly better condition than all others was artificial reefs (mean rank = 2.57; SD = 1.15) (Kruskal-Wallis test: $H = 33.04$; $p < 0.001$); however, even artificial reefs were considered to be in less than good condition, in that their mean rank exceeded the midpoint of 2.5.

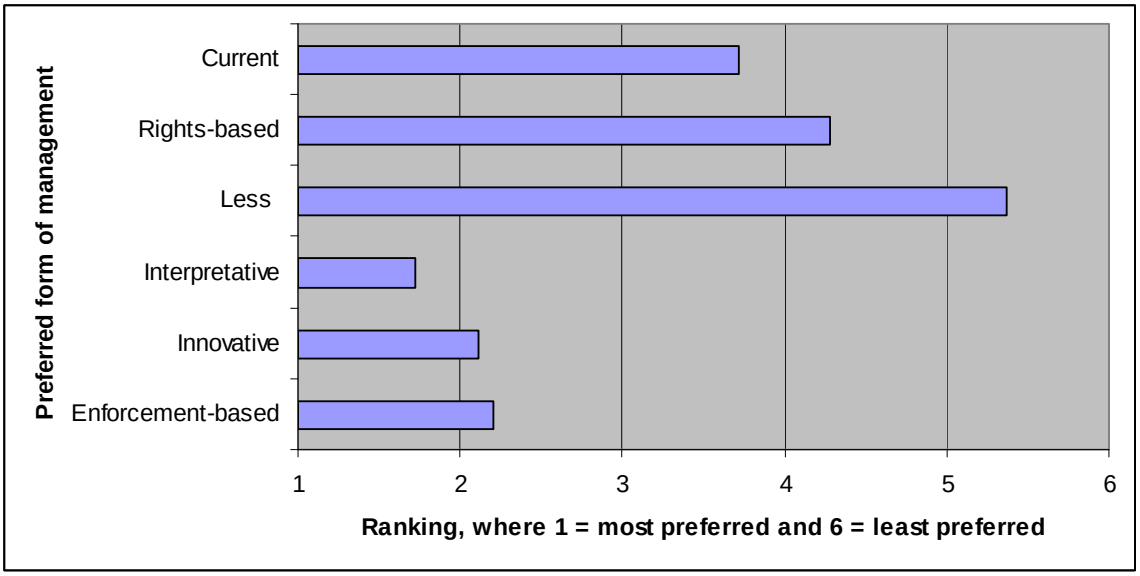

Figure 7: Preferred form of management (n = 46)

Figure 7 shows that the sample believed that the best way to address resource conditions would be to implement greater interpretation-based management (mean rank = 1.72 out of 6, where 1 is most preferred and 6 is least preferred; SD = 1.00). This was considered as a significantly more effective option than less management (mean rank = 5.37; SD = 1.25), rights-based management (mean rank = 4.28; SD = 1.71), and the current form of management (mean rank = 3.72; SD = 1.73) (Kruskal-Wallis test: H = 80.3; p = 0.0). While there was considerable support for enforcement-based management (mean rank = 2.20; SD = 1.46), it is important to note that innovative management (which includes marine protected areas), ranked behind interpretative management in terms of overall support (mean rank = 2.11; SD = 1.57). The results demonstrate that respondents consider zoning an important management strategy, and that they may support it over the current form of management.

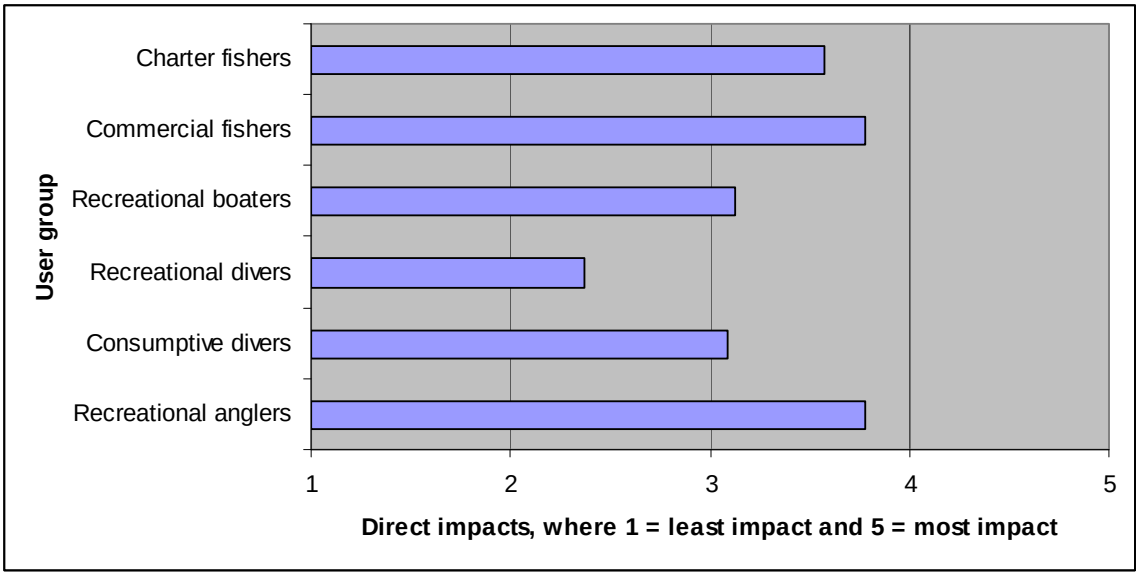

Figure 8: Views on direct impacts to SEFCRI region coral reefs (n = 46)

As shown in Figure 8, dive operators believed that all consumptive groups (recreational anglers, consumptive divers, commercial fishers, and charter fishers) had similar impacts on the coral reefs; however, they did believe that recreational anglers (mean impact = 3.78 out of 5; SD = 1.28) and commercial fishers (mean = 3.78; SD = 1.15) had the most impact, followed by charter fishers (mean = 3.57; SD = 1.17) and consumptive divers (mean = 3.09; SD = 1.47). Even recreational boaters were perceived to have a slight impact (mean = 3.13; SD = 1.17). By contrast, recreational (nonconsumptive) divers were considered to have much fewer impacts (mean = 2.37; SD = 1.29) than the other groups, including consumptive divers (Kruskal-Wallis test: $H = 5.32$; $p < 0.05$). These results suggest that dive operators perceived consumptive activities as having greater impacts on coral reefs (i.e. fishing, but also boating impacts such as anchor damage) than non-consumptive ones. This acknowledgement is significant as it shows that the respondents most likely provided objective views concerning consumptive use and consumptive diving, an activity most operators sanction. Also important in these results is the finding that dive operators do not generally perceive non-consumptive diving as having a significant impact, although past literature has shown otherwise, both in Florida (Talge, 1992) and elsewhere (Tratalos and Austin, 2001; Hawkins and Roberts, 1994; Dixon et al., 1993).

In terms of indirect impacts, the sample considered all sources harmful, but it identified land-based source of pollution as the most damaging (mean = 4.71 out of 5, where 1 is least impactful and 5 is more impactful; SD = 0.51). This was ahead of dredging (mean = 4.64; SD = 0.77), development (mean = 4.47; SD = 1.01), and global warming (mean = 3.64; SD = 1.18). Global warming may be perceived as an extra-local threat, at it was considered significantly less damaging than the other sources (Kruskal-Wallis test: $H = 20.33$; $p < 0.001$).

Finally, dive operators provided their opinions on artificial reefs, in terms of the effects of artificial reefs on fisheries, improvement of water quality and biodiversity, and reduction of user conflicts. All dive operators reported using artificial reefs; the average use of artificial reefs was 47.1% (SD = 19.8), showing that almost half of all dive trips reported were taken to artificial reefs. Respondents from Broward County reported the highest percentage of artificial reef use (53%).

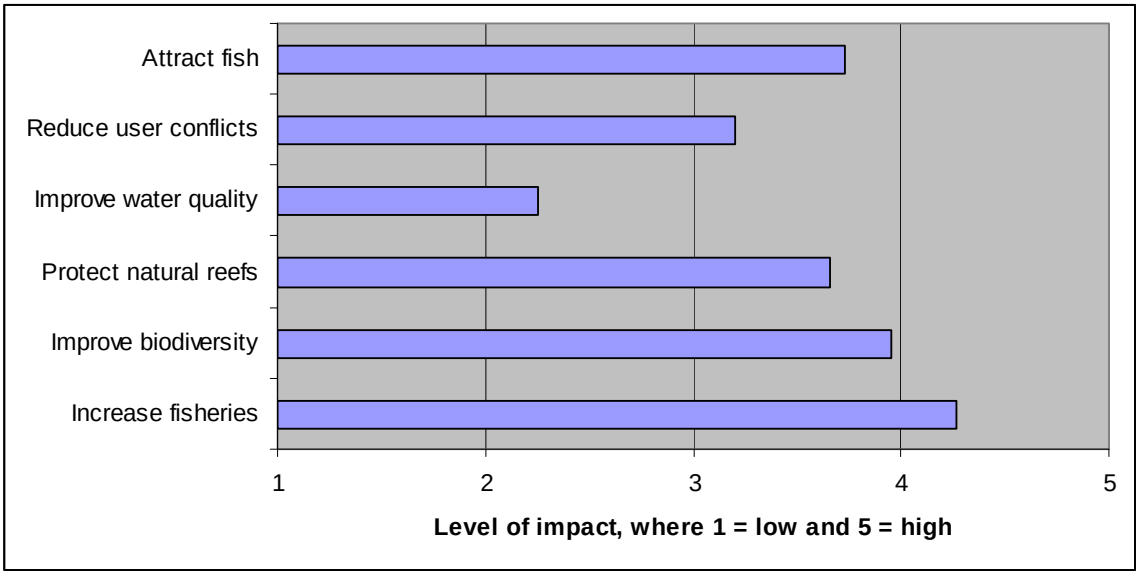

Figure 9: Views on artificial reefs (n = 46)

The most significant impacts of artificial reefs, as according to the sample, are those that relate to fisheries and biodiversity (see Figure 9). The role of artificial reefs in increasing fisheries (mean = 4.23 out of 5, where 1 is low impact and 5 is high impact; SD = 1.19) was considered most important, followed by improving biodiversity (mean = 3.95; SD = 1.35), attracting fish (mean = 3.73; SD = 1.39), and protecting natural reefs from over-use (mean = 3.66; SD = 1.44). Another function that dive operators believe artificial reefs serve is that they reduce user conflicts (mean = 3.2; SD = 1.18). Dive operators did not believe that water quality was affected by artificial reefs (mean = 2.25; SD = 1.18).

Discussion

The DEP SEFCRI region dive operator study resulted in a characterization of the southeast Florida dive operator industry and the industry participants' views on resource trends, impacts on coral reefs, and related resources, and preferences towards management that can effectively address resource trends. Because of consistent contact with the marine environment and their economic dependence on coral reefs and associated resources, dive operators represent as an important indicator group that qualitatively evaluate the condition of coral reefs in the SEFCRI region. Moreover, the results show that dive operators are mostly objective in their reporting on the condition on coral reefs (i.e. there were few to no biases identified in the results). Finally,

because of their relationship their clients and other community-based and professional organizations, dive operators can also assist in disseminating interpretative information.

Dive operators operating in coral reef zones often concentrate their activities in reef-rich sites, and can provide useful information on the condition and quality of resource and as a socioeconomic indicator (Alcala, 2007; Dearden et al., 2007; Santavy et al., 2003; Shivlani et al., 2003; Suman and Shivlani, 1998; NOAA, 1996). In the SEFCRI region, where diving and snorkeling activities vary across a number of natural and artificial dive sites, the present characterization demonstrates the importance of local knowledge in an understanding of regional conditions (see, for instance, Rivera Miranda's 2007 discussion on the use of local dive knowledge to determine coral reef conditions and stressors in southwestern Puerto Rico). The present characterization demonstrated that there is a general understanding among the dive community that both coral reef and water quality conditions have declined considerably in the 16-20 years (average) that the industry has been in operation. Moreover, the findings showed that dive operations believe that use conflicts, while important to other groups, may not impact their group, with the possible exception of recreational boaters. Importantly, the findings also identified the willingness of the group to accept innovative management schemes, including the implementation of marine protected areas to zone uses. While it could be argued that this is a biased response, in that the operators would inevitably gain from privileged access in no-fishing reserves, it should be noted that a majority of the respondents undertake consumptive diving trips (in contrast to dive operators in the Florida Keys (Suman and Shivlani, 1998).

Another key aspect of the dive operator characterization was the determination of objective information that the group provided on user impacts. Dive operators mostly agreed that all types of consumptive activities have impacts on coral reefs, including diving activities involving spear fishing and lobster diving. But, it must also be noted that the dive operator industry did not fully acknowledge the effects of non-consumptive diving on coral reefs, including the overall impacts on coral health by cumulative, incidental contact. This may be an area that management may seek to pursue in educating dive operators in the region.

Finally, the characterization identified the rich, social networks that dive operations create and are part of within coastal communities. Unlike other user groups that are either limited to networks of their own groups (ex. recreational fishers) or are generally not linked to any other groups (ex. commercial fishers), dive operations in the SEFCRI region tend to be linked with national, regional, and local dive organizations, tourism groups, nongovernmental organizations, and chambers of commerce, among others (see Figure 1). The relationship between dive operators and these organizations provides an opportunity to promote the management strategy most favored by dive operators in a way that the operators themselves provide information across these networks. With their intimate understanding of coral reef and associated resource conditions and the aforementioned linkages, as well as their stake in a healthy and sustainable coral reef ecosystem, dive operators represent among the most natural partners in the effort to protect coral reefs in the SEFRCI region.

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Appendix 1: Survey instrument

Name of operation_____

Name/position_____

Telephone_____

Address_____
_____
_____

GENERAL INFORMATION

1. Which of the following includes your age?

   18-30 31-40 41-50 51-60 over 60

2a. Are you Spanish/Hispanic/Latino? YES NO

- if YES: Puerto Rican Mexican Cuban Other

2b. What is your race?

White African American Native American Asian Other (_____)

3. How many family members do you support, including yourself?

Myself only 2 3 4 5 6 7 8 over 8

4. Are you a member of any of the following groups?

a. NAUI	YES	NO
b. PADI	YES	NO
c. FADO	YES	NO
d. A local dive organization	YES	NO
e. SSI	YES	NO
f. An environmental group	YES	NO
g. Chamber of Commerce	YES	NO

Are you a member of other local organizations? YES NO

If YES, then which one(s)?_____

5. How many years have you been a dive/snorkel operator in this county?

1-5 years 6-10 years 11-20 years over 20 years (____years)

6. How many years has this operation been in existence?

1-5 years 6-10 years 11-20 years over 20 years (____years)

7. What is your primary port? _____

8. Do you have a secondary port? YES NO

- If YES, then which one? _____

CONFLICTS, TRENDS, AND MANAGEMENT

14. Please rate the following uses in the order of their importance as a conflict to your diving/snorkeling activities, where 1 is most important and 6 is least important.

Use	Rate
1. Charter fishers	
2. Recreational anglers	
3. Recreational divers – consumptive	
4. Recreational divers - nonconsumptive	
5. Recreational boaters	
6. Commercial fishers	

For the next four questions, please provide your answer on a 1 to 5 scale, where 1 means **Strongly agree,** 2 means **Moderately agree**, 3 means **Neutral**, 4 means **Moderately disagree**, and 5 means **Strongly disagree**

15. Commercial fishers negatively affect my activities, by either fishing in the same areas where I take my divers/snorkelers, or by other activities.

    1 2 3 4 5 I don't know

16. Recreational anglers negatively affect my activities, by either fishing in the same areas where I take my divers/snorkelers, or by other activities.

    1 2 3 4 5 I don't know

17. Recreational (both consumptive and nonconsumptive) divers negatively affect my activities, by diving in the same areas where I take my divers/snorkelers, or by other activities.

    1 2 3 4 5 I don't know

18. Recreational boaters negatively affect my activities, by boating over my clients, scaring fish, or by other activities.

    1 2 3 4 5 I don't know

19. Can you identify any OTHER user groups with which you have use conflicts (i.e. those groups that affect the areas where you dive/snorkel)?

20. What are the coral reef conditions in southeast Florida and the area(s) where you dive/snorkel, compared to what they were like when you first started diving/snorkeling?
    a. Significantly better
    b. Somewhat better
    c. Same
    d. Somewhat worse
    e. Significantly worse

21. Have the coral reefs changed in southeast Florida since you first started diving/snorkeling?

YES NO

- If YES, then what are the main changes that have occurred to reefs since you first started diving/snorkeling?

_____

22. What is the condition of water quality since when you first started diving/snorkeling?
    a. Significantly better
    b. Somewhat better
    c. Same
    d. Somewhat worse
    e. Significantly worse

23. Please identify the general trend in each of the following as they relate to resource conditions in the areas where you take your divers/snorkelers.

		Better ←----------→ Worse				
a.	Fisheries	1	2	3	4	5
b.	Coral reefs	1	2	3	4	5
c.	Artificial reefs	1	2	3	4	5
d.	Water quality	1	2	3	4	5
e.	Use conflicts	1	2	3	4	5

NOTE to data collector: Please follow up on each trend with a question on *why* the trend has occurred.

24. Please rate the following forms of management to determine if management needs to be changed to address resource conditions and trends in southeast Florida, where 1 is the most preferred form of management and 6 is the least preferred form of management.

Management	Rating
1. Restrictive, enforcement-based management - higher penalties, more patrols and monitoring	
2. Innovative management - use separation of activities via zoning - marine protected areas	
3. Interpretative management - more outreach and education	
4. Less management	
5. Rights based management (limited entry, property rights)	
6. Current form of management	

NOTE to data collector: Please collect information on the type of management that the interviewee would prefer, especially if it is not included in the table above or if it is a subset of a type of management.

25. In terms of direct impacts on southeast Florida coral reefs, what is the extent of impacts on these areas by the following groups?

		Low ←------→ High				
a.	Recreational anglers	1	2	3	4	5
b.	Recreational divers (consumptive)	1	2	3	4	5
c.	Recreational divers (nonconsumptive)	1	2	3	4	5
d.	Recreational boaters	1	2	3	4	5
e.	Commercial fishers	1	2	3	4	5
f.	Charter fishers	1	2	3	4	5

Which group would you state has the greatest direct impacts on coral reefs and how?

_____

26. In terms of indirect impacts on southeast Florida coral reefs, what is the extent of impacts on these areas by the following activities?

		Low ←------→ High				
a.	Coastal development	1	2	3	4	5
b.	Dredging/filling	1	2	3	4	5
c.	Land-based pollution (agriculture, sewage, etc.)	1	2	3	4	5
d.	Global warming	1	2	3	4	5

Which activity would you state has the greatest indirect impacts on coral reefs and how?

_____

27. Do you take dive/snorkel trips to artificial reefs in southeast Florida?

YES NO

- if YES, then how often do you take such trips to artificial reefs, as a percentage of total trips in a typical year?___%

28. In terms of artificial reefs, what is the extent of impacts of these structures on the following conditions?

		Low ←------→ High				
a.	Increase fisheries	1	2	3	4	5
b.	Protect biodiversity	1	2	3	4	5
c.	Protect natural reefs	1	2	3	4	5
d.	Improve water quality	1	2	3	4	5
e.	Reduce user conflicts	1	2	3	4	5
f.	Attract fish from other areas (ex. natural reefs)	1	2	3	4	5

ECONOMIC INFORMATION

29. Number of vessels at the operation: ____number of vessels

30. Capacity of divers/snorkelers per vessel at the operation.

Vessel 1: ____divers/____snorkelers
Vessel 2: ____divers/____snorkelers
Vessel 3: ____divers/____snorkelers
Vessel 4: ____divers/____snorkelers

31. Number of employees at the operation.

a. Full time_____
b. Part time_____
c. Seasonal_____

32. Please provide your BEST estimate of the replacement value for the following items used for diving/snorkeling last year (2005).

a. Vessel(s) and electronic equipment	$_____
b. Diving/snorkeling equipment	$_____
c. Compressors	$_____
d. Other (_____)	$_____

33. Please provide your BEST estimate of the following expenses that you incurred in 2005.

a. Docking fees	$_____
b. Interest payment on vessel(s)	$_____
c. Vessel insurance on vessel(s)	$_____
c. Maintenance and repair on vessel(s)	$_____
d. Maintenance and repair on equipment	$_____
e. Rent/costs on fixed location (if applicable)	$_____
f. Advertising	$_____
g. Other costs (_____)	$_____

33. What approximate percentage of your total income is derived from the dive/snorkel operation? ____%

NOTES

TRIP INFORMATION

29. Please provide an estimate on the following trip-related questions below.

    a. Total number of trips last year _____trips
    b. Number of divers per trip _____divers
    c. Number of snorkelers per trip _____snorkelers
    d. Cost per trip
        i. Fuel and oil $_____
        ii. Supplies $_____
        iii. Crew $_____

30. What percentage of your divers/snorkelers is consumptive? _____%

31. Why do you dive/snorkel the areas that you do – that is, what is the PRIMARY reason that results in where you go?

    a. Proximity to port
    b. Habitat quality (ex. abundance of coral
    c. Lack of competition/conflicts from other users
    d. Abundance of wildlife
    e. Other (please list_____)

32. Have you changed the area(s) where you dive/snorkel since when you first started?

    YES NO

    - If YES, then how and why?_____

33. Please list the names (or locations) of dive/snorkel sites that you visited last year, providing the following information about each site:
    a. Whether the site is natural or part of an artificial reef
    b. Whether there is a coral reef (coral patches or other live coral included)
    c. Percentage of overall trips taken to the site
    d. Condition of the site, in terms of its resources, where 1 is excellent and 5 is poor
    e. The crowding on the site, where 1 is lots of space and 5 is crowded*

Site	Natural area/ artificial	Coral reef present (Y/N)	% of total trips	Condition of site (1 = excellent, 5 = poor)	Crowding of site (1= lots of space; 5 = crowded)

- Please mark the locations/sites that you use for consumptive trips.

34. Using the following charts, please draw in or point out the following:

    a. Areas dived/snorkeled in the past THREE years with percentage for each area, in terms of the percentage of trips taken to each area
    b. Areas dived/snorkeled when you started diving/snorkeling with percentages for each area, in terms of percentage of trips taken to each area
    c. Areas of user conflictts

Recreational anglers report

Introduction

The Southeast Florida Coral Reef Initiative Project to *Compile and Compare Scientific Data and Social Perceptions on Reef Conditions and Use* called for identification, assembly, and assessment of existing historical (use) maps, fishery data related to coral reef biodiversity, data on other fishing and diving impacts, the relative importance of reef versus other, offshore fishing (as measured in terms of participation rates and extraction levels), types, quantity, and trends of commercial and recreational extractive and nonconsumptive uses by county, stakeholder concerns on the indirect impacts on reefs, and stakeholder perceptions on artificial reefs. Florida's Local Action Strategy (LAS) developed through the State's membership in the U.S. Coral Reef Task Force, and known as the SEFCRI, identified four focus areas targeting threats to the reefs from Miami-Dade County, through Broward and Palm Beach, to Martin County. This project is a part of the Fishing, Diving, and Other Uses (FDOU) focus area.

The project called for the completion of three tasks: (I) The assemblage of existing information on the resource in the study area from all available sources; (II) the collection of historical and present day social perceptions concerning the resources from various stakeholders; and (III) the completion of a project summary that includes the synthesis of the results form the assemblage of existing information and data collection in a final report with supporting documentation.

As part of the project tasks II and III, the present effort identified and characterized the key, user groups (stakeholders) that utilize and/or rely on the regional coral reefs and associated resources: Commercial fishers; charter, for-hire fishing operations; recreational fishers (consisting of recreational anglers and recreational, consumptive divers); dive operations; researchers and managers; and the surfing community. Stakeholder identification and characterization followed the approach utilized by previous efforts in the region and elsewhere (Shivlani, 2006; Thomas J. Murray and Associates, 2005; Suman et al., 1999).

The region hosts a variety and magnitude of uses, as well as a diversity and density of users; thus the project decided that any study that considers historical and present social perceptions from current and past stakeholders must address the following:

1. What does it mean to be a stakeholder in southeast Florida, and how can that universe be defined (or at least circumscribed) to include all relevant uses?

2. Are there privileged, or dominant, narratives that certain stakeholders (and uses) may present that could undermine the narratives of others; and if so, then how can that be surmounted?

In addressing the first concern, this project worked closely with the FDOU team in bounding the universe of stakeholders, based on all available information, both in terms

of information concerning regional stakeholders and theoretical and practical studies on stakeholders in other areas. The second important factor that the project considered was the information it gathered, in that project methodology was refined to reach classes of users to the extent possible. Also, the project focused on the stratification of stakeholder perceptions, where applicable, such that experience and extent of use were considered to provide a more representative opinion.

Recreational fishers

The recreational fishing industry ranks as one of the foremost coastal activities, both in terms of participants and effects, in the U.S. According to the US Commission on Ocean Policy (2004), recreational fishing is comprised of nine million saltwater anglers who expend a total of $8.4 billion annually and generate up to 300,000 jobs. The total value of recreational fishing is estimated at over $20 billion. Furthermore, recreational fishing – unlike its commercial counterpart – is a sector that is growing. In the period between 1996 and 2000, the number of fishing trips nationwide increased by 20%.

Recreational fishing is among the most important marine activities in the State of Florida and indeed is part of the state's culture; iconic locations such as the Florida Keys and Lake Okeechobee, among many others, attract anglers for their renowned fishing areas and species, as well as their history. In 2000, the State of Florida sold over 600,000 recreational fishing licenses to residents and non-residents, of which over 89,000 were sold to Miami-Dade, Broward, and Palm Beach residents (Stephan and Adams, 2005). , in 2006, there were over 87,000 recreational anglers in the four SEFCRI counties. This total does not include the anglers who fish from shorelines (and thus do not recreational fishing licenses) and others who enjoy an exemption from obtaining a recreational fishing license.

In 2004, it was estimated that 6.5 million recreational anglers took over 27 million fishing trips in Florida. 14.5 million trips were taken on private or rented vessels and 12 million were conducted from the shoreline (FWRI, 2005). Several important reef species are harvested mainly by recreational fishers, including some species of grouper (FWRI, 2005). Coupled with this year-round effort in fin fish fisheries, there is the specialized recreational harvest of spiny lobster, both during the so-called 'mini-season' and the regular fishing season. The former attracts between 60,000 to 112,000 person-day trips over a two-day period, during which participants blanket the southeast Florida region in search of spiny lobster in the last Wednesday and Thursday of each July, a few days prior to the opening of the regular season) (Sharp et al., 2005). As for the regular season, there are over 100,000 special endorsements sold annually for recreational fishers.

While a few studies concerning recreational fishing have been conducted in parts of the SEFCRI region (Shivlani, 2006; Ault et al., 2001; Harper et al., 2000; Johns et al., 2000; BRC, 1991), little directed research has focused on use profiles, attitudes, perceptions, and beliefs of the recreational angling community. Even less research has been

completed describing similar factors for the recreational spiny lobster fishery in SEFCRI counties. As the largest user group in the region, recreational fishers can provide important information on changes in coral reef and related resource conditions and, in particular, regional fisheries. Also, by better understanding their views on resource conditions and current management, recreational fishers can be engaged to participate in coral reef management strategies.

Thus, another aspect of the DEP SEFCRI project 10 study effort consisted of a mail-based survey of recreational fishers and an intercept survey of recreational lobster divers, in order to better understand the socioeconomic and use characteristics of the recreational fishing community in the four county region, its views on resource conditions, and its perceptions on other user groups and management.

Methodology

The recreational fisher study used methodology similar to the commercial fishing study because it employed both mail and field-based surveys. The mail-based survey effort consisted of developing a survey instrument that could be self-administered and returned via mail, a pilot survey session to test the efficacy of the survey instrument and estimate return rates, and a full survey session. The survey effort followed the Dillman (1978) method but did not use follow-up reminders due to funding constraints and thus relied on pilot returns to determine the number of surveys to be mailed in the full session). The field-based survey effort consisted of the development of a recreational lobster diver survey and its implementation across eight sites in the four counties during the 2006 spiny lobster mini-season. Each effort is described in more detail below.

Mail-based surveys

In June 2006, the research team obtained the 2006 Florida saltwater fishing license (recreational fishing license) list for the SEFCRI counties. It contained the names and addresses of 87,676 recreational anglers. 30,227 anglers were from Miami-Dade County, 24,436 from Palm Beach County, 23,833 from Broward County, and 9,180 from Martin County. The research team decided not to commence with the mail survey until the fall of 2006 due to previous experience (Shivlani, 2006) with conducting mail surveys during hurricane season (June 1 – November 30); effectively, the research team wanted to ensure that developing or potentially imminent storms would not serve to dampen return rates.

In September 2006, a draft recreational fishing survey instrument was developed and circulated among the DEP FDOU team members. Following comments and revision, the survey instrument was finalized and modified for each county (in terms of the map used for each county to determine use patterns); see Appendix 1 for a copy of the mail-based survey questionnaire. The pilot session commenced on October 16, 2006, when 800 recreational fishing surveys were sent to 200 randomly selected recreational fishing license holders in each of the four SEFCRI counties. The mailings consisted of an

introductory letter, the survey instrument, and a business-reply, return envelope. By the end of the first week of November 2006, 96 surveys had been completed and returned, representing a net return rate of 12.8% (50 surveys were returned as undeliverable – hence the higher, net return rate).

On December 11, 2006, the research team sent out a total of 10,000 surveys to randomly selected fishing license holders in the four counties: 2,500 surveys were sent to each county. By January 15, 2007, the study effort yielded 1,058 completed surveys, representing an overall return rate of 10.6% and a net return rate of 10.8% (due to the fact that 200 surveys were undeliverable).

Recreational lobster mini-season surveys

In June 2006, following a discussion with the DEP FDOU project personnel, the research team decided to add a component to the recreational fishing study, consisting of a field-based, recreational lobster survey conducted during the two days of the 2006 mini-season at boat ramp and marina sites across the four counties. The recreational lobster, mini-season, takes place on the last, consecutive Wednesday and Thursday of each July and is open only to those individuals holding a recreational fishing license and a crawfish endorsement (FWC, 2007). In the SEFCRI region, each license holder is allowed to harvest 12 lobsters for each day of mini-season, or a total of 24 lobsters for the mini-season.

The team developed a survey questionnaire modeled after the commercial fishing survey but considerably shorter in length (14 questions – see Appendix 2 for a copy of the recreational lobster fishing survey questionnaire). The FDOU member team provided comments on the survey instrument in July 2006, after which the instrument was considered final.

The team identified eight sites (one in Martin County, two each in Palm Beach and Broward Counties, and three in Miami-Dade County) with boat ramps where data collectors intercepted and interviewed boaters returning from a fishing trip. The survey session occurred on July 26-27, 2006, from 10 am to 4 pm each day. A total of 400 surveys were completed.

Results

The results of the each survey effort are discussed separately and are presented in the order of the questions as these were provided to the participants.

Mail-back survey socio-demographic information

Of the 1,058 recreational fishermen who completed and returned surveys, 98.6% identified themselves as residents of the SEFCRI region. it was determined that 31.1%

of the 868 persons who provided their zip codes were from Palm Beach County, 25.1% were from Broward County, 27.1% were from Martin County, and 16.7% were from Miami-Dade County.

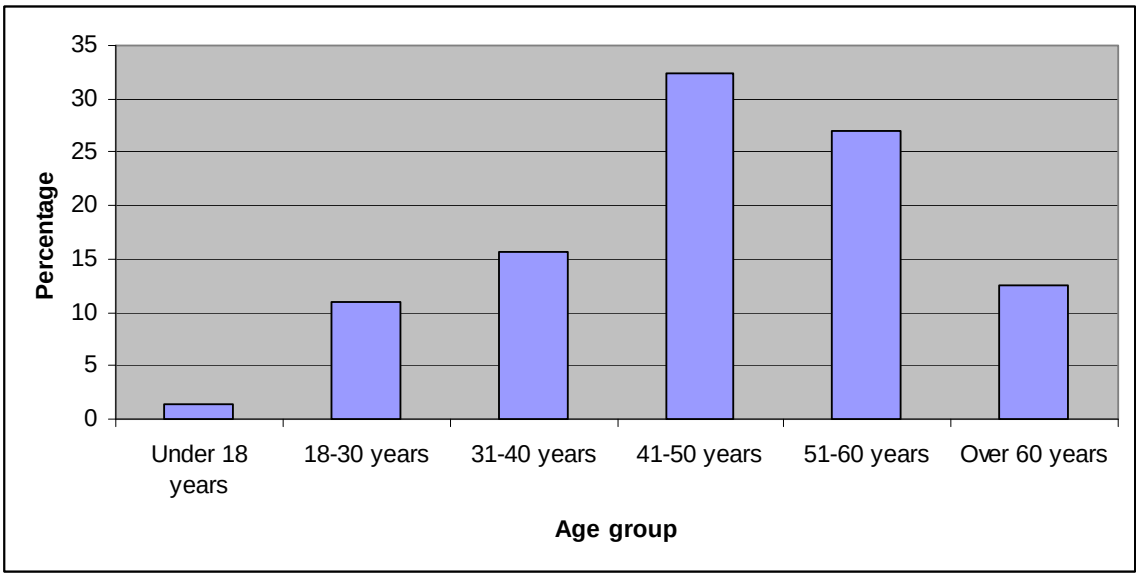

Figure 1: Age group of recreational fishers

In terms of their age groupings, the average age of the respondents was between 41-50 years old (mean = 4.09, where 1 is under 18 years old and 6 is over 60 years old; SD = 1.21) (see Figure 1) . That age group also represented the highest percentage of respondents (32.9%). It should be noted that Florida residents younger than 16 years or 65 years or older do not need licenses to fish (FWC, 2007); thus, the lower percentages at both the oldest and youngest age group ranges most likely reflects these licensing exclusions.

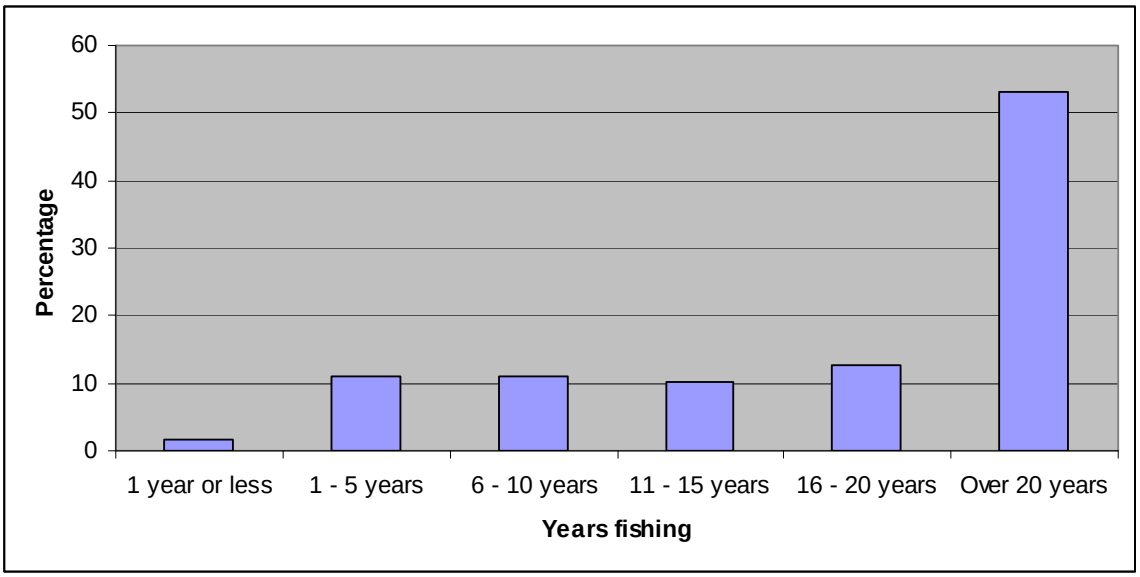

Figure 2: Years fishing in the SEFCRI region

The respondents reported considerable fishing experience (mean = 4.82, where 1 is one year or less fishing experience and 7 is over 20 years of fishing experience; SD = 1.52), where the average number of years of fishing was between 16-20 years (see Figure 2). In terms of percentage, over half of the recreational fishers (53.2%) had been fishing for over 20 years. Thus, the sample was skewed towards more experienced exponents, most of whom provided a perspective of two decades on resource conditions and fisheries.

A majority of the fishers were non-Hispanic (86.3%), and over half (54.1%) of the sample that identified itself as Hispanic listed a Miami-Dade zip code. This result is largely consistent with the region's demographics, where over half of Miami-Dade residents are of Hispanic origin. Also, 93.2% of the respondents were Caucasian in race, followed by 'others' and African Americans, who comprised 3.2% and 1.8% of the sample, respectively.

Mail-back survey use information

Recreational anglers provided information on the species they fished in 2005, the species that they considered most important, the number of trips (including trips to artificial reefs), the main reasons for areas fished, and areas fished.

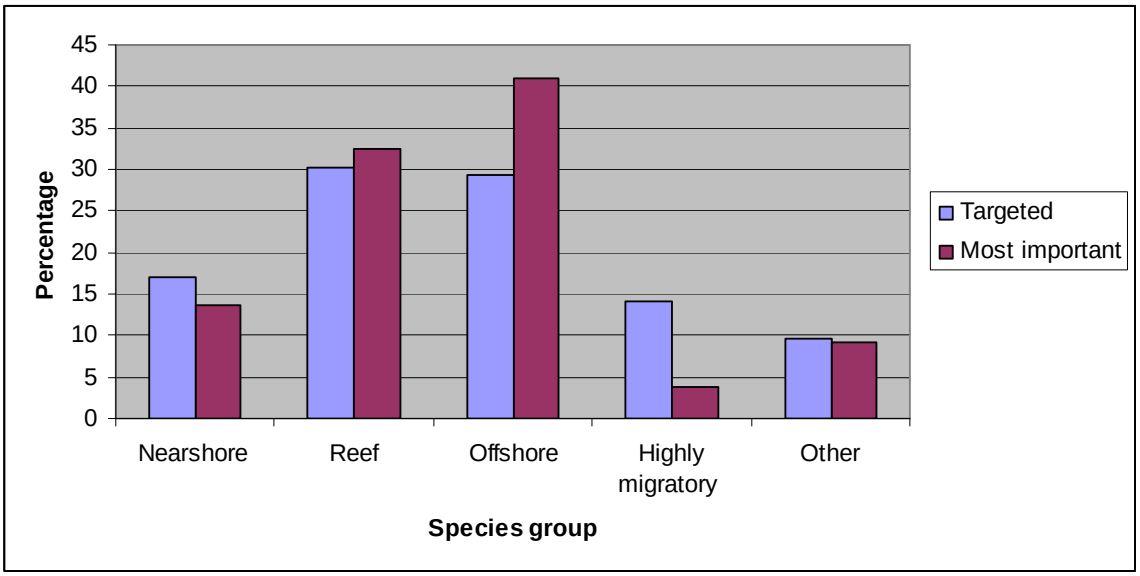

Figure 3: Species groups targeted and most important species group

As shown in Figure 3, the sample reported fishing a variety of species in 2005, of which reef fish (30.3%) and offshore species (29.0%) were the most frequently targeted. Accordingly, these two species groups were the most important to the fishers, as 40.2% and 32.6% of the respondents listed offshore species and reef fish as the most important species group, respectively. In both species groups, the percentage of respondents reporting having fished the group was lower than the

percentage that identified the group as the most important. This is contrasted with the percentages of fishers who reported fishing nearshore and highly migratory species in 2005, which were higher than the corresponding percentages of fishers who considered either group as the most important. Thus, the results suggest that fishers generally landed (as interpreted by targeted, or fished) fewer of the most important species than they did less important species. Moreover, nearshore species and highly migratory species may even represent a form of bycatch for reef fish and offshore pelagics, respectively. Finally, only a small percentage of the respondents (3.0%) listed spiny lobster as a species they targeted in 2005, and fewer (1.9%) considered it the most important species.

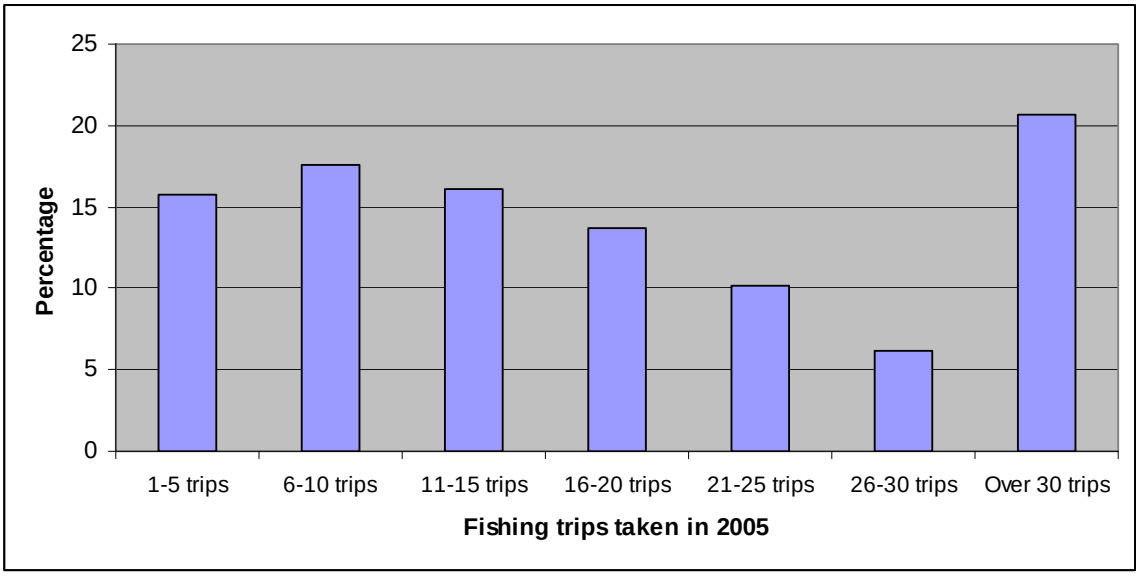

Figure 4: Total fishing trips taken in the SEFCRI region in 2005

Generally, the percentages of fishers taking 1-5, 6-10, and 11-15 trips in 2005 were similar (15-18%), while the percentage of fishers taking more trips (16-20 (14%), 21-25 (10%) and 26-30 (6%)) declined progressively (see Figure 4). Over 21% of the sample took over 30 trips. The average number of trips was between 16-20 trips (mean = 3.85; SD = 2.12, or 16-20 trips. These results suggest that there are two sub-populations of recreational anglers in the region: one that fishes an average of one trip per month, and one that fishes ~three or more trips per month.

When asked why they select the areas that they fish, 44.8% of the sample stated that it was because of proximity to port, followed by 42.3% who identified density of target species or correct bottom or water conditions. Fewer (7.8%) chose fishing areas to avoid conflicts, and among the almost 5% who listed 'other' reasons, several listed vessel size, boat ramp locations, and weather conditions as the main reasons for port selection.

Over half of the sample (52.8%) reported fishing over artificial reefs, with the percentage of artificial reef use increasing from Miami-Dade (where 35.7% of the respondents reported artificial reef use) to Palm Beach (49.2%), Broward (52.9%), Palm Beach, and

Martin (63.6%) counties. The average percentage of artificial use was 1.97 (SD = 1.05), or between 11-25% of fishing trips.

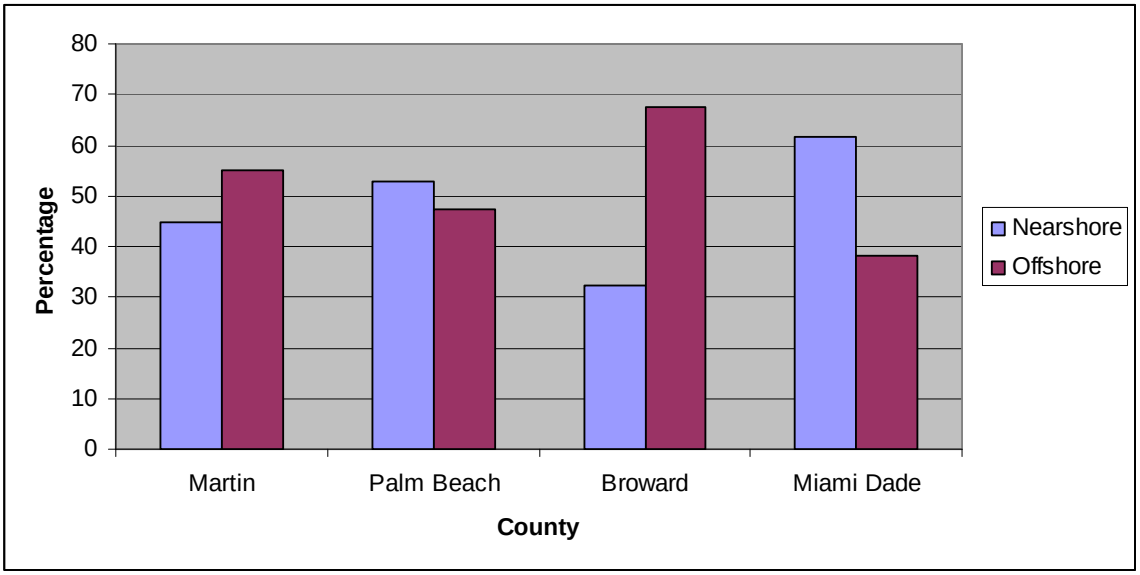

Figure 5: Percentage of nearshore and offshore trips

The respondents provided use information on the areas that they typically fish. The results were divided into nearshore and offshore areas (as determined by the reef line in the maps provided in the surveys for each of the four counties – see Appendix I), and it was determined that offshore areas dominated fishing effort in Broward (67.5%) and Martin Counties (55.1%), whereas nearshore areas were more popular in Miami-Dade (61.7%) and Palm Beach Counties (52.7%).

Finally, two-thirds of the recreational fishers (66.5%) stated that they had changed fishing areas since when they first started fishing, with a majority (45.8%) moving either north or south of their original fishing area, 39.3% fishing further offshore, and 14.1% fishing inshore. The main reason why most changed their fishing area was due to the lack of fish (40.3%), while 24.8% moved to avoid pollution, and 20.6% changed as a result of conflict and/or competition.

Mail-back survey perceptions

The respondents provided their views on use conflicts, resource trends, threats facing coral reefs and related resources.

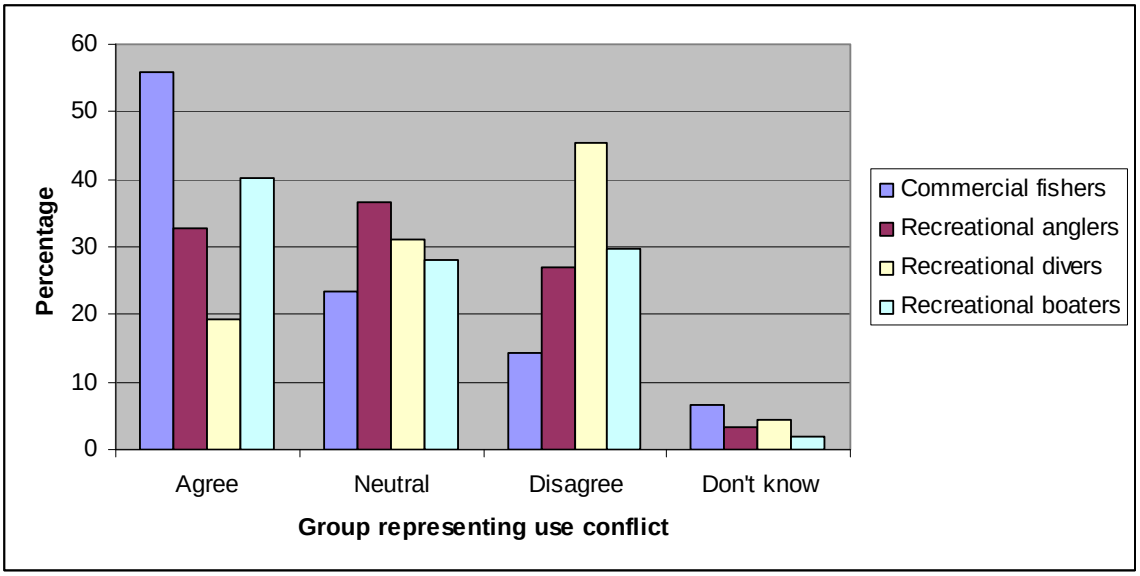

Figure 6: Views on use conflicts

As shown in Figure 6, most recreational anglers (55.6%) agreed that commercial fishing impacts their activities whereas only 14.3% disagreed. Just over 40% and almost a third (32.9%) of the anglers sampled agreed that recreational boaters and other recreational anglers also represent a use conflict, respectively. The group that was least often identified as impacting recreational angling was recreational diving. Whether consumptive or nonconsumptive diving, 45 % of the respondents disagreed that recreational divers affect their fishing activities.

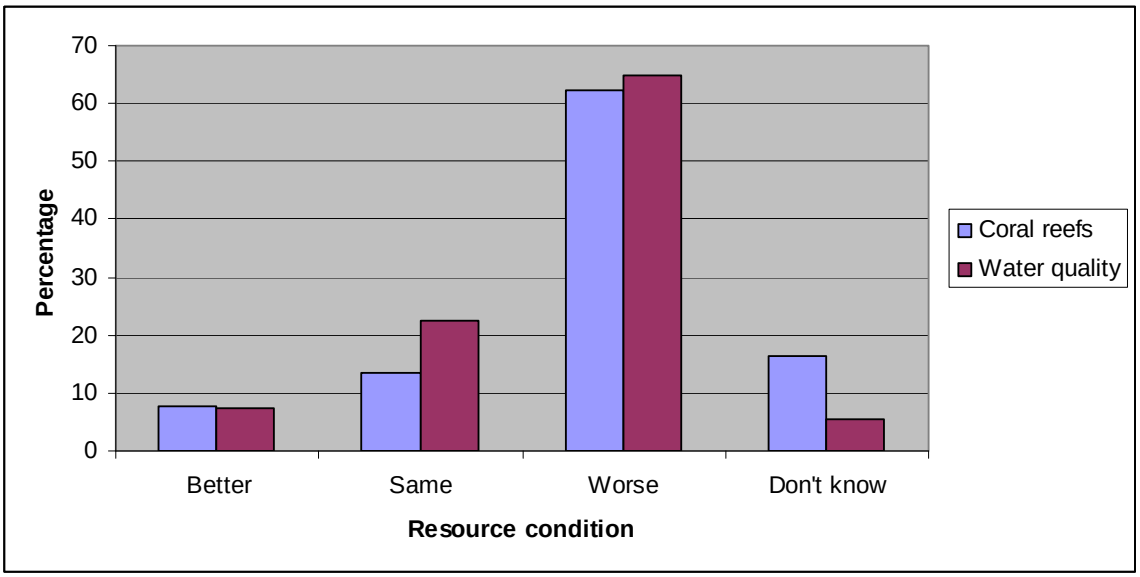

Figure 7: Views on coral reef and water quality conditions

A majority of recreational fishers agreed that both coral reef (62.2%) and water quality (64.9%) conditions had declined since they first started fishing, and less than 10% believed that either resource condition had improved (see Figure 7). Due perhaps to

the indirect actions that most anglers have with coral reefs (i.e. they tend to fish over coral reefs unless they participate in consumptive diving activities), a significantly larger percentage of anglers stated that they did not know about coral reef conditions as compared to water quality (Chi-square test: Chi-square = 76.2; $p < 0.001$).

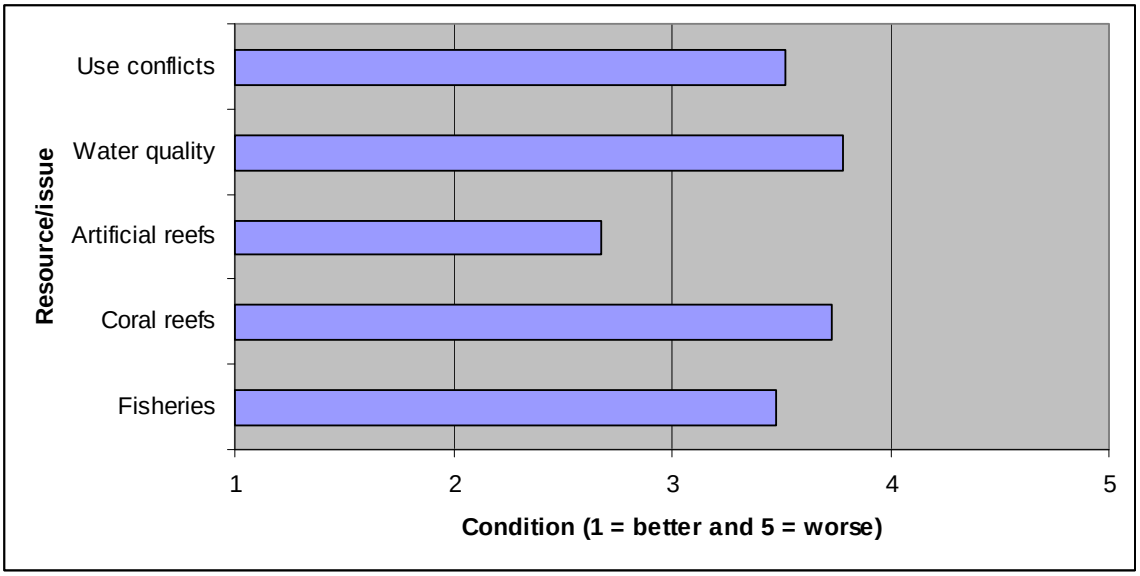

Figure 8: Views on resource conditions

As shown in Figure 8, respondents believed that water quality (mean = 3.78 out of 5, where 1 is better and 5 is worse; SD = 0.95) and coral reefs (mean = 3.74; SD = 0.94) were the resources that had experienced the greatest decline; however, fishers did not rank any resource or issue apart from artificial reefs (mean = 2.68; SD = 1.01) under 3, suggesting that their overall views on resources and issues, including fisheries (mean = 3.47; SD = 1.03) and use conflicts (mean = 3.54; SD = 0.89), were negative. That is, the results show that recreational anglers do not believe that resource conditions have improved since they started fishing. This is noteworthy because greater than 50% of those sampled have fished for longer than the two decades in the SEFCRI region. Likewise, with respect to conditions such as water quality and coral reefs, most recreational anglers believe that there has been a significant decline in resource conditions.

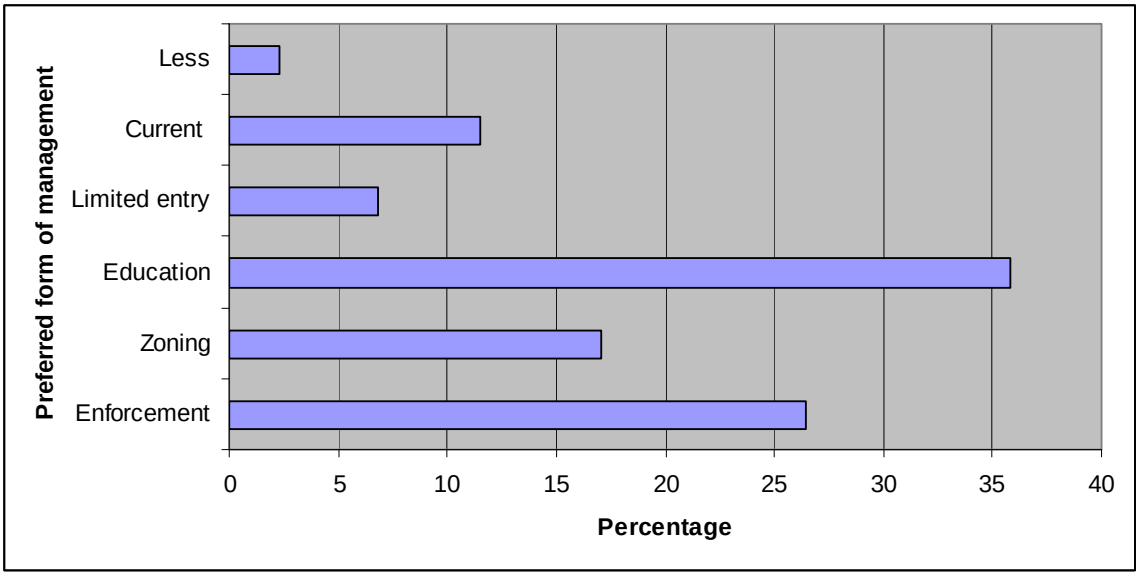

Figure 9: Preferred form of management

When asked about their preferred form of management, most respondents (35.4%) selected education, or interpretative management (see Figure 9). This was followed by increased enforcement (26.7%), zoning (17.2%), and the current form of management (11.5%). The least popular options were limited entry (6.7%) and less management (2.4%). The results demonstrate that the recreational fishing community does not favor decreasing overall management and that while there is less support for limiting participation, almost a fifth of the sample would accept some type of zoning strategy, including marine protected areas (as listed in the survey). However, it is also clear that most fishers prefer a two-pronged approach consisting of greater outreach and education and increased enforcement.

Recreational lobster mini-season survey summary results

The recreational lobster mini-season survey led to the completion of 400 surveys, of which 20 were unusable, due to either being incompletely filled out or because the data collector determined that the information provided was otherwise incorrect. As the study effort represented a pilot, the results are presented mainly in summary format and follow the survey questionnaire.

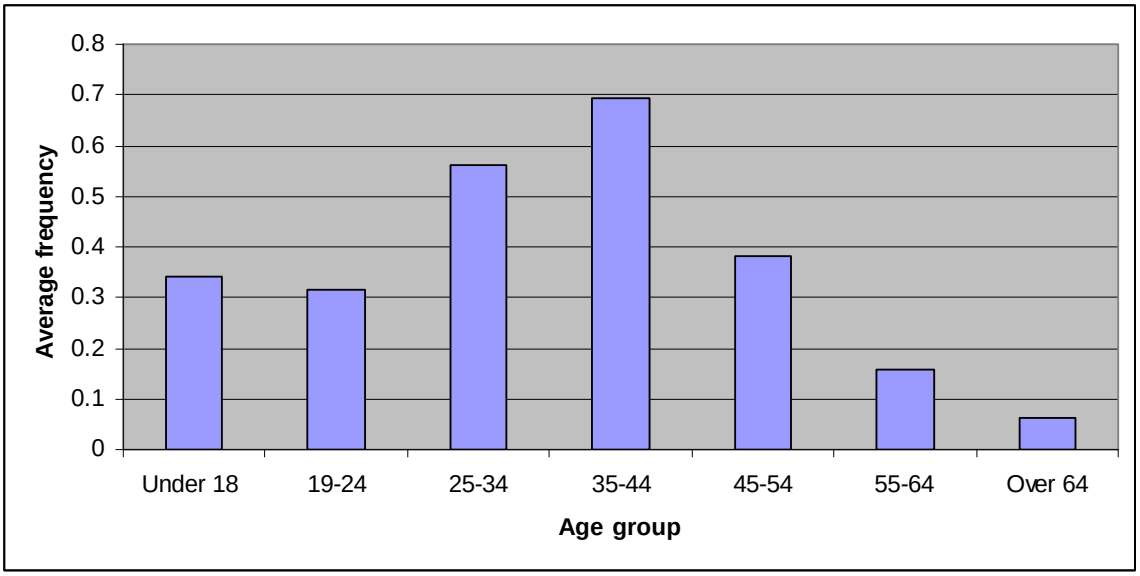

Figure 10: Number of individuals per age group (n = 400)

As shown in Figure 10, respondents provided information on the number of persons in each age group, ranging from less than 18 years old to more than 64 years old. The age groups between 25 and 44 were the most commonly listed, with the 35-44 age group representing the majority (mean = 0.69; SD = 1.01). Generally, the age groups were skewed to the left, due most likely to the rigorous nature of the sport. Over 31% of the sample identified itself as Hispanic (of which 72% was of Cuban origin), and 86.8% was Caucasian by race.

In terms of years fishing, the average among lobster divers was 14.1 years (SD = 12.1). The respondents expected to take an average of 9.86 trips (SD = 14.6) in 2006, and 63.9% believed that they would take ten or fewer trips.

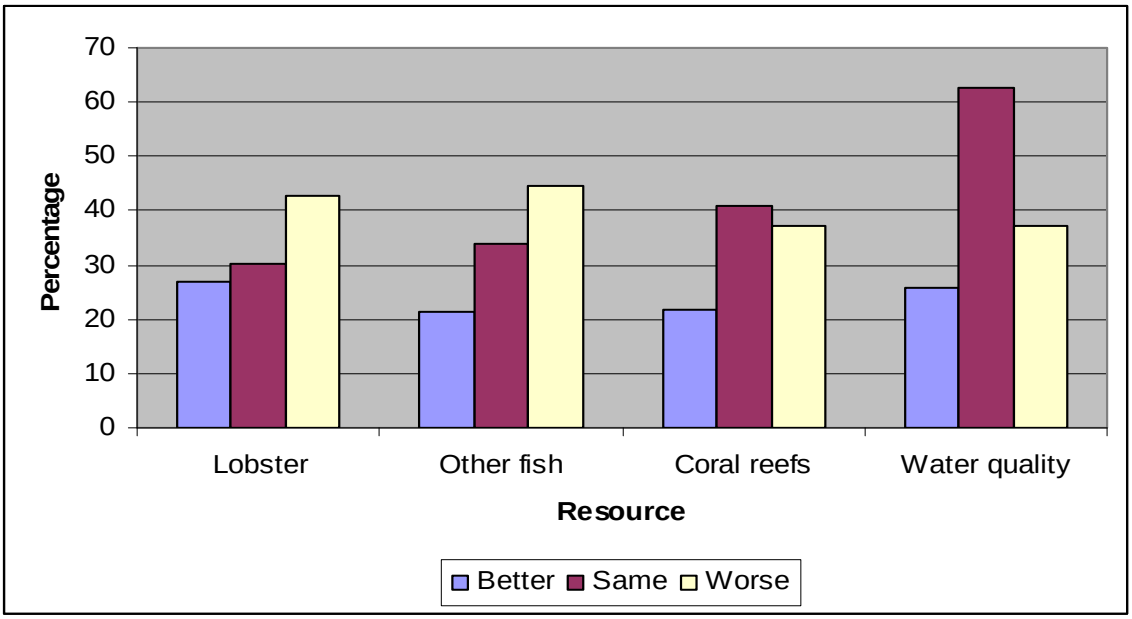

Figure 11: Views on resource conditions

As shown in Figure 11, divers believed that resources such as spiny lobster and other fish were in worse condition than when they first started diving, but more respondents believed that coral reefs and water quality were in stable condition rather than in decline. It should be noted, however, that for each of the resources, the percentages denoting worse conditions exceeded those denoting improved conditions. When the mean responses are compared, it is clear that divers believed that coral reefs were in worse condition (n = 300; mean = 3.46 out of 5, where 1 is better and 5 is worse; SD = 0.99) than other fish (n = 321; mean = 3.32; SD = 1.02), spiny lobster (n = 338; mean = 3.28; SD = 1.13), and water quality (n = 300; mean = 3.23; SD = 0.99).

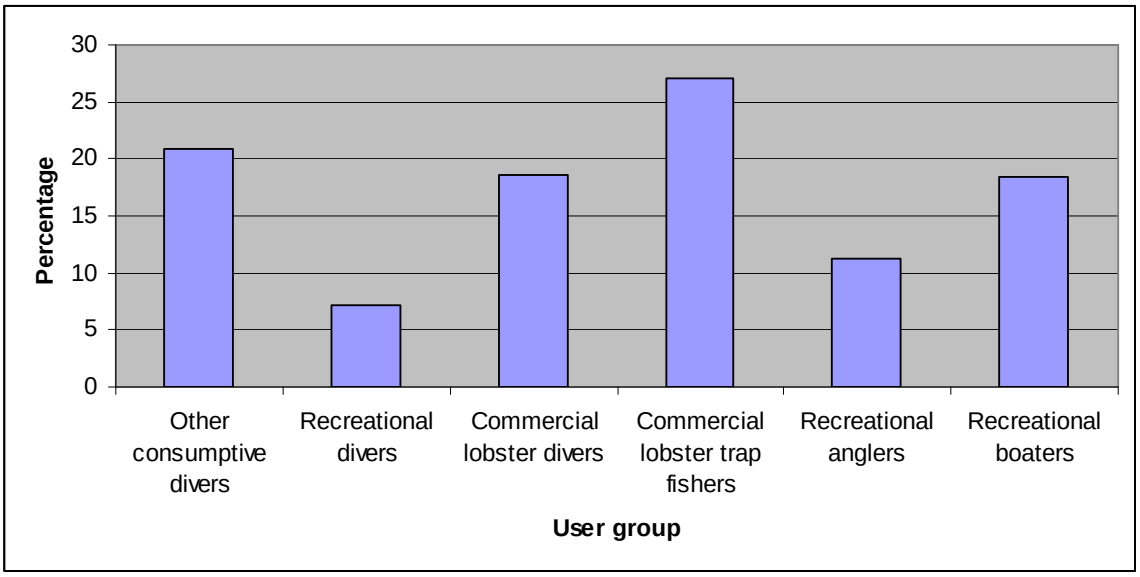

Figure 12: Direct threats to SEFCRI region coral reefs

Respondents believed that commercial lobster trap fishers (27.1%) have the greatest impact on the region's coral reefs, but over a fifth of the sample (20.9%) also identified consumptive divers (including sport lobster divers) as a major impact source (see Figure 12). As might be expected, the group that was perceived to have the least impact was that of recreational, nonconsumptive divers, which only 7.1% of the divers identified as having impacts on coral reefs.

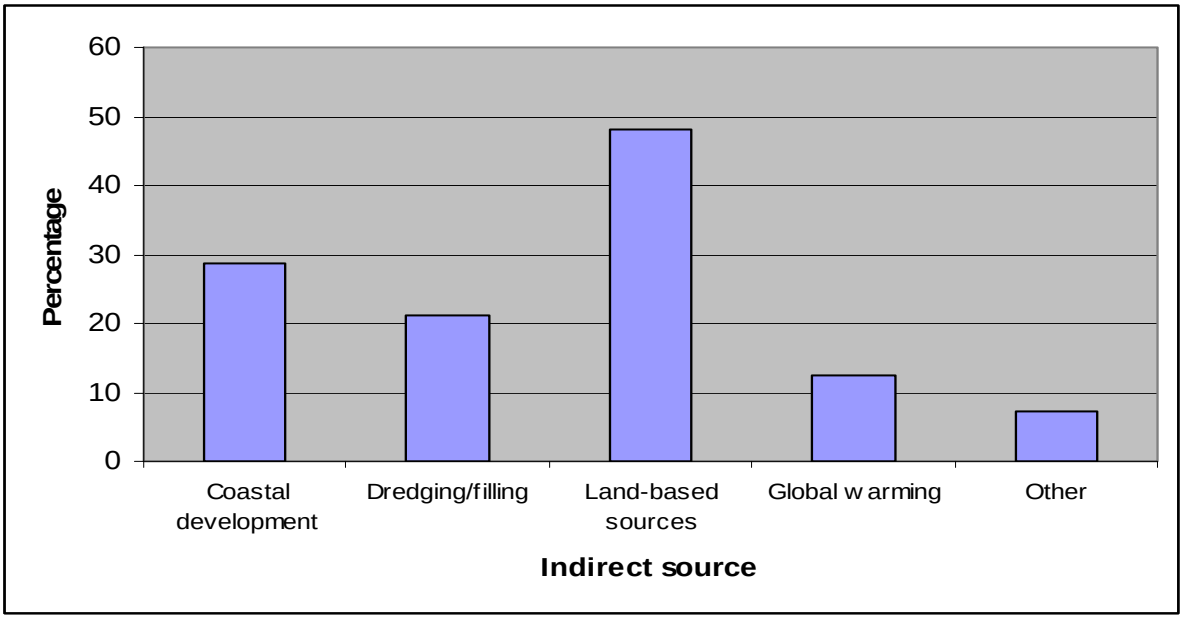

Figure 13: Indirect threats to SEFCRI region coral reefs

When asked to select the most harmful indirect source of coral reef impacts in the SEFCRI region, 48.1% of the divers identified land-based source of pollution, followed by coastal development (28.7%), dredging and filling activities (21.1%), and global warming (12.4%). Among the other threats that respondents (7.4%) identified were hurricanes, population growth, and freshwater input.

In their last trip, 93.5% of those surveyed targeted spiny lobster, but less than 1% (0.7%) actually had a successful trip (where they landed spiny lobster). Also, over a third (35%) of the sample reported diving on artificial reefs, and the average use of artificial reefs by recreational lobster divers was 33.1% (n = 125; SD = 28.9).

Over 28% of the divers reported having changed their fishing area since they began diving. In terms of where they go to fish, 47.6% listed proximity to port as the main reason for their site selection, followed by density of target species and/or correct benthic or water conditions (29.7%). Only 6.6% selected their dive site in order to avoid use conflicts or competition.

Finally, most respondents believed that their activities during the mini-season had between minor and moderate impacts on coral reefs (n = 349; mean = 2.28, where 1 is negligible and 4 is considerate; SD = 0.94), and over three quarters of those surveyed

(77.7%) agreed that recreational lobster diving has some impacts on coral reefs. Asked how management should address impacts, only a small percentage was in favor of increasing recreational fishery access. For example, either lengthening mini-season (15.3% in favor) or increasing bag limits (17.8% in favor). Instead, almost half of the respondents (49.2%) were in favor of reducing commercial fishing effort as a mean of improving management.

Discussion

The DEP SEFRCI region recreational fisher study resulted in a characterization of the southeast Florida recreational fishing community and its participants' views on resource trends, impacts on coral reefs and related resources, and preferences towards management. In addition a pilot, recreational lobster study led to an understanding of use patterns and views on resource conditions and management options within a specialized segment of the recreational fishing community. However, the mail-back study and its findings should be considered in context, as it is not representative of the entire recreational fishing population of the region. Several of the study's findings suggest the need for greater education and outreach within the recreational fishing sector especially with respect to its impacts on SEFCRI region fisheries and, in turn, on the coral reefs.

The mail-back study targeted only individuals who hold a recreational fishing license and would most likely fish coral reef resources in the SEFCRI counties through vessel access. By contrast, due to the fact that they fish from the shoreline and structures, shore-based fishers were not directly targeted by the study. But, it is clear that SEFCRI region shore-based fishers do target reef-related species, as shown in studies in Biscayne National Park and environs (EDAW, 2005; Harper et al., 2000). So, the study findings should be taken in context. The results presented here include the use patterns and views of the recreational fishing sector that most likely uses the region's coral reefs, but the results are not representative of the shore-based, recreational fishing population even though they may target reef fish.

Also, as previously discussed in this report, there are several exemptions to owning a recreational fishing license, including exemptions by age groups, military service, disability, and fishing on a for-hire vessel, among others (FWC, 2007). While headboat and other, for-hire catch and effort information for the SEFCRI region is covered in other sources (Johnson et al., 2007; Brinson et al., 2006), user perceptions on resource conditions and other user groups are not; thus, the present findings should be considered as the views of the *licensed* segment of the SEFCRI recreational fishing sector.

Among the most significant findings from the mail-based survey is the view held by most recreational fishers that their group has the least impacts on coral reefs (contrasted with the view that commercial fishers have the greatest impacts). Johnson et al. (2007) report that recreational landings in the SEFCRI region averaged 66% of total landings

for the time period between 1990 and 2000, and reef fish landings for the recreational sector averaged 68% for the same time period. Although the report found that commercial reef fish catches declined during the 11-year period, no such trend was reported for recreational landings (mean = 3.27 million pounds per year). Similarly, Ault et al. (2001) discuss the 444% increase in the recreational fishing effort (due to increased participation) in south Florida and its impacts on region's reef fisheries, stating that without any effective controls on overall quotas, the fishery has had extensive fishery impacts.

While these statistics do not consider the impacts of gear types or concentrated fishing effort (e.g., the impacts of trap gear on hard-bottom habitats and related debris; Sheridan et al., 2005; Chiappone et al., 2004), it is clear that recreational fishing effort represents the most important fishery sector, in terms of inter-annual effort. As such, if the opinions as determined by this study are consistent across the recreational fishery sector, it is essential that management effort focus on dispelling such misperceptions and establish a conservation ethic that informs recreational anglers on their total share of the impacts and on how they can assist in protecting SEFCRI region coral reefs.

It must also be noted that the recreational fishing sector, as determined from the overall response rate to the mail-back and recreational lobster survey (as well as previous survey efforts with recreational boaters, many of whom are recreational anglers (Shivlani, 2006)), can serve as a useful partner in the effort to protect local, coral reef resources. Respondents' perceptions suggest an overall decline in coral reef and water quality conditions over their fishing history in southeast Florida, and their management preferences demonstrate a desire for stronger enforcement, improved educational efforts for particular sectors of the recreational fishing community, and a willingness to accede to more innovative measures, such as zoning. Most importantly, the study found that the least preferred form of management is less management. This may indicate that there is a perceived need for greater oversight of southeast Florida's marine resources, which in a collaborative manner – with recreational fishers and other user groups – may yield meaningful results in the protection of the region's coral reefs, coral reef fisheries, and associated resources.

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Appendix 1: Mail-based survey instrument

Check (X) the appropriate items or fill in the blanks. Please write an answer that cannot be adequately expressed by checking or filling in the blanks.

1a. Are you a Southeast Florida Resident? [ ] YES [ ] NO

- If NO, then are you a: [ ] non resident seasonal [ ] non resident on vacation

1b. What is your zip code? ___ ___ ___ ___ ___

2. How many years have you been fishing recreationally in south Florida?

[ ] One year or less [ ] 1-5 years [ ] 6-10 years [ ] 11-15 years [ ] 16-20 years [ ] Over 20 years

3. Which of the following includes your age?

[ ] Under 18 years [ ] 18-30 years [ ] 31-40 years [ ] 41-50 years [ ] 51-60 years [ ] over 60 years

4a. Are you Spanish/Hispanic/Latino? [ ] YES [ ] NO

4b. Which of the following best describes your race?

[ ] White [ ] African American [ ] Native American [ ] Asian [ ] Other (_____)

5. Which of the following species did you fish last year? Please check all the species that apply.

[ ] Inshore species (bonefish, tarpon, permit, pompano) [ ] Reef fish (snappers, groupers, grunts, jacks)

[ ] Pelagics (dolphin, king or Spanish mackerel, wahoo) [ ] Highly migratory species (billfish, sharks, tuna)

[ ] Other species (please list_____)

6. Of the species that you listed in the previous question, which species is the MOST important or that which you target MOST frequently? Please only check ONE of the species from the list.

[ ] Inshore species (bonefish, tarpon, permit, pompano) [ ] Reef fish (snappers, groupers, grunts, jacks)

[ ] Pelagics (dolphin, king or Spanish mackerel, wahoo) [ ] Highly migratory species (billfish, sharks, tuna)

[ ] Other species (please list_____)

7. How many fishing trips did you take last year in southeast Florida?

[ ] 1-5 trips [ ] 6-10 trips [ ] 11-15 trips [ ] 16-20 trips [ ] 21-25 trips [ ] 26-30 trips [ ] Over 30 trips

8. Why do you fish the areas that you do – that is, what is the PRIMARY reason that results in where you fish?

[ ] Proximity to port [ ] Density of target species/correct bottom or water conditions

[ ] Lack of competition/conflicts from other users [ ] Other (please list_____)

9. Do you fish artificial reefs in southeast Florida? [ ] YES [ ] NO

- If YES, then what percentage of your total trips is taken to artificial reefs in a typical year?

[ ] Less than 10% [ ] 11-25% [ ] 26-50% [ ] 51-75% [ ] 76-99% [ ] All trips

For the next four questions, please respond to the statements provided in terms of whether you agree or disagree with the statements.

10. Commercial fishers negatively affect my fishing activities, by either fishing in the same areas, targeting the same species, or by other activities.

[ ] Strongly agree [ ] Moderately agree [ ] Neutral [ ] Moderately disagree [ ] Strongly disagree [ ] I don't know

11. Other recreational anglers negatively affect my fishing activities, by either fishing in the same areas, targeting the same species, or by other activities.

[ ] Strongly agree [ ] Moderately agree [ ] Neutral [ ] Moderately disagree [ ] Strongly disagree [ ] I don't know

12. Recreational (both consumptive and nonconsumptive) divers negatively affect my fishing activities, by diving on my gear, targeting the same species, anchoring and diving where I am fishing, or by other activities.

[ ] Strongly agree [ ] Moderately agree [ ] Neutral [ ] Moderately disagree [ ] Strongly disagree [ ] I don't know

13. Recreational boaters negatively affect my fishing activities, by boating over my fishing gear, scaring my targeted species, or by other activities.

[ ] Strongly agree [ ] Moderately agree [ ] Neutral [ ] Moderately disagree [ ] Strongly disagree [ ] I don't know

14. What are the coral reef conditions in southeast Florida and the area(s) where you fish, compared to what they were like when you first started fishing?

[ ] Significantly better [ ] Somewhat better [ ] Same [ ] Somewhat worse [ ] Significantly worse [ ] I don't know

15. What is the condition of water quality since when you first started fishing?

[ ] Significantly better [ ] Somewhat better [ ] Same [ ] Somewhat worse [ ] Significantly worse [ ] I don't know

16. Please circle the general trend in each of the major activities/resources since when you first started fishing, where 1 is better and 5 is worse.

	Better ←----------→ Worse				
a. Fisheries	1	2	3	4	5
b. Coral reefs	1	2	3	4	5
c. Artificial reefs	1	2	3	4	5
d. Water quality	1	2	3	4	5
e. Use conflicts	1	2	3	4	5

17. Which of the following forms of management do you believe needs to be put in place to address resource conditions and trends in southeast Florida to better protect the area and its coastal and marine resources

[ ] More enforcement [ ] Zoning, marine protected areas [ ] More education [ ] Allow less fishing, limit entry

[ ] Leave management as it currently [ ] Less management

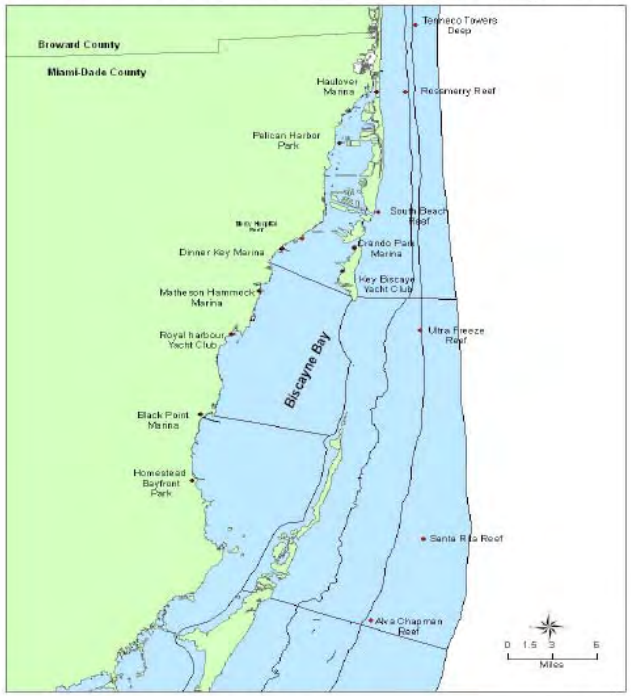
18. In terms of direct impacts on southeast Florida coral reefs, which of the following groups has the greatest impacts/effects?

[ ] Recreational fishers [ ] Recreational divers [ ] Recreational boaters [ ] Commercial fishers [ ] For-hire/charter

19. In terms of indirect impacts on southeast Florida coral reefs, which of the following groups has the greatest impacts/effects?

[ ] Coastal development [ ] Dredging/filling [ ] Land-based pollution (agriculture, sewage) [ ] Global warming

20. Please **draw** in the areas where you usually go fishing, and please mark your primary docking area with an **X**.



21. Have your fishing areas changed since you first started fishing? [ ] YES [ ] NO

- If YES, then how? [ ] I fish closer to shore [ ] I fish further offshore [ ] I fish further north or south

- if YES, then why? [ ] Fewer fish [ ] Too much competition [ ] Pollution [ ] Other _____

Department of Environmental Protection

Coral Reef Conservation Program
Biscayne Bay Environmental Center
1277 NE 79th Street
Miami, Florida 33138

Jeb Bush
Governor

Colleen M. Castille
Secretary

October 5, 2006

Dear Recreational Fishing License holder,

The Florida Department of Environmental Protection is conducting a survey of recreational fishers in Southeast Florida. The survey is part of a study to assess coral reef conditions in Southeast Florida.

Recreational fishing is a very important pastime in Florida, and we are asking for your help, as a recreational fishing license holder, in completing the enclosed questionnaire. Your input will help us develop plans to increase awareness and improve protection of coral reefs in our coastal communities.

The survey will take about 10 minutes to complete. A self-addressed stamped envelope is provided. We would appreciate it if you complete the questionnaire and return it promptly. Your responses will be kept strictly confidential. Only summary statistics will be included in the project's final report.

If you have any questions concerning the questionnaire, please contact Mr. Manoj Shivlani whom we have retained to conduct this survey.

Mr. Manoj Shivlani
DEP Fishing, Diving, and Other Uses Study
P.O. Box 560580
Miami, Florida 33156
Tel: 305-968-7136

Thank you for your cooperation.

Sincerely,

Chantal Collier

Chantal Collier
Coral Reef Program Manager

Appendix II: Recreational lobster diver survey

Florida Department of Environmental Protection (DEP) Southeast Florida Coral Reef Initiative (SEFCRI) Spiny Lobster Diver Study

1. Zip code (or country, if not US)_____

2. Please list the number of persons in your group by age group, starting with your age group. NOTE: Please mark respondent's age group with an asterisk.

____<18 yrs ____19-24 yrs ___25-34 yrs ___35-44 yrs

____45-54 yrs ____55-64 yrs ____>64 yrs

3a. Are you Spanish/Hispanic/Latino? YES NO

- if YES: Puerto Rican Mexican Cuban Other

3b. What is your race?

White African American Native American Asian

Other ( )

4a. How many years have you dived for lobster? _____years

4b. How many trips do you plan to take this season? ____trips

5. What is the condition/abundance of the following resources in the areas where you dive, compared to what it was like when you first started diving?

Resource condition	Lobster	Other fish	Coral reefs	Water quality
Significantly better				
Moderately better				
Same				
Moderately worse				
Significantly worse				

- if the coral reef conditions have changed since you first started diving, then what are the main changes?

_____

6. Please state which of the following uses presents the greatest conflict to your use. Also please state which group you believe has the greatest impact on the region's coral reefs.

Use	Conflict/ impact
1. Other recreational lobster divers/spearfishers	
2. Other recreational divers - nonconsumptive	
3. Commercial lobster divers	
4. Commercial lobster trap fishers	
5. Recreational anglers	
6. Recreational boaters	

7. In terms of indirect impacts on southeast Florida coral reefs, which of the following activities do you believe has the greatest impact?

Coastal development Dredging/filling LBS pollution

Global warming Other_____

8. Please state whether management in the following areas should be increased, decreased, or kept the same.

Management type	Increase/decrease/same
1. 2-day season	
2. Bag limits	
3. Commercial lobster traps	
4. Education and outreach	
5. Enforcement	
6. Marine protected areas	

9. Do you dive for lobster (or to spear fish) in artificial reefs in southeast Florida? YES NO

- if YES, then how often do you dive artificial reefs, as a percentage of total trips in a typical year?___%

10. Please refer to the table below to show the species that you targeted in your last trip and what you caught.

Species	*Targeted*	*Caught*
Lobster		
Reef fish		
Other finfish		
Stone crab		
Other (_____)		

11. Why do you dive the areas that you do – that is, what is the PRIMARY reason that results in where you fish?

a. Proximity to port
b. Density of target species/correct bottom or water conditions
c. Lack of competition/conflicts from other users
d. Other (please list_____)

12. Have you changed your fishing area since when you first started fishing?

YES NO

- If YES, then how and why?

_____

13. Which of the following best describes the level of coral reef habitat damage that you think occurs during mini-season, relative to that which occurs on a daily basis outside of mini-season?

Negligible Minor Moderate Considerate

14. Using the following charts for each species, please draw in or point out the following:

a. Areas fished in the past THREE years with percentage for each area, in terms of the percentage of trips taken to each area
b. Areas fished when you started fishing with percentages fore each area, in terms of percentage of trips taken to each area
c. Areas of user conflicts

Date_____

Location_____

Researchers and managers report

Introduction

The Southeast Florida Coral Reef Initiative Project to *Compile and Compare Scientific Data and Social Perceptions on Reef Conditions and Use* called for identification, assembly, and assessment of existing historical (use) maps, fishery data related to coral reef biodiversity, data on other fishing and diving impacts, the relative importance of reef versus other, offshore fishing (as measured in terms of participation rates and extraction levels), types, quantity, and trends of commercial and recreational extractive and nonconsumptive uses by county, stakeholder concerns on the indirect impacts on reefs, and stakeholder perceptions on artificial reefs. Florida's Local Action Strategy (LAS) developed through the State's membership in the U.S. Coral Reef Task Force, and known as the SEFCRI, identified four focus areas targeting threats to the reefs from Miami-Dade County, through Broward and Palm Beach, to Martin County. This project is a part of the Fishing, Diving, and Other Uses (FDOU) focus area.

The project called for the completion of three tasks: (I) The assemblage of existing information on the resource in the study area from all available sources; (II) the collection of historical and present day social perceptions concerning the resources from various stakeholders; and (III) the completion of a project summary that includes the synthesis of the results form the assemblage of existing information and data collection in a final report with supporting documentation.

As part of the project tasks II and III, the present effort identified and characterized the key, user groups (stakeholders) that utilize and/or rely on the regional coral reefs and associated resources: Commercial fishers; charter, for-hire fishing operations; recreational fishers (consisting of recreational anglers and recreational, consumptive divers); dive operations; researchers and managers; and the surfing community. Stakeholder identification and characterization followed the approach utilized by previous efforts in the region and elsewhere (Shivlani, 2006; Thomas J. Murray and Associates, 2005; Suman et al., 1999).

The region hosts a variety and magnitude of uses, as well as a diversity and density of users; thus the project decided that any study that considers historical and present social perceptions from current and past stakeholders must address the following:

1. What does it mean to be a stakeholder in southeast Florida, and how can that universe be defined (or at least circumscribed) to include all relevant uses?

2. Are there privileged, or dominant, narratives that certain stakeholders (and uses) may present that could undermine the narratives of others; and if so, then how can that be surmounted?

In addressing the first concern, this project worked closely with the FDOU team in bounding the universe of stakeholders, based on all available information, both in terms of information concerning regional stakeholders and theoretical and practical studies on stakeholders in other areas. The second important factor that the project considered was the information it gathered, in that project methodology was refined to reach classes of users to the extent possible. Also, the project focused on the stratification of stakeholder perceptions, where applicable, such that experience and extent of use were considered to provide a more representative opinion.

Researchers and managers

Among the most active and knowledgeable of user groups in the coastal zone, researchers and managers are increasingly recognized as important stakeholders (Weible et al., 2004; Delaney, 2003; Bunce et al., 2000; Cicin-Sain and Knecht, 1998). The uses that researchers and managers represent are not identical, but their focus tends to be similar in that both groups' activities address resource conditions and trends, and other stakeholder uses and impacts, and perceptions and attitudes. Also, unlike other user groups that provide a particular, use-based perspective, researcher and manager views can elucidate effects of multiple use interactions, as well as identify and analyze the impacts of intra and inter-group interactions and conflicts. While not the focus of this report, it is important to emphasize that this perspective does not in any way elevate the research and management community from holding and promoting its values (see, for instance, Weible et al., 2004; Helvey, 2004), which can either converge with other stakeholder values or differ significantly (i.e. heighten or dampen use conflicts and cooperation).

In a recently completed study, similar to that which was conducted as part of this project, Kleypas and Eakin (2007) conducted an Internet-based survey with registered participants of the 10th International Coral Reef Symposium, asking participants to rank the severity of 39 threats to coral reefs in their region of interest. The findings, based on 286 responses from 41 countries, determined that threats were most often associated with anthropogenic impacts, including population growth, coastal development, and overfishing. Within the Caribbean region, researchers ranked population growth as the greatest threat, followed by factors such as coastal development, coral disease, and sea urchin die-off.

While the aforementioned and an earlier, related study (Ginsburg and Glynn 1994) focused in part on the south Florida research and management community, most other research in the SEFCRI region on stakeholders has focused on more traditional users[4]

[4] The adjacent Florida Keys, however, contain excellent examples of research and management based participation as stakeholders in decision-making processes. Since the 1990 designation of the Florida Keys National Marine Sanctuary (FKNMS) and the subsequent formation of the FKNMS Advisory Council and its working groups, research on stakeholders in the Florida Keys has included scientists and managers (Morin, 2001; NAPA, 2001) and, in particular, their role in promoting protected area management (Delaney, 2003; Cowie-Haskell and Delaney, 2002).

(Shivlani, 2006; EDAW, 2005; Johns et al., 2000). The present report in part addresses the information gap through the characterization of a sample of researchers and managers with SEFCRI region interests, including the group's use of the region and its resources, its opinions on other user groups, and its views on resource conditions and trends.

Methodology

The researcher and manager study mostly followed the methodology developed for the commercial fishing study, in that it used a field-based approach to survey researchers and managers; however, the study deviated in its approach from that of the commercial fishing survey and other efforts in that it relied mainly on a directed (as opposed to a random) sample that was obtained from a variety of sources. The study effort consisted of the development of a survey instrument that was modeled after the commercial fishing study survey instrument but also included several questions on research and management issues. Initial contact with each individual was via email or telephone to describe the study, and a face-to-face interview was performed to the conduct surveys. It should be noted that when the researcher or manager was either not located in the SEFCRI region or was otherwise unavailable for a direct interview a phone interview was conducted.

In March 2007, the research team developed the researcher and manager survey instrument. Sections included questions on socio-demographic information, use patterns, attitudes, perceptions, and beliefs. The survey instrument was circulated among the FDOU member team and following revisions, the survey was finalized later that month[5].

Also in March 2007, the research team worked with the FDOU member team to develop a list of SEFCRI region researchers and managers that the latter believed possessed first-hand knowledge of the local resources and resource conditions (via studies within and/or management responsibilities for coastal and marine areas with the SEFCRI region). The research team supplemented this list with names of other researchers and managers that were identified on faculty, researcher, and personnel lists on institution websites. Finally, the research team requested that each survey participant provide names and contact information for other researchers and managers. As the approach did not involve a representative sample of all researchers and managers and rather focused on selecting those individuals identified as having considerable knowledge about and experience in the SEFCRI region, the research team focused instead on interviewing researchers and managers across a variety of institutions and disciplines.

The researcher and manager study led to the completion of 55 surveys, conducted from March to May 2007. The total represented five more surveys or 10% additional

[5] Two additional questions were added during the survey session, as per a request by a survey participant.

sampling than originally budgeted, and these were completed due to respondents agreeing to participate as part of the initial email request.

Results

The results of the survey are presented in the order of the questions as these were provided to the participants (a copy of the survey is available in Appendix I of this report).

Socio-demographic information and research and management profiles

The average age of the researchers and managers interviewed was 3.35 (SD = 1.13), or slightly over 41-50 years old. Almost three-quarters of the sample, or 74.5%, was 41 years or older. In terms of ethnicity and race, 94.5% identified themselves as non-Hispanic, and 92.7% considered themselves as Caucasian. The research and management community supported an average of 2.4 family members (SD = 1.34), including themselves.

Rates of affiliation across all groups were high for researchers and managers, with 61.1% of the respondents reporting that they were members of a regional coral reef organization (most notably SEFCRI, which was listed by 43.6% of the sample), followed by 40.7% who belonged to local research groups, and 40.7% who were environmental group members (including Greenpeace, the Izaak Walton League, The Nature Conservancy, The Ocean Conservancy, and Surfrider Foundation, among others). While local organization affiliation rates were lower by comparision, with only 23.6% belonging to any such group, the overall, high rates of affiliation suggest a fraternity of interests and shared knowledge across the research and management community.

The sample had been working in research and/or management for an average of over 11-15 years (mean = 3.18; SD = 0.95), with 90% having 11 or more years of experience. By contrast, the sample had an average of slightly less than 11-15 years (mean = 2.87; SD = 1.07) working in research and/or management in the SEFCRI region, with under 73% having 11 or more years of experience. Most, or 46.3%, of the respondents were involved in research only, with 24.1% participating only in management. The remaining 29.6% reported conducting both research and management activities. Finally, the sample devoted an average of 64.3% (SD = 30.1) of its activities on coral reefs, compared to 48.9% (SD = 33.0) of its activities to coral reefs in the SEFCRI region. Clearly, the researchers and managers surveyed had other research topics than coral reefs and research areas than the SEFCRI region on which they focused part of their overall effort.

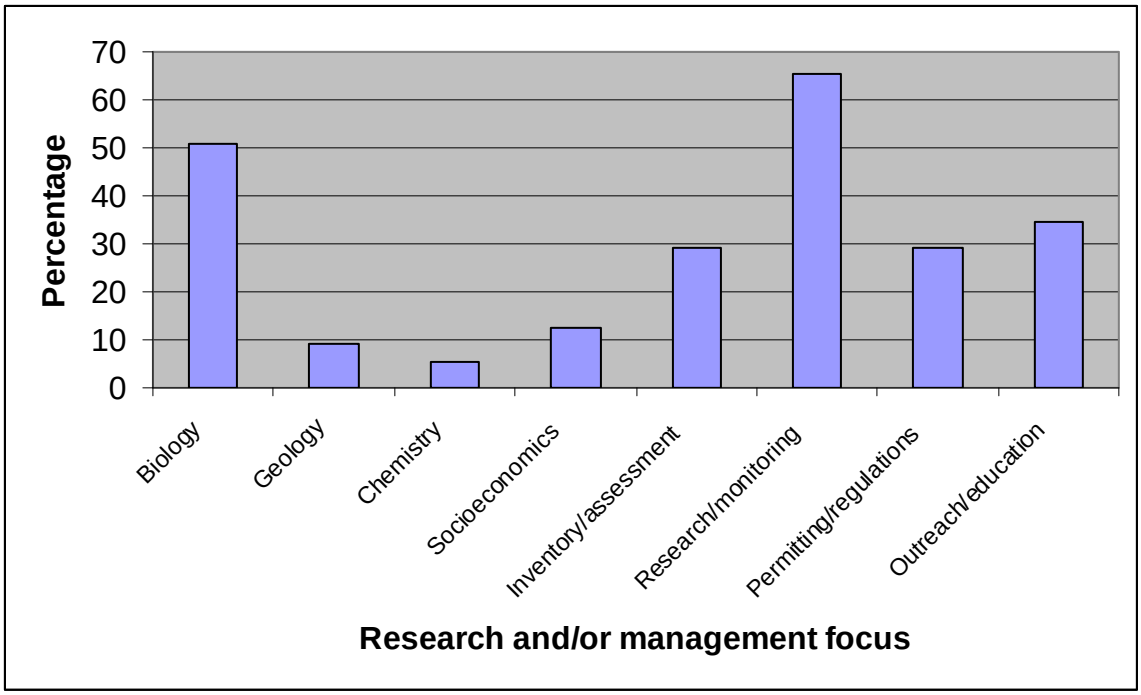


Figure 1: Research and/or management focus (n = 55)

When asked about their research and/or management focus on coral reefs in the southeast Florida region, almost two thirds of the respondents (65.5%) identified research and monitoring activities, followed by biology, ecology, or genetics (50.1%), outreach and education (34.6%), inventory and assessment (29.1%) and permitting and regulatory activities (29.1%) (Figure 1). Socioeconomics, geology, and chemistry were all listed as the primary focus areas less than 13% of the time.

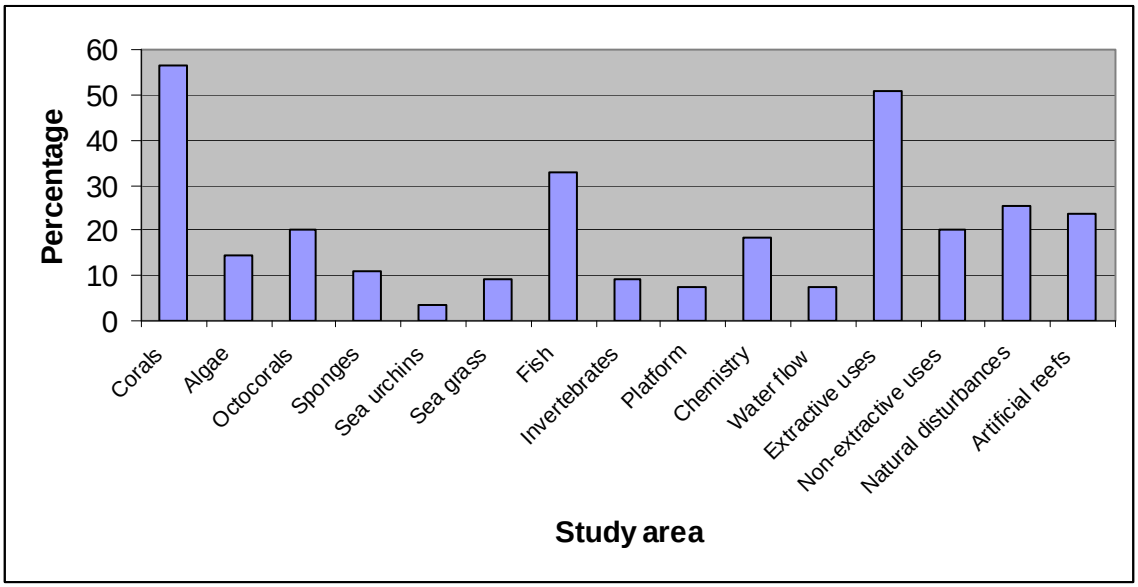


Figure 2: Study area of focus among researchers and managers (n = 55)

As shown in Figure 2, a majority of the sample (56.4%) identified stony corals as their primary focus of study and/or management, compared to 32.7% that targeted reef fish and/or fisheries, 20% that studied octocorals, and 18.2% that assessed water chemistry and/or quality. In terms of activities on coral reef ecosystems, over half of the sample concentrated on extractive uses (such as fishing), followed by natural disturbances (25.5%), and artificial reefs (23.6%). Interestingly, only 20% of the researchers and managers surveyed reported evaluating non-extractive uses and their impacts on coral reef ecosystems.

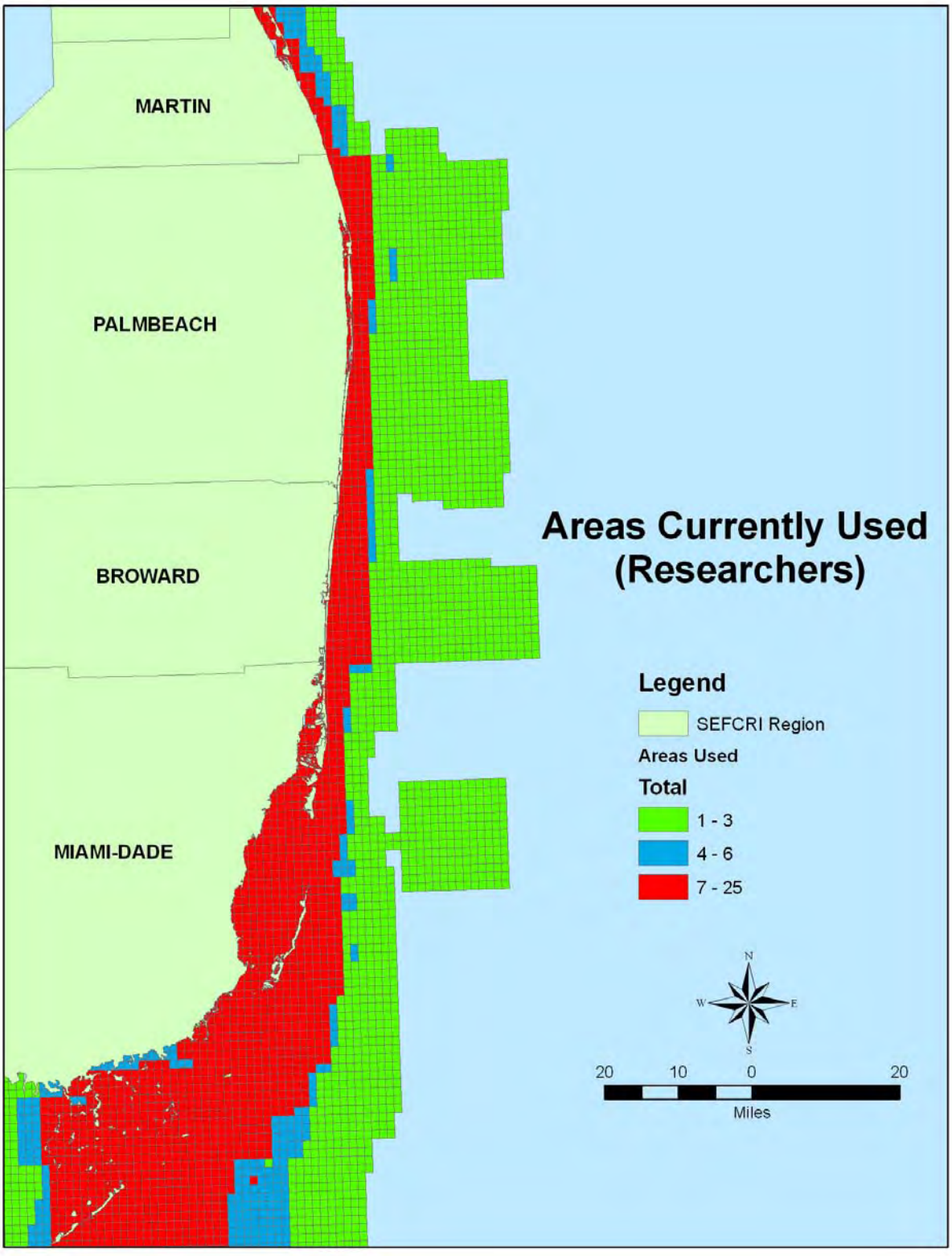


Figure 3: Areas used by researchers and managers – present (total refers to number of respondents)

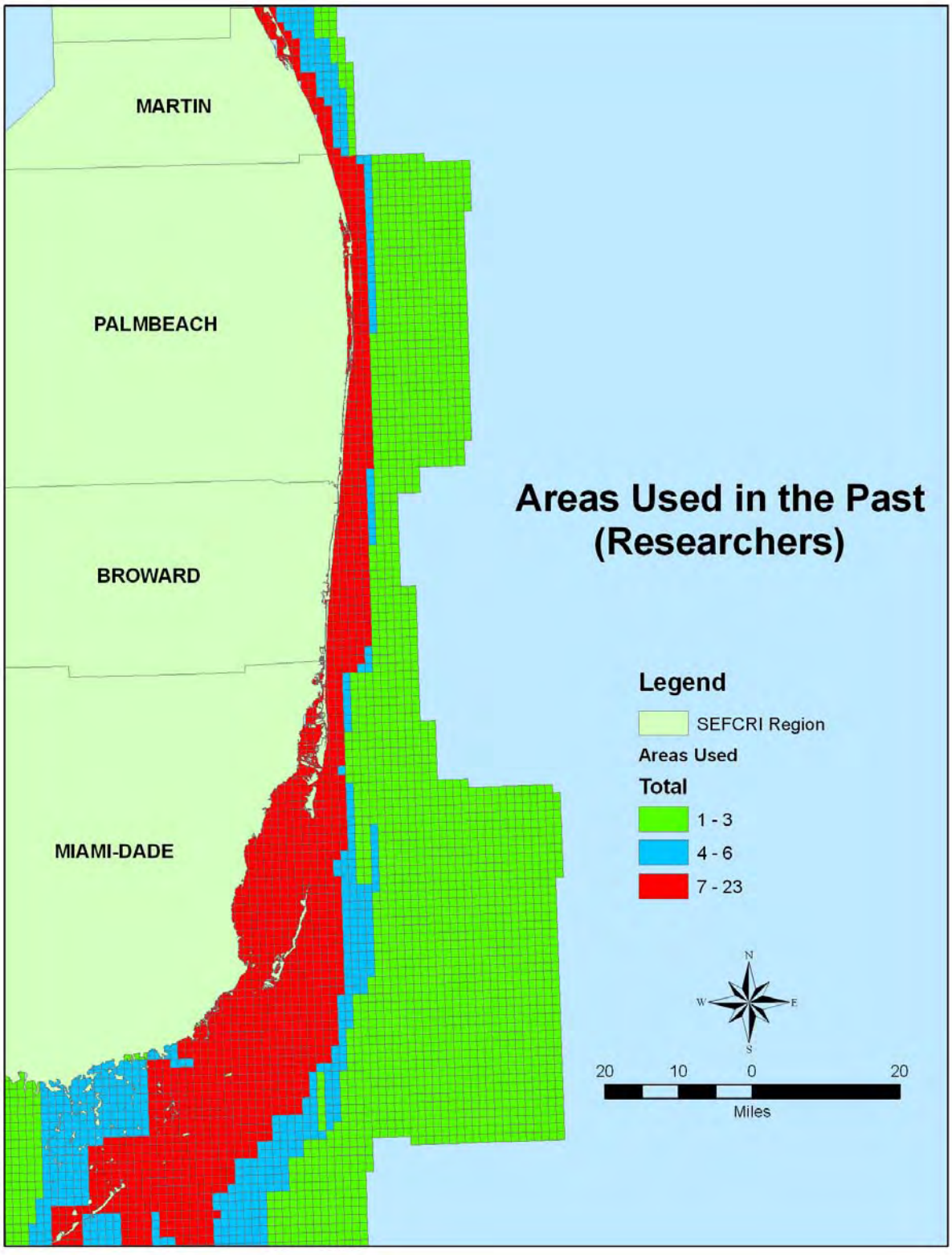


Figure 4: Areas used by researchers and managers – past (total refers to number of respondents)

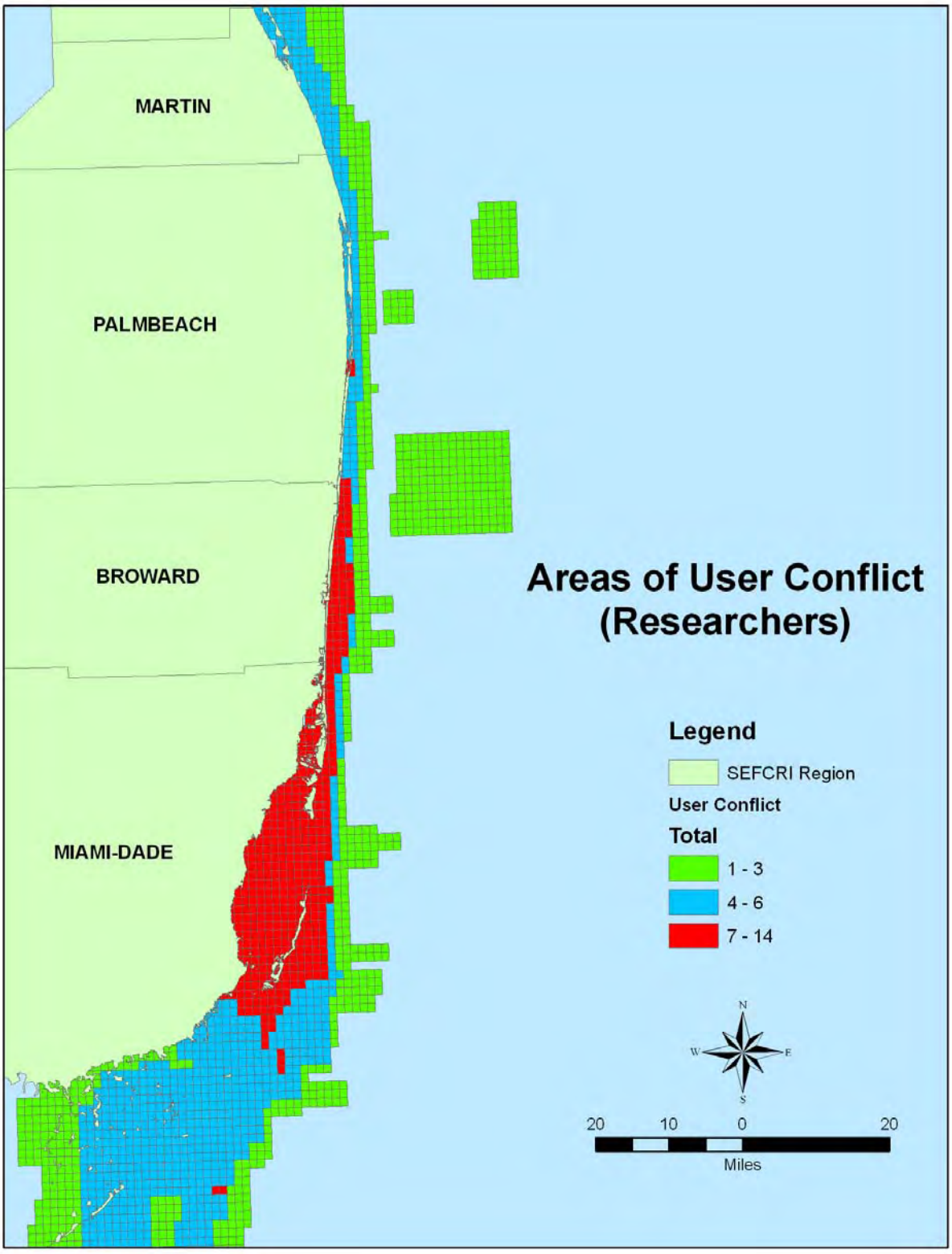


Figure 5: Areas of use conflict for researchers and managers (total refers to number of respondents)

The maps in Figures 3, 4, and 5 show areas of present use, past use, and use conflicts, respectively, as these were identified by the researchers and managers surveyed. Taken together, it appears that use patterns have not changed much within the research and management community, and that the focus has been primarily on areas close to the shore. This is to be expected, as research and/or management in coral reefs was one of the main criteria used to target survey participants. It is important also to note that many researchers and managers identified a geographic focus in the Florida Keys, with more research taking place now in parts of Florida Bay and the Upper Florida Keys than in the past.

Finally, researchers and managers identified areas of use conflict most frequently in nearshore habitats. Areas of high use, such as Biscayne National Park, were singled out as high conflict zones, and generally, the highly populated coastal zones of Broward and Miami-Dade Counties drew the most conflicts.

Perceptions

Researchers and managers provided their views on resource, coral reef, and water quality conditions in the SEFCRI region. The average view on resource conditions was that they were in 'somewhat worse' condition (n = 54; mean = 4.06 out of 5, where 1 is significantly better and 5 is significantly worse; SD = 0.72), which was comparable to coral reef conditions (n = 52; mean = 4.15; SD = 0.66). Respondents believed that water quality conditions were significantly better (mean = 3.77; SD = 0.70) than either resource or coral reef conditions (Kruskal Wallis test: $H = 7.91$; $p < 0.05$); nevertheless, even average water quality conditions were reported to be 'somewhat worse'. Overall, a majority of researchers and managers believed that resource (77.4%), coral reef (85.2%), and water quality (63.5%) conditions were worse currently than when they first started working in the SEFRCI region.

Nearly 82% of the sample agreed that changes have occurred on southeast Florida reefs since the time they began working in the region... Among the changes identified were a decline in coral cover, (40% cited), followed by an increase in algae cover on reefs (30.9%), general coral reef morality (16.4%), higher incidences of coral bleaching (14.5%) and coral disease (12.7%), and fewer reef fish (12.7%). Also, 20% of the sample believed that indirect, anthropogenic impacts had increased, including coastal construction, overpopulation, and declining water quality, all of which are affecting the region's coral reefs.

Figure 6: Level of conflict with other user groups (n = 53)

With respect to other user groups, researchers and managers reported very few conflicts (see Figure 6). The only trend within the results suggested that there were slightly higher rates of conflicts within the recreational user groups, compared to the commercial and for hire sectors. Respondents listed sport (or consumptive) divers as presenting the most conflict (mean rank = 4.66 out of 6, where 1 is most conflict and 6 is least conflict; SD = 2.00), followed by recreational anglers (mean rank = 4.70; SD = 2.00), recreational divers (mean rank = 4.74; SD = 2.96), and recreational boaters

(mean rank = 4.81; SD = 1.96). By contrast, charter fishers (mean rank = 5.57; SD = 1.26) and commercial fishers (mean rank = 5.23; SD = 1.67) presented the least conflict among all user groups. However, it should be re-emphasized that *none* of the groups presented a conflict, as all mean ranks were greater than 4.5, suggesting very low levels of conflict.

These views were reinforced with the sample's views on whether individual user groups presented conflicts. Overall, researchers and managers moderately disagreed that commercial fishers (n = 53; mean = 4.30, where 1 is strongly agree and 5 is strongly disagree; SD = 1.25), recreational anglers (n = 53; mean = 4.06; SD = 1.35), recreational (both consumptive and nonconsumptive) divers (n = 53; mean = 4.13; SD = 1.29), or recreational boaters (n = 53; mean = 3.88; SD = 0.91) negatively affected their activities. These results suggest that as a user group, researchers and managers, do not have direct use conflicts with other users, and this is most likely related to the use profiles of the group (which tends to focus on corals and related organisms) and the nature of their activities (being mainly non-extractive).

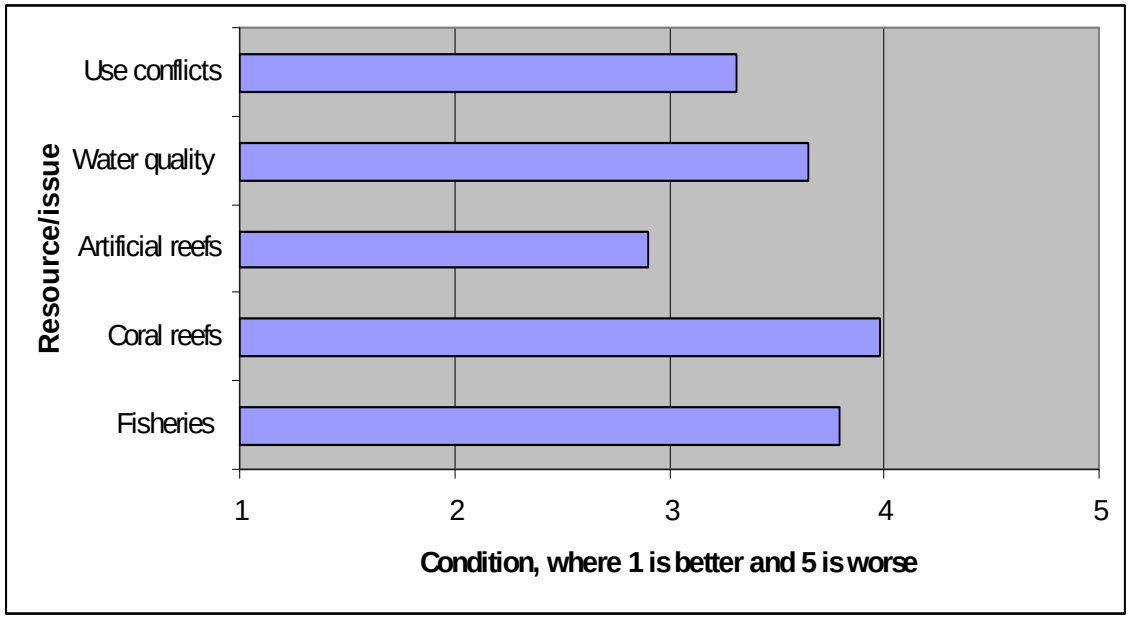


Figure 7: Resource conditions

As shown in Figure 7, researchers and managers believed that coral reefs (n = 50; mean = 3.98 out of 5, where 1 is better and 5 is worse; SD = 0.74) represented the resource in the worst condition, followed by fisheries (n = 47; mean = 3.79; SD = 0.91) and then water quality (n = 49; mean = 3.65; SD = 0.81). Use conflicts were also perceived to have worsened (n = 49; mean = 3.31; SD = 0.80), and only artificial reefs were considered to be in better condition than in the past (n = 42; mean = 2.90; SD = 0.88). These results reaffirm the earlier views on resource, coral reef, and water quality conditions, suggesting that researchers and managers hold a very dim view on the overall resource trends in the SEFCRI region.

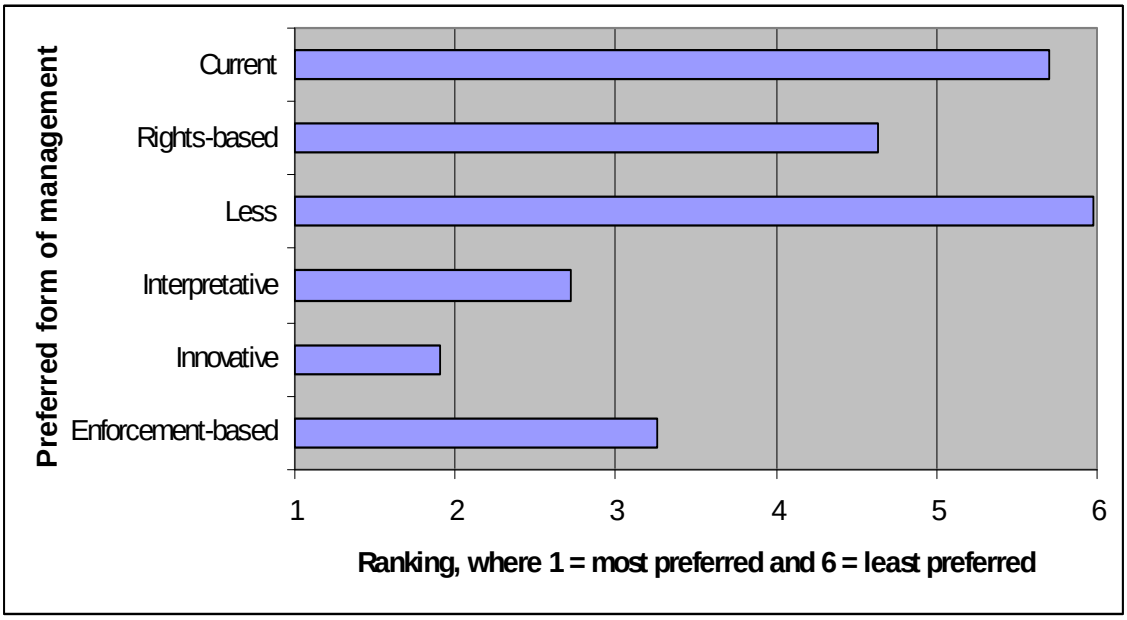


Figure 8: Preferred form of management (n = 54)

The sample believed that the best way to address current resource conditions is by instituting a form of innovative management (mean rank = 1.91out of 6, where 1 represents most preferred and 6 represents least preferred; SD = 1.77), including zoning and marine protected areas (see Figure 8). An innovative approach to management was preferred over all other forms of management, including interpretative (mean rank = 2.72; SD = 2.16) and enforcement-based (mean rank = 3.26; SD = 2.19), which many respondents believed should be used in conjunction with innovative management to achieve overall management objectives. Thus, researchers and managers mostly acknowledged that there is no single, effective management type, and that any approach must incorporate increased enforcement and outreach and education. However, the sample was also clearly against having less management (mean rank = 5.98; SD = 0.14), which it considered as the least preferred form of management. Equally noteworthy, the sample did not rank the current form of management (mean rank = 5.70; SD = 0.86) as significantly preferable over less management (Kruskal Wallis test: $H = 1.02$; $p = 0.31$), suggesting that it did not perceive much difference between the current form of management and less management. Finally, while there was low support for rights-based management (mean rank = 4.63; SD = 1.93), it was still perceived as an improvement over either the current form of management or having less management (Kruskal Wallis test: $H = 13.9$; $p < 0.001$).

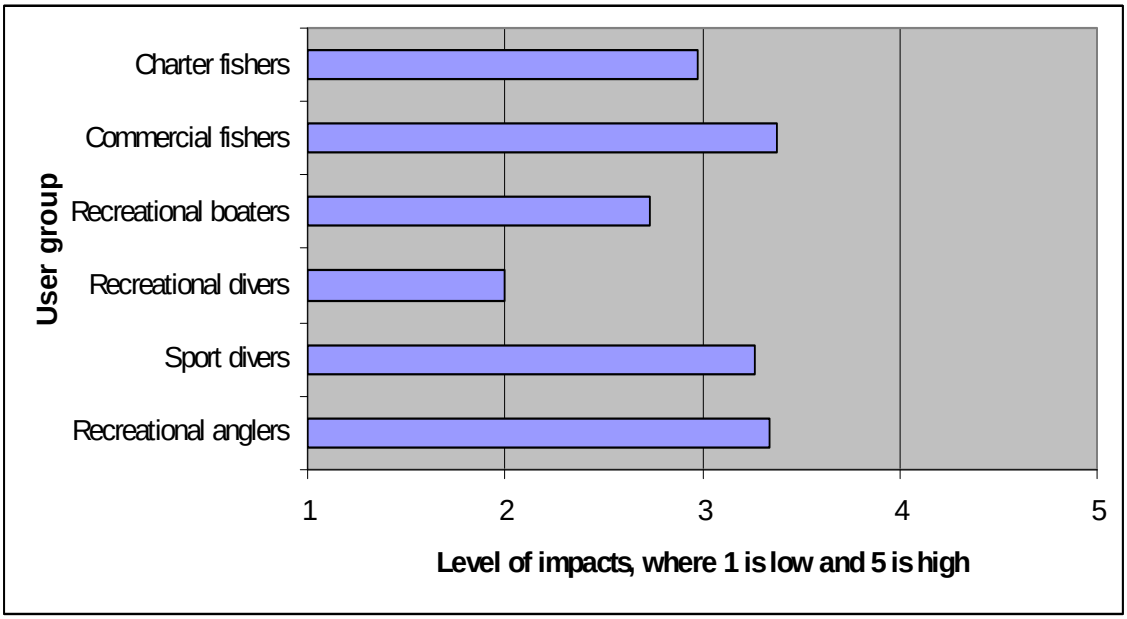


Figure 9: Direct impacts on coral reefs

In terms of direct impacts on coral reefs, researchers and managers identified commercial fishers (n = 52; mean = 3.38 out of 5, where 1 represents low impact and 5 represents high impact; SD = 0.95) as the user group that exceeds all others in direct impacts (see Figure 9). The view was justified by several respondents by adding that commercial trap and net fisheries are the segments of the industry most responsible for these impacts, as these uses result in habitat damage and non-selective overfishing, respectively. However, the sample also considered recreational anglers (n = 53; mean = 3.34; SD = 1.24) sport, or consumptive, divers (n = 52; mean = 3.27; SD = 1.09), and charter fishers (n = 52; mean = 2.98; SD = 1.01) as having comparable impacts as commercial fishers (Kruskal Wallis test: H = 4.61; p = 0.20). In fact, 32.7% of the researchers and managers identified recreational anglers as the group that has the greatest direct impact on coral reefs, compared to 25.5% who identified commercial fishers, 21.2% who identified recreational divers, and 20% who identified recreational boaters. Generally, consumptive activities were perceived as having greater impacts than nonconsumptive activities. Recreational divers (n = 52; mean = 2.00; SD = 0.99) were considered to have the smallest direct impact on coral reefs, significantly lower than the consumptive form of diving (Mann Whitney test: z-score = 5.23 p = 0.00). Finally, recreational boating was ranked as having low impacts (n = 51; mean = 2.73; SD = 1.20) compared to other consumptive uses (Kruskal Wallis test: H = 12.7; $p < 0.05$), but it was considered more harmful than recreational diving (Mann Whitney test: z-score = 3.00; $p < 0.005$).

Researchers and managers believed that coastal development (n = 54; mean = 4.37 out of 5, where 1 represents low impact and 5 represents high impact; SD = 0.76) presented the greatest, indirect threat to coral reefs in the SEFCRI region. Also important were land-based sources of pollution, which the sample ranked second (n

= 53; mean = 4.21; SD = 0.72), followed by dredge and fill activities (n = 53; mean = 3.96; SD = 1.00) and global warming (n = 51; mean = 3.86; SD = 1.17). Importantly, the group considered each threat as having a similar level of impact (Kruskal Wallis test: H = 5.87; p = 0.11) and requiring an integrated, regional approach to indirect impacts. Additionally most respondents identified that coastal development (54.5%), acts as a driver for all other impacts, including global warming (identified by 38.2% of the respondents), land based sources of pollution (23.6%), and dredging and filling operations (10.9%). Many researchers and managers considered global warming, especially via effects such on the intensification of hurricanes, ocean acidification, and higher, mean sea surface temperatures, as representing a significant, indirect threat to coral reefs. This finding was in direct contrast with other user groups' views on global warming, which were in part shaped by a poor understanding of climate change and its effects on coral reefs and/or opinions that global warming either did not represent a significant, indirect threat or that it was less important than the other, more local impacts.

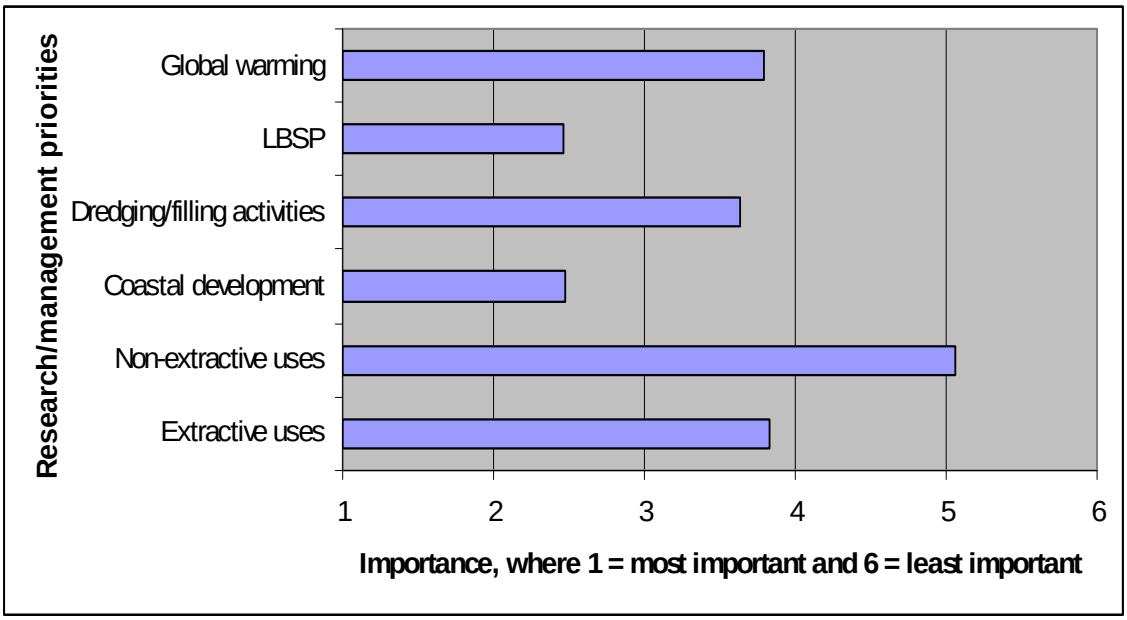


Figure 10: Research and management priorities (n = 54)

Figure 10 shows that researchers and managers ranked land based sources of pollution (LBSP) (mean rank = 2.46 out of 6, where 1 represents most important priority and 6 represents least important priority; SD = 1.91) as the most important research/management priority, slightly ahead of coastal development (mean rank = 2.48; SD = 1.88). Dredge and fill activities ranked third (mean rank = 3.62; SD = 1.98) and were considered significantly less important than LBSP and coastal development (Kruskal Wallis test: H = 12.6; p < 0.005). The prioritization of indirect sources of impacts ahead of direct sources, such as extractive uses (mean rank = 3.83; SD = 1.98) and non-extractive uses (mean rank = 5.06; SD = 1.60), suggests that researchers and managers believe that indirect impacts represent a greater threat to the SEFCRI region and its resources than do direct impacts. The sample also provided additional information on a research or management aspect or area that requires greater effort.

Many respondents believed that there is a need to broaden the research agenda from species-specific management towards ecosystem-based management. Others argued for an integrated approach to management, encompassing the principles of horizontal integration across agencies in an effective form of integrated coastal zone management. Within specific areas, several study participants called for additional studies in coral diseases and their causes, improving the quantification of fishing effort (especially in the recreational fishing sector), and managing indirect impacts, especially coastal construction and LBSP. Finally, a few others called for additional research in management tools, including marine protected area management, enforcement efficacy, and outreach and education strategies.

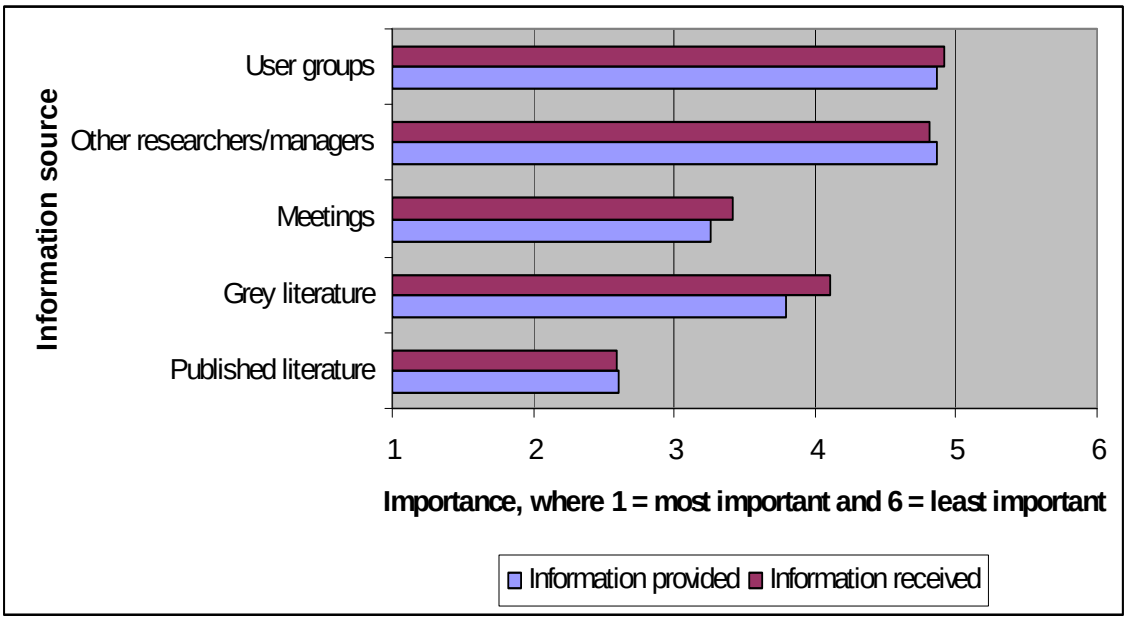


Figure 11: Information sources on research and management activities

In terms of ranking the information describing research and management activities, published literature served as the most important conduit for broadcasting results (n = 53; mean rank = 2.60 out of 6, where 1 is the most important source and 6 is the least important source; SD = 2.13), as well as for receiving information from other studies (n = 52; mean rank = 2.59; SD = 2.13) (see Figure 11). Similarly, meetings served as an important means by which to disseminate (n = 53; mean rank = 3.26; SD = 2.16) and obtain (n = 53; mean rank = 3.41; SD = 2.11) results. Less important than published literature was grey literature, for both providing (mean rank = 3.79; SD = 2.07) and receiving information (n = 53; mean rank = 4.11; SD = 2.34). Obtaining information directly from either colleagues or user groups were the least preferred formats for information exchange. In fact, the sample ranked user groups last in terms of the importance of the information provided to users (n = 53; mean rank = 4.87; SD = 1.93) and the information user groups provided (n = 53; mean rank = 4.91; SD = 1.89). Clearly, there exists a preference towards published literature and formal meetings as the methods to exchange information as compared to direct discussions with colleagues and other users groups. Asked about how information exchange could be improved,

most respondents called for more frequent meetings that should include the research and management community and user groups and which should be conducted in a common language (i.e. elimination of scientific jargon). Many respondents also believed that it is essential to promote the use of the Internet, both in the form of literature and information databases and in research, management, and user group e-mail list server groups (ex. Coral-List), to exchange information; several added that there should be free, on-line access to relevant, published literature on such databases. Finally, many researchers and managers called on greater integration across research and management institutions to be able to disseminate recent findings and to ensure a wide broadcast of results to user groups and the public.

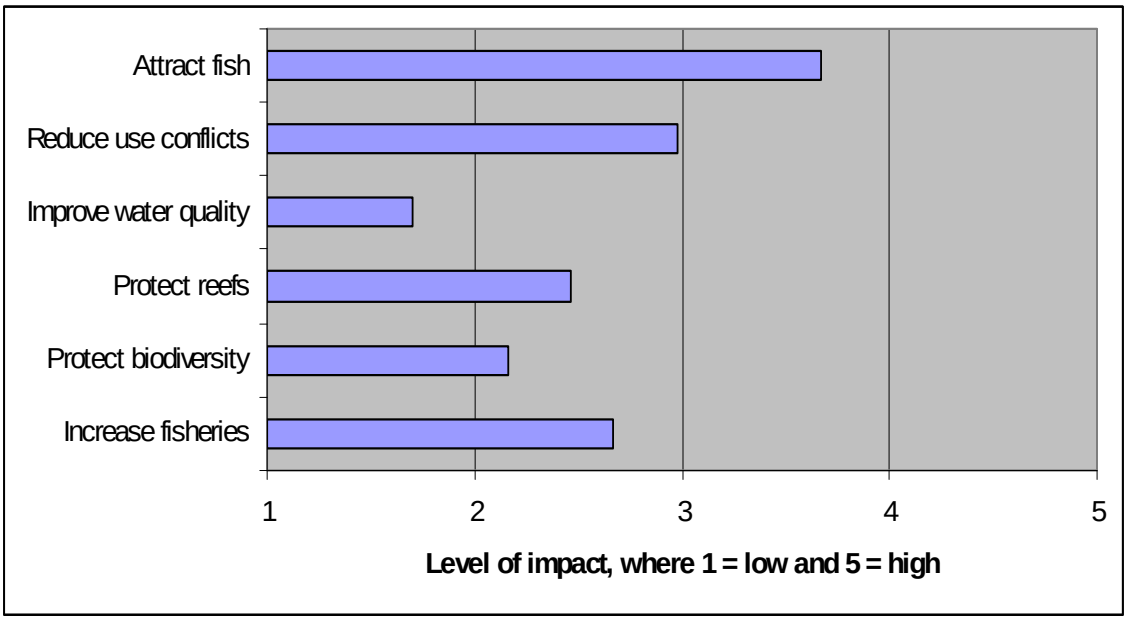


Figure 12: Views on artificial reefs

Less than half of the researchers and managers surveyed (47.3%) reported conducting research or management around artificial reefs in southeast Florida. In terms of the impact of artificial reefs, the sample ranked the ability of the structures to attract fish as the most significant impact (n = 46; mean = 3.67 out of 5, where 1 represents low impact and 5 represents high impact; SD = 1.03) (See Figure 12). Respondents were less certain, however, of the impact that artificial reefs had in increasing overall fisheries (n = 45; mean = 2.67; SD = 1.24) (Mann Whitney test: z-score = 3.75; $p < 0.001$). Apart from attracting fish, the other attribute that the sample ranked higher than others was the role of artificial reefs in reducing user conflicts (n = 47; mean = 2.98; SD = 1.05). Researchers and managers clearly did not view artificial reefs as improving water quality (n = 43; mean = 1.70; SD = 1.17), and the rankings suggest that they were not convinced that the structures had significant impacts in protecting natural reefs (n = 46; mean = 2.46; SD = 1.29) or biodiversity (n = 45; mean = 2.16; SD = 1.22).

Finally, following discussions with the first set of researchers and managers who were interviewed, the research team added two questions to the survey. Because neither

question was asked of the full sample, the findings are discussed in terms of their qualitative information that they provide. The additional questions focused on: (a) the baseline to which coral reefs should be restored, and the most effective means by which this can be accomplished, and; (b) management effectiveness now compared to how it was when the respondent started his/her research or management activities in the SEFCRI region, and what aspects of management should be prioritized to improvement coral reef protection.

Just under half of the respondents believed that it is not possible to restore coral reefs to a particular condition and many argued that management goals should now focus on either maintaining coral reefs at present condition (i.e. prevent further damage) or restore coral reefs to ecosystem health (ex. improve overall functionality). Among those respondents who provided a previous baseline, the most common restoration period was between 20 to 30 years (or to within a generation to a generation and a half). The range provided spanned 40 years, or two generations, with a few respondents calling for a shorter, 10-year, baseline to others calling for a 50 year baseline. Due to the small sample, it is unclear to conclude *why* researchers and managers selected the baseline conditions that they did, but the results suggest that the number of years working in the field may affect the baseline selected. For example, those respondents who had been started their professional careers 10 or fewer years ago provided an average baseline of 20 years, whereas those who had been working in the field for over 10 years provided an average baseline of over 30 years.

With respect to how to achieve coral reef restoration, several respondents suggested using more aggressive and innovative management tools, including increased enforcement, more outreach and education, and the implementation of marine protected areas. Others called for a greater focus into research topics such as the impacts of climate change, coral diseases, and overfishing. Finally, other respondents proposed changing legal regimes to de-politicize the management of coastal and marine resources, increase regional coordination via integrated coastal management measures, and to transform the user ethic from espousing use to promoting preservation.

When asked about management effectiveness, a majority of the respondents agreed that management had improved. A few others believed that there had been no substantive changes, but only a small minority argued that management had worsened. While many researchers and managers reiterated their previous calls for increased enforcement, education and outreach, and zoning strategies, others suggested the centralization or prioritization of coral reef management (across jurisdictional and hierarchical levels of government) as a means by which to improve management effectiveness, arguing that current efforts were either insufficient or fragmented. Finally, many in the sample believed that the current levels of institutional, staff, and financial capacities within organizations responsible for coral reef research and management were at suboptimal levels to provide for effective management. As a result, these respondents proposed that funding and training programs be augmented and

intensified, respectively, to address and mitigate against the increasing impacts on coral reefs.

Discussion

The DEP SEFCRI region researchers and managers study resulted in a characterization of the southeast Florida coral reef research and management community, its participants' views on resource trends, impacts on coral reefs, and related resources, and preferences towards management that can effectively address resource trends. The main findings show that there is consensus within the research and management community that coral reefs in particular and marine and coastal resources in general are in decline in the SEFCRI region. These results are particularly relevant because they are derived from a varied set of researchers and managers, participating in a diverse set of disciplines. Also, while researchers and managers favor innovative forms of management (ex. zoning), the results demonstrate that the sample supports a multi-pronged, management strategy that incorporates various aspects of enforcement, interpretation, and innovation. Finally, as shown by the low support for the current form of management and views on management efficacy, there appears to be dissatisfaction among the research and management community on the current management direction. Many believe that management in its present form may be incapable of addressing the increased regional and global threats facing coral reefs. Respondents felt the solutions required to remedy the situation need to emphasize particular research and management areas and strengthen inter-agency and regional coordination.

The researchers surveyed as part of this study represent a variety of academic fields, including disciplines within the biological sciences (ecology, evolutionary biology, and genetics), chemistry and toxicology, geology, geophysics, and hydrology, sociology, economics, and anthropology, environmental law, and environmental education, among others. Area focus among the managers surveyed includes commercial and recreational fisheries, water quality, land based sources of pollution, artificial reefs, and outreach and education, among others. Respondents ranged from several local and regional universities, county, state, and federal government agencies, and nongovernmental organizations. The majority opinion of the sample was that coral reefs in the region are in a state of decline, corroborated by region-wide assessments for the US (Pandolfi et al., 2005) and the Caribbean (Gardner et al., 2003). Also, as reported by Kleypas and Elkin (2007), who showed that researchers from the Caribbean in their study identified coastal development and population growth as factors for coral reef decline in the region, the results from this study demonstrate that researchers and managers attributed most of the SEFCRI region coral reef decline to land-based, or indirect, causes. Among the most important of these were coastal development and land-based sources of pollution.

The management mechanisms that researchers and managers identified for improving coral reef management in the region were multi-pronged, in that few respondents

agreed that a single strategy would assist in sustaining coral reefs. The preferred combination consisted of the designation of a zoning strategy to reduce impacts on coral reefs, policed by a more effective enforcement framework, and promoted through an intensive interpretative program. The findings of this study also indicate the considerable discontent within the research community on the current form of management in the SEFCRI region. In addition, the findings demonstrate that researchers and managers would favor management that is integrated (or even centralized around coral reef protection) across agencies so that jurisdictional boundaries do not impede the implementation of necessary measures (Cicin-Sain and Knecht, 1999). Finally, several respondents in the sample argued that there is a need for increased communication across researchers, managers, and user groups to improve management and facilitate information exchange, most importantly in a language that is comprehensible across stakeholders.

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Appendix I: Survey instrument

Name _____

Position_____

Telephone_____

Address_____
_____
_____

GENERAL INFORMATION

1. Which of the following includes your age?

18-30 31-40 41-50 51-60 over 60

2a. Are you Spanish/Hispanic/Latino? YES NO

- if YES: Puerto Rican Mexican Cuban Other

2b. What is your race?

White African American Native American Asian Other (_____)

3. How many family members do you support, including yourself?

Myself only 2 3 4 5 6 7 8 over 8

4. Are you a member of any of the following groups?

- Local coral reef research group	YES	NO
- Regional coral reef organization	YES	NO
- An environmental group	YES	NO

Are you a member of other local organizations? YES NO

If YES, then which one(s)?_____

5. How many years have you been a researcher/manager?

1-5 years 6-10 years 11-20 years over 20 years (____years)

6. How long have you worked in research/management in the southeast Florida region?

1-5 years 6-10 years 11-20 years over 20 years (____years)

7. Are you mainly involved in:

Research Research and management Management

8. Which of the following best describes your research and/or management focus on coral reefs in the southeast Florida region?

a. Biology/ecology/genetics
b. Geology and hydrology
c. Chemistry
d. Socioeconomics
e. Inventory and assessment
f. Research and monitoring
g. Permitting and regulations
h. Outreach and education
i. Other_____

9. Within coral reef ecosystems, on which of the following do you most concentrate? You may select more than one.

a. Coral reefs and related organisms
    i. Corals
    ii. Algae
    iii. Octocorals
    iv. Sponges
    v. Sea urchins
    vi. Sea grasses
b. Coral reef fish and fisheries
c. Coral reef invertebrates and fisheries
d. Coral reef platform, structure
e. Water chemistry and quality
f. Water flow in and around coral reefs
g. Uses of and impacts on coral reefs
    i. Extractive uses
    ii. Non-extractive uses
    iii. Natural disturbances
    iv. Artificial reefs

10. What percentage of your research or management activities are devoted or related to coral reefs?
_____%

11. What percentage of research or management activities are devoted or related to coral reefs in the SEFCRI region?
_____%

12. How would you rate the condition of the resources that you study and/or manage since when you first started?

a. Significantly better/healthier
b. Somewhat better
c. Same
d. Somewhat worse
e. Significantly worse

13. In general, how would you rate coral reef conditions in the southeast Florida region, compared to how conditions were when you first started?

a. Significantly better
b. Somewhat better
c. Same
d. Somewhat worse
e. Significantly worse

14. Have the coral reefs changed in southeast Florida since you first started research/management?

YES NO

- If YES, then what are the main changes that have occurred to reefs?

_____

15. In general, how would you rate water quality conditions in the southeast Florida region, compared to how conditions were when you first started?

a. Significantly better
b. Somewhat better
c. Same
d. Somewhat worse
e. Significantly worse

CONFLICTS, TRENDS, AND MANAGEMENT

16. Please rate the following uses in the order of their importance as a conflict to your research/management activities, where 1 is most important and 6 is least important.

Use	Rate
1. Charter fishers	
2. Recreational anglers	
3. Recreational divers – consumptive	
4. Recreational divers - nonconsumptive	
5. Recreational boaters	
6. Commercial fishers	

For the next four questions, please provide your answer on a 1 to 5 scale, where 1 means **Strongly agree,** 2 means **Moderately agree**, 3 means **Neutral**, 4 means **Moderately disagree**, and 5 means **Strongly disagree**

17. Commercial fishers negatively affect my activities, by either fishing in the same areas where I conduct research and/or manage resources.

1 2 3 4 5 I don't know

18. Recreational anglers negatively affect my activities, by either fishing in the same areas where I conduct research and/or manage resources.

1 2 3 4 5 I don't know

19. Recreational (both consumptive and nonconsumptive) divers negatively affect my activities, by diving in the same areas where I conduct research and/or manage resources.

1 2 3 4 5 I don't know

20. Recreational boaters negatively affect my activities, by boating near or over the areas where I conduct research and/or manage resources

1 2 3 4 5 I don't know

21. Can you identify any OTHER user groups with which you have use conflicts (i.e. those groups that affect the areas where you conduct research and/or manage resources)?

22. Please identify the general trend in each of the following as they relate to resource conditions in the areas where you conduct research and/or manage resources.

	Better ←----------→ Worse
a. Fisheries	1 2 3 4 5
b. Coral reefs	1 2 3 4 5
c. Artificial reefs	1 2 3 4 5
d. Water quality	1 2 3 4 5
e. Use conflicts	1 2 3 4 5

NOTE to data collector: Please follow up on each trend with a question on *why* the trend has occurred.

23. Please rate the following forms of management to determine if management needs to be changed to address resource conditions and trends in southeast Florida, where 1 is the most preferred form of management and 6 is the least preferred form of management.

Management	Rating
1. Restrictive, enforcement-based management - higher penalties, more patrols and monitoring	
2. Innovative management - use separation of activities via zoning - marine protected areas	
3. Interpretative management - more outreach and education	
4. Less management	
5. Rights based management (limited entry, property rights)	
6. Current form of management	

NOTE to data collector: Please collect information on the type of management that the interviewee would prefer, especially if it is not included in the table above or if it is a subset of a type of management.

24. In terms of direct impacts on southeast Florida coral reefs, what is the extent of impacts on these areas by the following groups?

	Low ←------→ High
a. Recreational anglers	1 2 3 4 5
b. Recreational divers (consumptive)	1 2 3 4 5
c. Recreational divers (nonconsumptive)	1 2 3 4 5
d. Recreational boaters	1 2 3 4 5
e. Commercial fishers	1 2 3 4 5
f. Charter fishers	1 2 3 4 5

Which group would you state has the greatest direct impacts on coral reefs and how?

25. In terms of indirect impacts on southeast Florida coral reefs, what is the extent of impacts on these areas by the following activities?

	Low ←------→ High
a. Coastal development	1 2 3 4 5
b. Dredging/filling	1 2 3 4 5
c. Land-based pollution (agriculture, sewage, etc.)	1 2 3 4 5
d. Global warming	1 2 3 4 5

Which activity would you state has the greatest indirect impacts on coral reefs and how?

26. In terms of research/management focus/priorities, please rank the following areas as to their importance, where 1 is most important and 6 is least important.

Focus area	Rating
1. Extractive uses	
2. Non-consumptive uses	
3. Coastal development	
4. Dredging, filling, and beach nourishment	
5. LBSP	
6. Global warming/climate change	
7. Other (_____)	

- What aspect or area(s) do you believe need further research/management that are currently not being addressed?

_____

27. Please state whether you receive or provide information on ongoing research and management activities in the SEFCRI region via the following sources AND rank their importance, where 1 is most important and 6 is least important.

Focus area	Rating for provided info	Rating for received info
Published literature		
Grey literature (reports, newsletters)		
Meetings		
Other researchers/managers		
User groups		
Other_____		

- How do you believe that information exchange could be improved?

_____

28. Do you conduct research and/or manage resources around artificial reefs in southeast Florida?

YES NO

29. In terms of artificial reefs, what is the extent of impacts of these structures on the following conditions?

	Low ←------→ High
a. Increase fisheries	1 2 3 4 5
b. Protect biodiversity	1 2 3 4 5
c. Protect natural reefs	1 2 3 4 5
d. Improve water quality	1 2 3 4 5
e. Reduce user conflicts	1 2 3 4 5
f. Attract fish from other areas (ex. natural reefs)	1 2 3 4 5

30. Using the following charts, please draw in or point out the following:

a. Areas studied/managed in the past THREE years with percentage for each area
b. Areas studied/managed when you started with percentages for each area
c. Areas of user conflicts

Surfer report

Introduction

The Southeast Florida Coral Reef Initiative Project to *Compile and Compare Scientific Data and Social Perceptions on Reef Conditions and Use* called for identification, assembly, and assessment of existing historical (use) maps, fishery data related to coral reef biodiversity, data on other fishing and diving impacts, the relative importance of reef versus other, offshore fishing (as measured in terms of participation rates and extraction levels), types, quantity, and trends of commercial and recreational extractive and nonconsumptive uses by county, stakeholder concerns on the indirect impacts on reefs, and stakeholder perceptions on artificial reefs. Florida's Local Action Strategy (LAS) developed through the State's membership in the U.S. Coral Reef Task Force, and known as the SEFCRI, identified four focus areas targeting threats to the reefs from Miami-Dade County, through Broward and Palm Beach, to Martin County. This project is a part of the Fishing, Diving, and Other Uses (FDOU) focus area.

The project called for the completion of three tasks: (I) The assemblage of existing information on the resource in the study area from all available sources; (II) the collection of historical and present day social perceptions concerning the resources from various stakeholders; and (III) the completion of a project summary that includes the synthesis of the results form the assemblage of existing information and data collection in a final report with supporting documentation.

As part of the project tasks II and III, the present effort identified and characterized the key, user groups (stakeholders) that utilize and/or rely on the regional coral reefs and associated resources: Commercial fishers; charter, for-hire fishing operations; recreational fishers (consisting of recreational anglers and recreational, consumptive divers); dive operations; researchers and managers; and the surfing community. Stakeholder identification and characterization followed the approach utilized by previous efforts in the region and elsewhere (Shivlani, 2006; Thomas J. Murray and Associates, 2005; Suman et al., 1999).

The region hosts a variety and magnitude of uses, as well as a diversity and density of users; thus the project decided that any study that considers historical and present social perceptions from current and past stakeholders must address the following:

1. What does it mean to be a stakeholder in southeast Florida, and how can that universe be defined (or at least circumscribed) to include all relevant uses?

2. Are there privileged, or dominant, narratives that certain stakeholders (and uses) may present that could undermine the narratives of others; and if so, then how can that be surmounted?

In addressing the first concern, this project worked closely with the FDOU team in bounding the universe of stakeholders, based on all available information, both in terms

of information concerning regional stakeholders and theoretical and practical studies on stakeholders in other areas. The second important factor that the project considered was the information it gathered, in that project methodology was refined to reach classes of users to the extent possible. Also, the project focused on the stratification of stakeholder perceptions, where applicable, such that experience and extent of use were considered to provide a more representative opinion.

Surfing community

Surfers, due to their close interactions with the nearshore environment, are often among the most dedicated conservationists. Surfers Against Sewage (SAS), a UK-based surfer group, was founded by surfers in the southwestern UK (Cornwall) to protest against local water pollution in 1990, and it now boasts over 20,000 members across various marine recreational activities, including surfers, windsurfers, swimmers, and beach goers (EHP, 1996). The US-based Surfrider Foundation, formed in 1984 to promote awareness about water quality and marine pollution issues, has over 50,000 members in 64 chapters across the US and International Affiliates (Surfrider Foundation, 2007). These groups and their members reflect a conservation ethic that is different than that which is part of other, consumptive stakeholders (such as commercial, charter, and recreational fishers) and understanding their unique knowledge of and perceptions on coral reefs and associated resources can assist in developing a more complete understanding of stakeholder groups in coastal systems.

The effort described in this report concerns a survey of the surfing community, as exemplified by members of the Surfrider Foundation's southern Florida chapters, and the community's use of and views on southeast Florida coral reefs. This group of stakeholders has not been previously characterized in the region, in terms of their use patterns, views on resource conditions, and attitudes towards management (although previous research (Shivlani, 2006) that assessed coral reef awareness did partially characterize surfing activities across southeast Florida, where 3% of beach visitors and 7.5% of residents reported participating in surfing in southeast Florida).

Methodology

Due to the logistical and related difficulties in conducting an in-person, intercept surfer questionnaire, the project team developed an internet-based approach to surveying the surfing community. While surfing is a popular activity in all four SEFCRI counties, it is largely a seasonal sport. Also, previous research (Shivlani, 2006) determined that intercept surveys may not yield suitable response rates, due primarily to the small percentage of beach visitors reporting surfing as an activity. Following consultations with the Surfrider Foundation regional manager for Florida and FDOU team member, Erica D'Avanzo, the project team decided to use Surfrider Foundation southern Florida members as the surfer population to be surveyed as part of the project effort.

The first step in developing the surfer survey instrument used in the project involved generating a draft survey that included questions specific to the surfer community and its uses of the coastal and marine environment, as well as the modification of more general questions on use conflicts, perceptions on resource conditions, and attitudes towards management that were common across all user groups. Once complete, the survey instrument was circulated within the FDOU team for comments, changes, and suggestions. Following the internal comment period, the survey was considered final.

Unlike the other survey efforts included in the project which were implemented using more traditional surveying methodologies (i.e. in-person interviews, mail-back questionnaires), the project team created an online, fillable version for the surfer survey. Using a web-based survey program (www.surveymonkey.com), the project team developed and pilot tested the questionnaire (in a limited capacity, within project and FDOU team members, to determine the ease of completing the survey). Once all participants commented on and approved the online version, a password-protected link to the survey was created and provided to Ms. D'Avanzo, who then announced the survey and provided the link to the 900 Surfrider Foundation southern Florida chapter members.

The survey period commenced on January 29, 2007 and remained active for one month, Members were reminded once to participate in the survey and the last survey was received on February 25, 2007.

In total, 151 surfers participated in the survey. This represents a 16.8% response rate from a population of 900 surfers. Over 87% of the surveys were completed in the first week of the survey session. Potential caveats of using a relatively new technology (i.e. Internet-based surveying) were not encountered. For example, the majority of returned surveys were correctly and entirely completed, and participants did not report experiencing difficulties in completing the questionnaire. To ensure the survey was effectively limited to the target audience, the site was password protected, which also prevented multiple responses from a single computer node.

Results

The results of the survey are presented in the order of the questions as these were provided to the participants (a copy of the survey is available in Appendix I of this report).

Of the 151 respondents, 66.2% identified themselves as southeast Florida residents. As per identification via zip codes, a total of 64 respondents (42%) listed one of the four SEFCRI counties as their present zip code. Miami-Dade (17.2%) and Palm Beach (15.9%) counties accounted for a majority of the SEFCRI-based surfers, whereas only 4.6% were from Broward and Martin Counties, each.

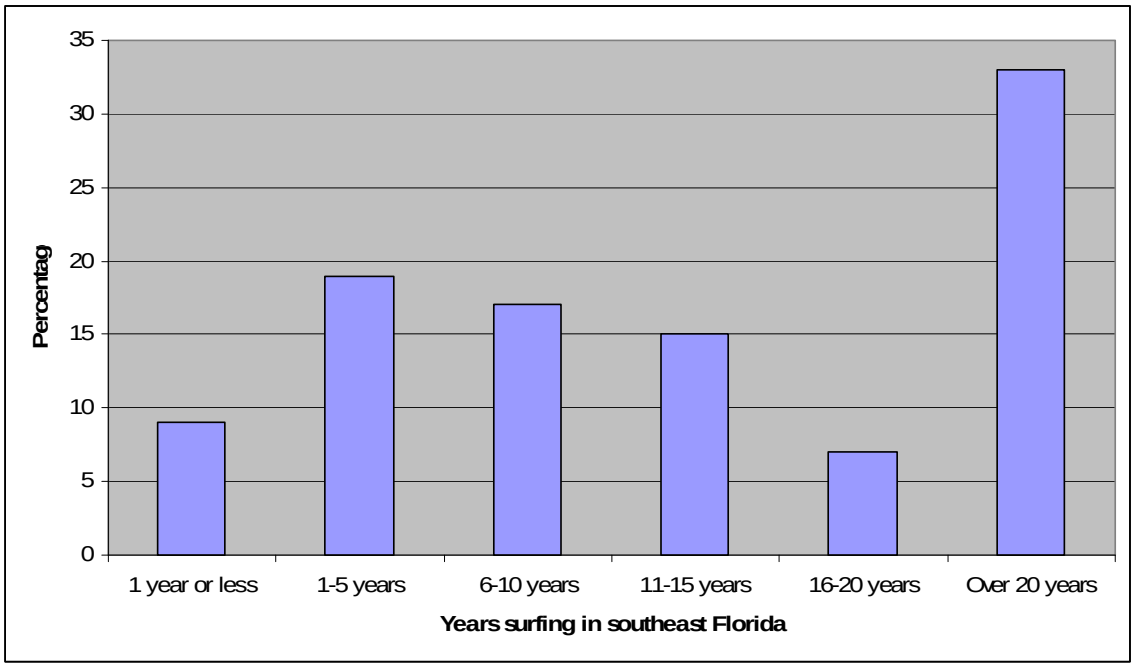

Figure 1: Years surfing in southeast Florida (n = 151)

As shown in Figure 1, respondents had considerable experience surfing in southeast Florida. On average, the surfers reported 11-15 years of experience (mean = 3.91; SD = 1.78). Altogether, 55% of the respondents had 11 years or more experience surfing in southeast Florida, and only 9% had been surfing for less than one year.

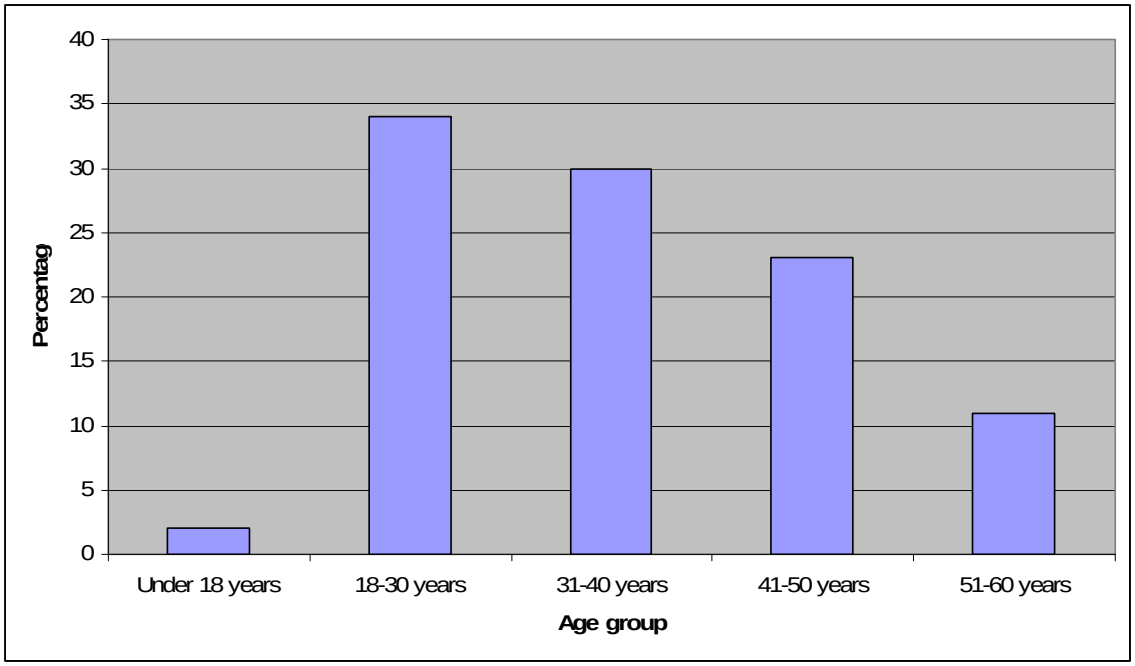

Figure 2: Surfer age groups (n = 151)

As shown in figure 2, over half of the respondents were 31 years or older, but the largest age group was that of 18-30 year olds (34%); by contrast, only 11% of the surfers were over 51 years old, and none were in the over 60 year bracket. On average, the surfers were between 31-40 years old (mean = 3.08; SD = 1.10). Only 10.1% of the sample described itself as being Latino, of which 5.3% were from the SEFCRI region, and all of these respondents were from Miami-Dade County. Also, 90.6% of the surfers identified themselves as Caucasian, and 8.1% stated that they belonged to an 'other' race.

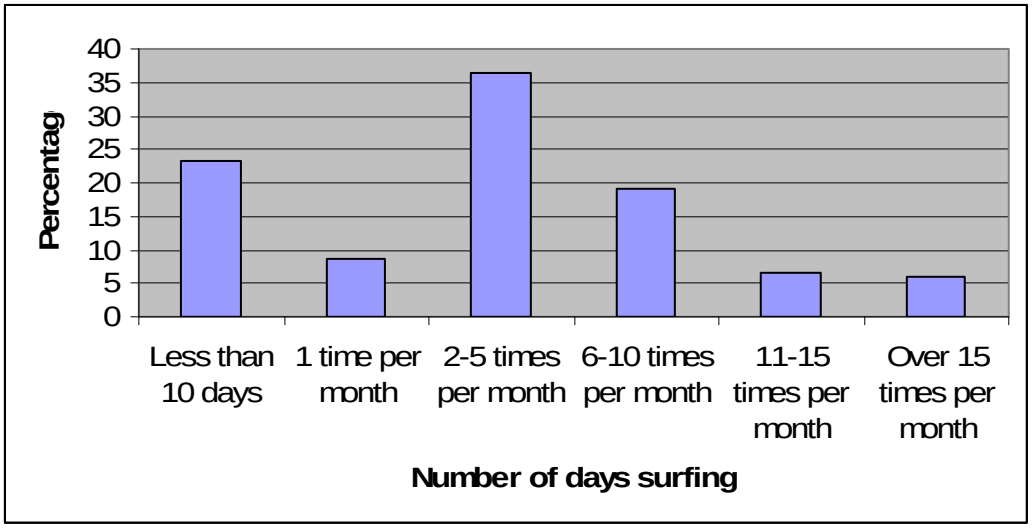

Figure 3: Number of days surfing (n = 151)

Respondents stated the number of times that they surf in a year. Figure 3 shows that over a fifth of the sample reported that they surf for less than 10 days per year in southeast Florida; of this total, only 8% were from the SEFCRI region, suggesting more consistent use among those residents. Over 35% of the surfers, representing the majority, stated that they surf 2-5 times per month, and the percentage of surfers that surfed more often than that declined with each higher surf frequency group (ex. only 6% of the sample reported surfing over 15 times per month).

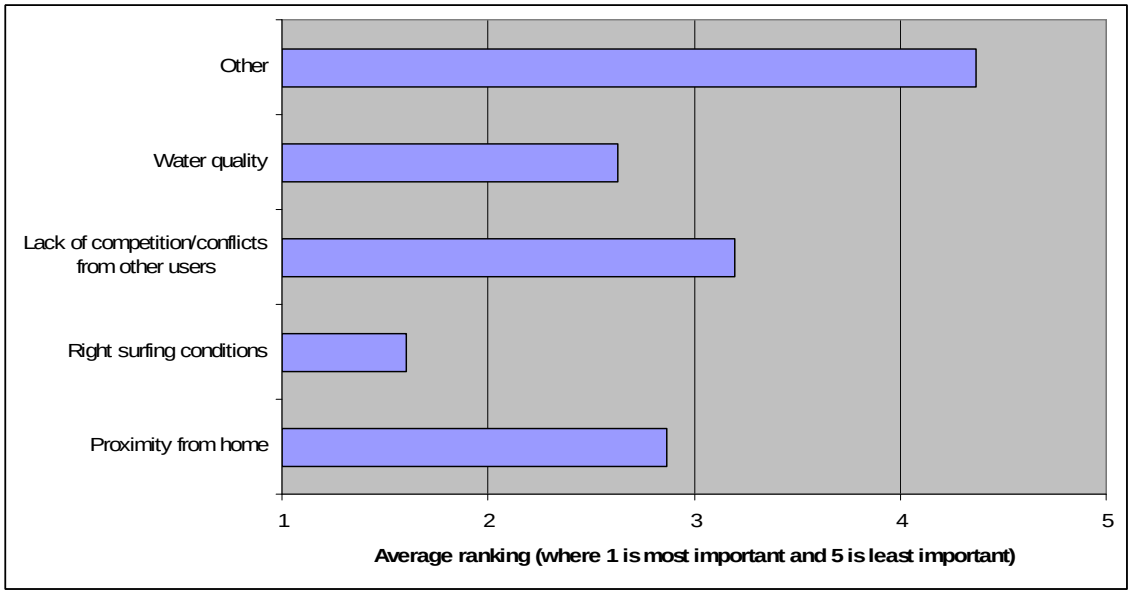

Figure 4: Reasons for surf site selection,

When asked to rank the main reason for why they surf where they do (where 1 is most important and 5 is least important), surfers ranked the right surfing conditions (n = 123; mean = 1.60; SD = 1.00) as the most important reason (Figure 4). This was followed by water quality (n = 129; mean = 2.63; SD = 1.15), which ranked higher than proximity from home and lack of competition or conflicts, suggesting that healthy surf conditions heavily influence surfer choices (and even more so than the location of the surf site). Less important were factors such as proximity (n = 131; mean = 2.87; SD = 1.25) and lack of competition or conflicts (n = 134; mean = 3.20; SD = 1.08). Fifty eight percent (58%) of the sample listed Sebastian Inlet as a surf site that they visit, and because only a small percentage of the respondents actually reside in and near that area, it is clear that Sebastian Inlet offers the right surfing conditions that attract regional use. Other popular areas included Jupiter Inlet (31.7%), Delray Beach (22.8%), Miami Beach (21.4%), and Lake Worth Inlet/Pumphouse or Reef Road (20.7%). All other sites attracted less than 20% of the surfers. However, 37.2% of the sample also listed 'other' sites, 10% of these sites were located in the SEFCRI region; other, neighboring areas that were also listed were Cocoa Beach, Melbourne, and New Smyrna Beach.

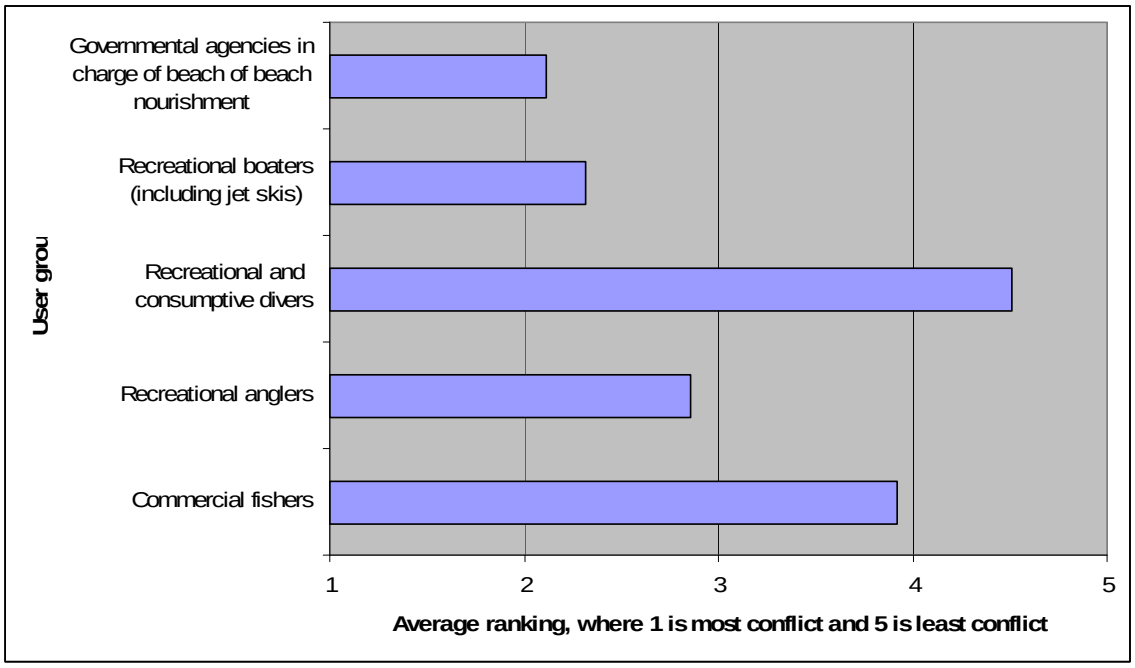

Figure 5: Perceptions on use conflicts

As shown in Figure 5, government agencies responsible for beach nourishment were selected as the user group that most adversely affects surfing activities (n = 125; mean = 2.11 out of 5, where 1 represents the most conflict and 5 represents the least conflict; SD = 1.31). Recreational boaters (particularly personal watercraft operators) were second (n = 128; mean = 2.32; SD = 1.24). The other stakeholder groups (recreational anglers (n = 118), consumptive and nonconsumptive divers (n = 117), and commercial fishers (n = 116)) were not perceived as having significant impacts as all three groups had average rankings above 2.5. These perceptions are mainly consistent with surfer use patterns, which tend to be concentrated in the nearshore area. As a result, they are most likely to have conflicts with shallow water craft such as personal watercraft. Also, the conflict reported with government agencies is not spatial (i.e. for competition over common areas), but stems from special interest because surfers believe nourishment activities alter breaks, impact surfing conditions, and degrades water quality (mainly during the project construction phase). Surfers also listed other sources of conflict that were not included on the ranking list. The most common source of conflict listed was limited access (as related to limited public access areas near developments that discourage beach visits), which 40% (of the 52 respondents who answered this question) believed was negatively affecting their ability to surf in the region. Others listed debris, construction, and tourists (displaying poor etiquette) as additional sources of conflict.

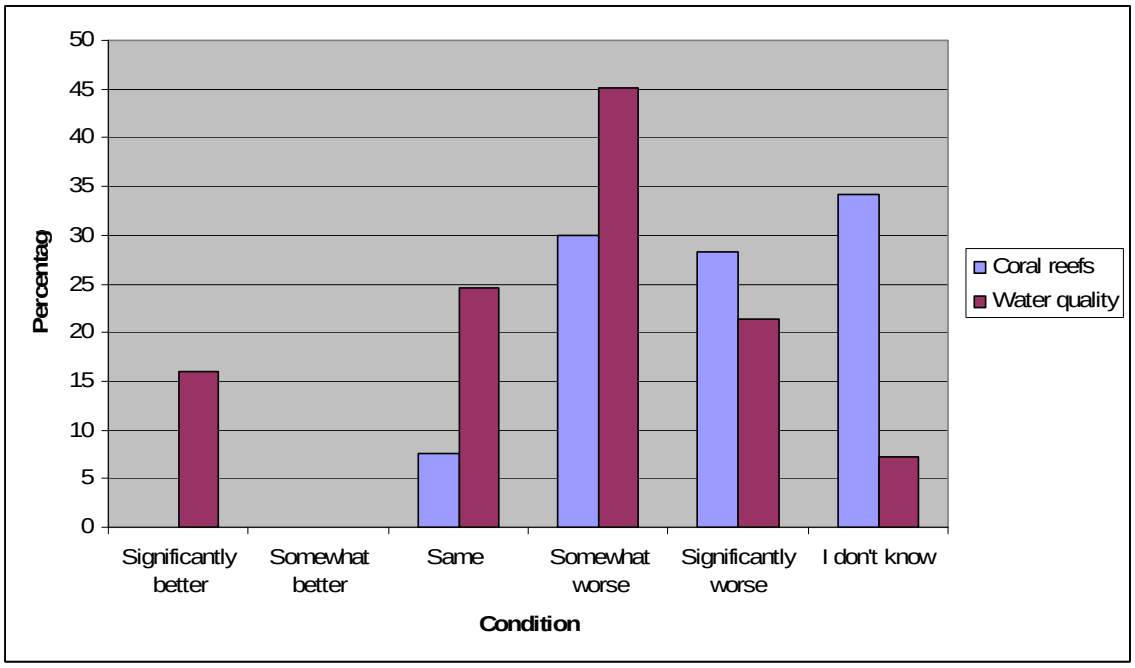

Figure 6: Perceptions on coral reefs (n = 120)

Most surfers (58%) who commented on the condition of coral reefs in southeast Florida believed that the reef conditions were worse than when they first started surfing (Figure 6). However, a large percentage (34%) of the respondents stated that they did not know enough to answer the question. Importantly, only 8% of the surfers believed that the region's coral reefs remained unchanged, and none felt that coral reef conditions have improved. With respect to water quality, two thirds (66%) of the respondents agreed that water quality conditions were worse than when they first started surfing. Only 2% believed that water quality had improved, and 25% felt that it remained unchanged. Unlike in the question concerning the condition of coral reefs where over a third of the sample did not know whether changes had occurred in coral reefs, only 7% of the respondents did not know enough about water quality to comment on its condition (Chi-square test: Chi-square = 40.02; $p < 0.005$). Also, changes in water quality conditions were in part related to the respondents' experience; that is, surfers who reported water quality as having worsened had been surfing significantly longer (mean = 4.31; SD = 1.69) than those reported quality as improved or unchanged (mean = 3.45; SD = 1.71) (Mann Whitney U-test; $p = 0.03$). Taken together, the surfing community has a very dim view on coral reef and water quality conditions, and it appears that surfers with more experience perceive a long-term decline in such conditions.

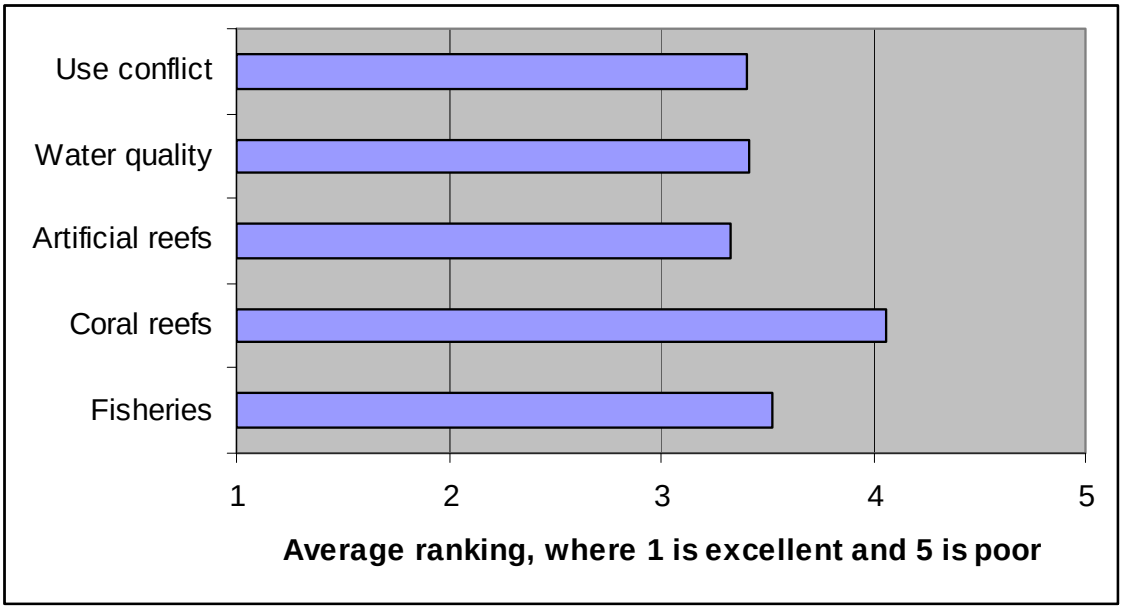

Figure 7: Perception on resource/activities trends

With respect to resource conditions (where 1 is excellent and 5 is poor), surfers provided their opinions on conditions such as use conflicts (n = 120), water quality (n = 125), artificial reefs (n = 119), coral reefs (n = 122), and fisheries (n = 122) (Figure 7). All conditions were, on average, skewed towards the 'poor' end of rankings, in that none of the conditions ranked 2.5 or lower (it should be noted, however, that on resources such as artificial reefs and fisheries, 30% or more of the respondents believed that they did not know enough about these resources to provide an opinion on their conditions). Instead, coral reefs and fisheries were perceived as being in the worst condition, followed by water quality, use conflicts, and artificial reefs. As in the questions concerning trends in coral reefs and water quality, the results indicate dissatisfaction with the region's coastal and marine resources and/or conditions.

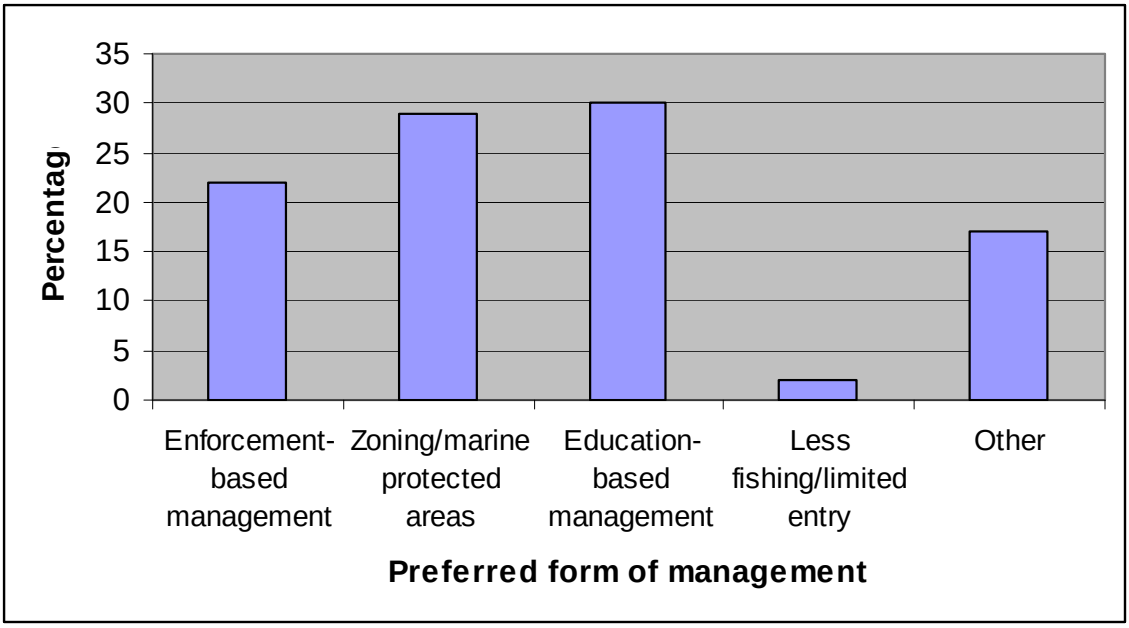

Figure 8: Preferred form of management (n = 126)

Surfers also provided their opinions on preferred forms of management, as shown in Figure 8. As could be expected by their views on resource trends and conditions, none of the respondents favored the current form of management or less management. Very few (2%) favored limiting fishing or implementing limited entry in fisheries, and more were in favor of increased enforcement (22%). However, the two most popular forms of management were the institution of zoning, in the form of marine protected areas (29%), and more education and outreach (30%). Several surfers who listed 'other' believed that no single option is sufficient, and many of them listed education and enforcement as a combined set of changes by which to improve management. Others believed that the focus should be on reducing land-based sources of pollution, including agricultural runoff and sewage as a means by which to improve resource conditions.

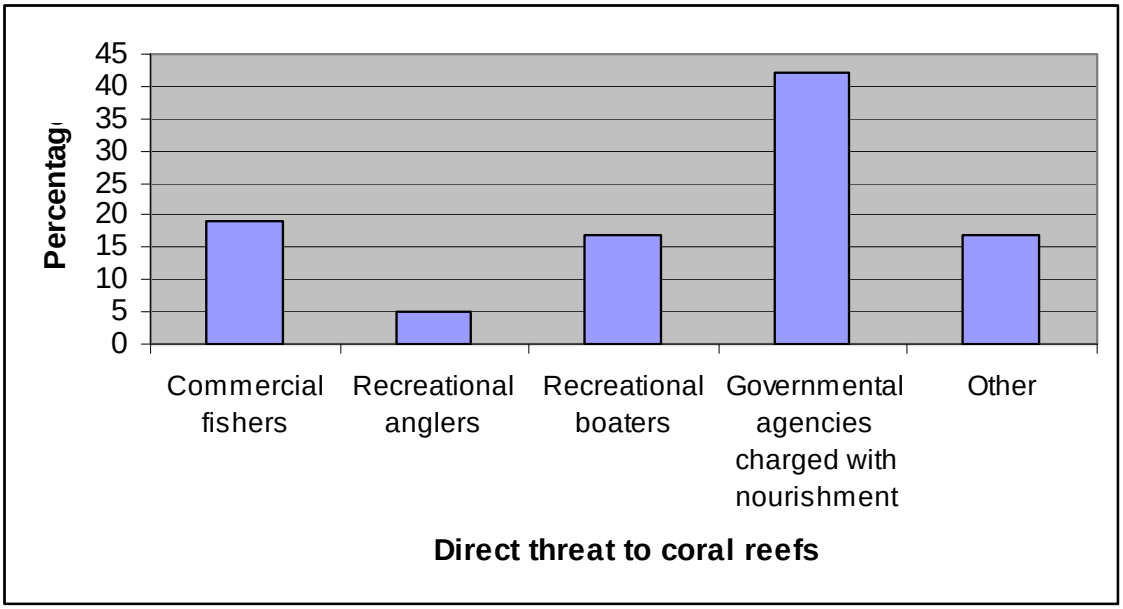

Figure 9: Primary direct threats to coral reefs (n = 123)

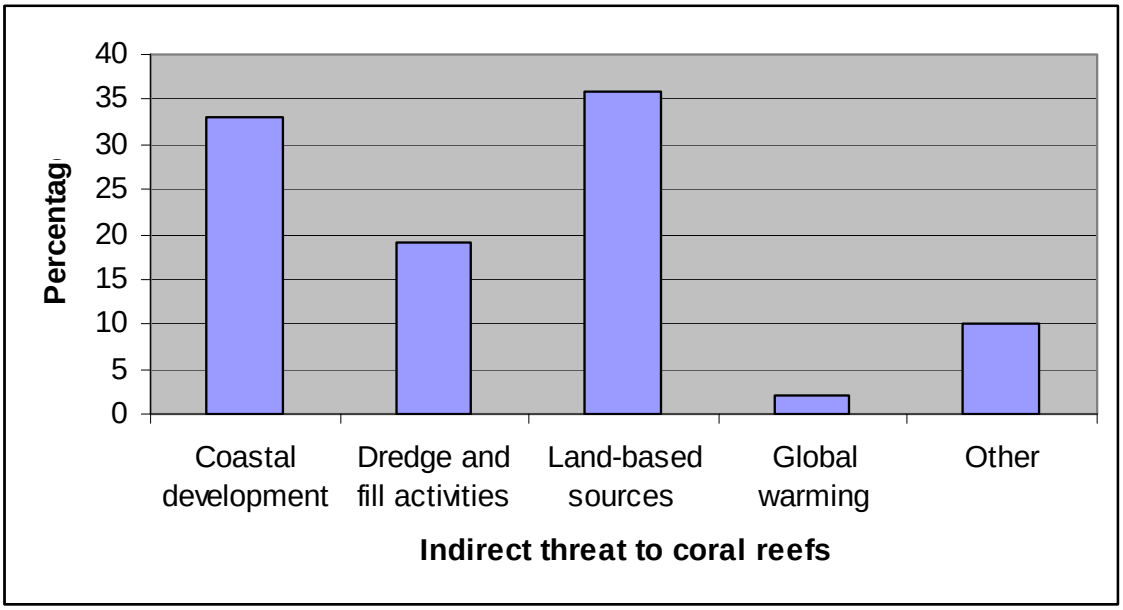

Figure 10: Primary indirect threats to coral reefs (n = 125)

Results show that the surveys surveyed believe that governmental agencies charged with beach nourishment present the primary direct threat to southeast Florida's coral reefs (42%), followed by commercial fishers (19%), other threats (17%), and recreational boaters (17%; Figure 9). Interestingly, recreational fishers/anglers were not considered much of a direct threat (5%) by surfers. The respondents agreed that land-based sources of pollution (36%) represented the primary indirect threat, but a third also identified coastal development as a major stressor (Figure 10). Fewer surfers (19%)

pointed to dredging and filling, and only 2% believed that global warming is the primary, indirect threat to the region's coral reefs.

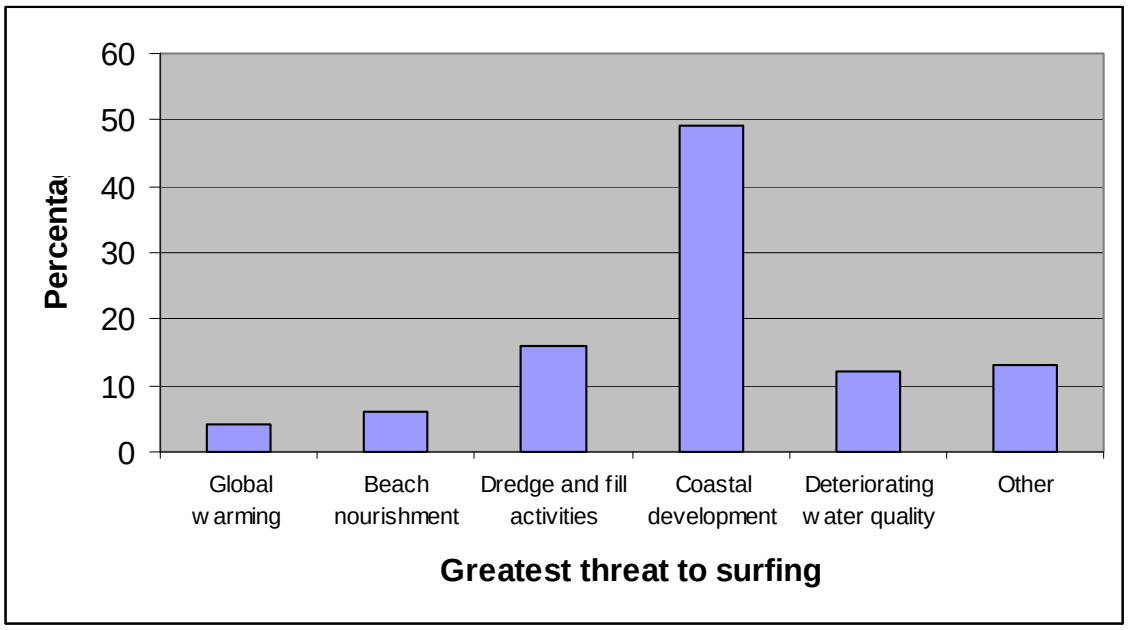

Figure 11: Greatest threat to surfing (n = 126)

Surfers were also asked to identify the most important threat to surfing in southeast Florida (Figure 11). Interestingly, most respondents felt that coastal development (49%) represents the single, greatest threat, well ahead of other conditions/activities that they identified as having deleterious effects on the region's resources (e.g. water quality deterioration) or which are activities related to conflicting user groups (e.g. beach nourishment, dredge and fill activities). Again, global warming and sea level rise were perceived as the most important threat by the fewest respondents. In suggesting that coastal development represents the greatest threat, it may be that surfers believe that because development leads to or includes so many of the other threats, coastal development may serve as a conglomerated set of threats that together pose the greatest challenge to surfing. As shown in earlier results, many surfers argued that access, due to the closure of the coast via coastal development, represents a conflict. Thus, it is feasible that coastal development may be perceived in terms of its overall and cumulative impacts and thus ranks as the primary threat.

Discussion

The surfer community study, conducted through an emerging medium, the Internet, provided a method to effectively target and survey a group that participates in a primarily seasonal activity and is diffuse across the study region. . Moreover, by working with an established surfing organization such as Surfrider Foundation, the study was able to engage a stakeholder group that is difficult to reach. Finally, as the overall project focuses on characterizing past and present use and views on use conflicts and

resource conditions from a diversity of groups, this portion of the study assessed an important non-consumptive interest group because surfers maintain a vested interest in water quality conditions.

Resource-based users can often provide reliable information on past and present resource conditions. Thomas J. Murray and Associates, Inc. (2005) used a combination of consumptive and non-consumptive resource-based user groups in Key West, Florida, to determine the changes in coastal resource conditions and quality of life on the island... The study found that groups such as commercial fishing operators, water operators (comprised of dive and snorkel operators, kayak and other water craft operators, and other related businesses), and fishing charters, among others, can provide important insights on actual and perceived changes in resource conditions, as these are related to the advent of an activity such as cruise ship tourism. Other studies (Lynch, 2004; Suman et al., 1999; Luttinger, 1997) have evaluated stakeholder group opinions and conflicts in marine protected areas to determine areas of use conflicts, views on resource conditions and trends, and opinions on management.

Within the present effort, it was determined that the surfing community in the SEFCRI is comprised of a geographically diverse group of mostly younger surfers who tend to utilize the northern areas of the SEFCRI region (however, surfing is diffusely distributed across various sites in the region). The surfers surveyed were also frequent users of the region's coastal zone, taking multiple surfing trips in southeast Florida every month. Also, their opinions on resource conditions suggest a mainly negative view on the future direction of resource sustainability (as related to coral reefs, water quality, and fisheries, in particular). Most surfers blame coastal development in general, land-based sources of pollution, and beach nourishment for declines in resource conditions. Finally, with respect to surfer characterization, it is also clear that most surfers do not have use conflicts, and this may be due to the areas that they use. Among the few groups that present marginal conflicts, this survey identified boaters, government agencies responsible for beach nourishment, and tourists.

As a nonconsumptive and nearshore-oriented stakeholder group that are generally knowledgeable about water quality and other coastal resource conditions, surfers may serve as a useful indicator group to collectively evaluate such conditions and trends. Moreover, their views on existing management, which are largely negative and which call for increased management via education and enforcement, show that surfers may be willing to participate in and learn from outreach and education programs and be supportive of zoning (e.g.. marine protected areas). It should be noted, however, that as members of Surfrider Foundation, the survey respondents may comprise the most active and motivated portion of the surfing community and thus may not be representative of the entire stakeholder group. But, even if this group were to be utilized in future efforts, the results of this study and previous research with other stakeholder groups suggest that SEFCRI region surfers can serve as an effective indicator group by providing qualitative information on resource conditions and use conflicts.

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Appendix I: Survey instrument

Florida Department of Environmental Protection (DEP) Southeast Florida Coral Reef Initiative (SEFCRI) surfer survey questionnaire

Check (X) the appropriate items or fill in the blanks. Please write an answer that cannot be adequately expressed by checking or filling in the blanks.

1a. Are you a Southeast Florida Resident? [ ] YES [ ] NO

1b. What is your zip code? ___ ___ ___ ___ ___ ; if not a US resident, then country of residence_____

2. How many years have you been surfing in south Florida?

[ ] One year or less [ ] 1-5 years [ ] 6-10 years [ ] 11-15 years [ ] 16-20 years [ ] Over 20 years

3. Which of the following includes your age?

[ ] Under 18 years [ ] 18-30 years [ ] 31-40 years [ ] 41-50 years [ ] 51-60 years [ ] over 60 years

4a. Are you Spanish/Hispanic/Latino? [ ] YES [ ] NO

4b. Which of the following best describes your race?

[ ] White [ ] African American [ ] Native American [ ] Asian [ ] Other (_____)

5. How many days on average do you spend surfing in southeast Florida in a typical year?

[ ] Less than 10 days [ ] 1 time per month [ ] 2-5 times per month [ ] 6-10 times per month

[ ] 11-15 times per month [ ] Over 15 times per month

6. How do you select the areas where you surf – that is, what is the PRIMARY reason that results in where you surf? Please rank your responses, where 1 is the most important and 5 is the least important

REASON	RANK				
	Most important				Least important
Proximity to home	1	2	3	4	5
Right surfing conditions	1	2	3	4	5
Lack of competition/conflicts from other users	1	2	3	4	5
Water quality	1	2	3	4	5
Other (please list_____)	1	2	3	4	5

7. Which of the following "areas" do you most often surf at in southeast Florida? Check all those that apply.

[ ] Sebastian Inlet [ ] Jensen Beach [ ] Jupiter Inlet [ ] Lake Worth Inlet/Pumphouse or Reef Road

[ ] Delray Beach [ ] Boca Raton [ ] Boca Raton Inlet [ ] Deerfield Beach [ ] Fort Lauderdale Beach

[ ] Hollywood Beach [ ] Miami Beach [ ] Other (_____)

8. Which of the following groups present conflicts that negatively affect your surfing activities? Please rank your responses, where 1 represents the group that presents the worst conflict and 5 the least conflict.

GROUP	RANK				
	Worst conflict				Least conflict
Commercial fishers	1	2	3	4	5
Recreational anglers	1	2	3	4	5
Recreational divers (including spear fishers, lobster divers)	1	2	3	4	5
Recreational boaters (including personal water craft)	1	2	3	4	5
Governmental agencies in charge of beach nourishment	1	2	3	4	5

- Please write in any other group(s) not listed that conflict with your surfing _____

9. If you surf at a reef break in southeast Florida, what are the coral reef conditions, compared to what they were like when you first started surfing? i.e. Are they less visible or do you notice negative or positive changes?

[ ] Significantly better [ ] Somewhat better [ ] Same [ ] Somewhat worse [ ] Significantly worse [ ] I don't know

10. What is the condition of water quality in southeast Florida since when you first started surfing?

[ ] Significantly better [ ] Somewhat better [ ] Same [ ] Somewhat worse [ ] Significantly worse [ ] I don't know

11. Please circle the general trend in each of the condition of the following major activities/resources, where 1 is better and 5 is worse.

	Better ←----------→ Worse					
a. Fisheries	1	2	3	4	5	Don't know
b. Coral reefs	1	2	3	4	5	Don't know
c. Artificial reefs	1	2	3	4	5	Don't know
d. Water quality	1	2	3	4	5	Don't know
e. Use conflicts	1	2	3	4	5	Don't know

Florida Department of Environmental Protection (DEP) Southeast Florida Coral Reef Initiative (SEFCRI) surfer survey questionnaire

12. Which of the following forms of management do you believe needs to be put in place to address your water resources and trends in southeast Florida to better protect the area and its coastal and marine resources? Please select only ONE answer.

[ ] More enforcement [ ] Zoning, marine protected areas [ ] More education [ ] Allow less fishing, limit entry

[ ] Leave management as it currently [ ] Less management [ ] Other (_____)

13. In terms of direct impacts on the southeast Florida coral reef ecosystem, which of the following groups do you think has the greatest impacts/effects? Please select only ONE answer.

[ ] Recreational fishers [ ] Recreational divers [ ] Recreational boaters [ ] Commercial fishers

[ ] Governmental agencies charged with beach nourishment [ ] Other_____

14. In terms of indirect impacts on the southeast Florida coral reef ecosystem, which of the following groups/activities do you think has the greatest impacts/effects? Please select only ONE answer.

[ ] Coastal development [ ] Dredging/filling [ ] Land-based pollution (agricultural runoff, sewage)

[ ] Global warming [ ] Other (_____)

15. Since you first started surfing in southeast Florida, have you changed your surfing area? YES NO

- if YES, then why? _____

16. What do you believe to be the single GREATEST threat to surfing in southeast Florida? Please select only ONE answer.

[ ] Global warming/sea level rise [ ] Beach nourishment [ ] Dredge and fill activities [ ] Coastal development

[ ] Deteriorating water quality [ ] Other_____

- End of survey questionnaire-

Thank you very much for your participation. If you wish to learn more about this study effort or have any questions concerning the questionnaire, please contact Mr. Manoj Shivlani who is heading this survey.

Mr. Manoj Shivlani
DEP Fishing, Diving, and Other Uses Study
P.O. Box 560580
Miami, Florida 33156