

Project Final Report

I. "Tortugas 2000-A Post Mortem: Evaluation of Actual versus projected socioeconomic impacts of the Dry Tortugas Ecological Reserve".

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II. Abstract

The final report summarizes primary and secondary data collected to evaluate the trends in commercial fishing following institution of the Dry Tortugas Ecological Reserve. The analysis of survey data indicates that the original projections of economic impact and fishery behavior were generally accurate in terms of relative changes in catch, effort and overall economic activity. The use of commercial fishing panels subsequent to the Tortugas 2000 process was shown to provide a representative index of change in overall fishery activity in the study area.

III. Executive Summary

This project compared the expected socio-economic impacts that were originally estimated under the National Environmental Policy Act (NEPA) as part of a Regulatory Impact Review (RIR) and an Initial and Final Regulatory Flexibility Analysis for promulgating the Tortugas 2000 regulations with actual impacts in the region's fishery. Focusing on the changes that are behaviorally influenced contrasted with those that result from environmental causes, re-surveys were completed for the fishing industry surveyed in 1997-1998 as part of the DTER evaluations. The project compared the fishing activities spatially and updated the primary economic output and economic impacts for the region; and described the social, cultural, and economic aspects associated with MPA regulations, both in the DTER and in the Keys.

IV. Purpose

The use of marine protected areas (MPAs) as a management tool has gained considerable momentum in the last decade around the world. As an option that generally requires less

effort relative to traditional fisheries management measures, the long-term fisheries benefits of MPAs have been extolled as reservoirs of undisturbed biodiversity, centers of larval and adult fish production, and areas of marine resource export, among. However, the effects of MPAs from a socioeconomic perspective, especially comparisons of expected and realized impacts, are less well. The expanding consideration of MPAs as a management tool, coupled with the difficulties associated with quantifying spatial and socioeconomic impacts, suggests that the socioeconomic evaluation of successful MPAs may provide invaluable information on management measures and socioeconomic justifications for MPA designation and implementation.

A. Fishing Industry Problem Addressed.

The consideration of MPAs as management tools has expanded without convincing many stakeholders of the socio-economic basis of their use. Skepticism toward the implementation of MPAs was a significant impediment to their development and future use. In creating these special zones, socioeconomic impact analyses must be completed as required under the National Environmental Policy Act (NEPA). In addition, a Regulatory Impact Review (RIR) and an Initial and Final Regulatory Flexibility Analysis (if small businesses are potentially impacted by the no take regulations) are to be conducted as well. However, many of the benefits and costs identified in these analyses are speculative in nature and thus a great deal of uncertainty exists about both the benefits and the costs of the DTER.

B. Objectives of the project.

The main goal of this project was to determine the actual socioeconomic impacts of the Dry Tortugas Ecological Reserve, part of which was implemented in July 2001 in Gulf of Mexico Fishery Management Council waters, as measured by economic effects and user attitudes and perceptions. A secondary goal is to expand monitoring efforts to determine the regional impacts of marine reserves in the Florida Keys. The project focused on the following objectives:

1. Compare the actual socioeconomic impacts resulting from the implementation of the Dry Tortugas Ecological Reserve with those projected by National Oceanic and Atmospheric Administration (NOAA) in the original socioeconomic impact assessment.
2. Assess the value and applicability of subsequent fishery panel data collections conducted as a part of the Florida Keys National Marine Sanctuary (FKNMS) socioeconomic monitoring program for future monitoring efforts.

V. Approach

The work performed is described in three sections: data collection planning; field data collection; and post-data collection analyses. The sections are chronologically ordered and provide a timeline for the work performed. Finally, the sections summarize the findings, which are described in greater detail in part VI.

Data collection planning

This section involved planning for all of the aspects of the project that were described in the initial project proposal, and these included the determination of the Tortugas Ecological Reserve Study Area population, the formation of a strategy by which to reach and survey a relevant proportion (sample) of the population, the development of an extensive, field-based survey instrument to solicit required information, and the identification of post-data collection analyses (which provided an important feedback method by which to refine the former aspects of data collection planning).

In the first two months of the project, the research team formed a strategy by which to reach and survey a relevant proportion of the population, focusing on three approaches, each of which is described in more detail.

1. The 1998-99 Dry Tortugas Ecological Reserve Study Area sample

Using the list of 93 commercial fishing operations that had been surveyed in 1998-99 as part of the socioeconomic impact analysis study, the research team worked in tandem with regional fish processors, the Florida Sea Grant Extension Service, and a National Marine Fisheries Service port agent, and the Monroe County Commercial Fishermen, Inc. organization to identify those fishers currently in operation. As almost six years had transpired since the initial and present studies, it was deemed important that the list be updated, and that only relevant operations (i.e. those currently fishing) be contacted. It should be noted that this approach was used only after first trying to directly contact the fishers themselves.

2. Regional fish house TER fisher lists

The research team worked with 12 fish processors in the Lower Florida Keys and Fort Myers Beach to determine the population of affiliated and non-affiliated (independent) commercial fishers who fished the Dry Tortugas region in 2003. The manager or owner of each fishing processor provided a list of the fishers who provided them with fishery product in 2003 and who fished the Dry Tortugas. The population was further defined by presenting processor representatives with maps bounding the study area, which used it as a guide to determine which of their fishers worked the area.

3. FFWCC and NMFS fishing lists

A third approach adopted, but never utilized, was the acquisition of Florida Fish and Wildlife Conservation Commission list of commercial fishers reporting landings from

areas 2.0 and 2.9¹. The research team had utilized this approach during the 1998-99 study, when it contacted all Florida fishers residing in Southeast and Southwest Florida who reported landings in areas 2.0 and 2.9 to (a) determine whether the fishers indeed fished the area on an inter-annual basis and (b) would be willing to participate in the survey. Unfortunately, the FFWCC could not provide the fisher information for the landing areas due to confidentiality restrictions.

A related approach then attempted was to use a similar, National Marine Fisheries Science (NMFS) list to identify and contact Dry Tortugas commercial fishing operations. However, after several attempts, NMFS concluded that it too could not provide the necessary information.

The research team decided to use the first two approaches to identify the TER fishing population and to conduct its field-based sampling. While it is probable that the approaches may have missed a few operations that could have been reached by the failed third approach, the number of operations not included was most likely very low. This is because the two approaches used focused on identifying relevant operations from field-based sources. Therefore, by utilizing fish processors which handle almost all the fishery products landed in the region and from the Dry Tortugas, the research team was able to correctly identify those fishing operations that participate in the fishery on an inter-annual basis. Moreover, the processors were also able to lend additional support, both with providing contact information for their fishers and as centers where the fishers could be intercepted.

Similarly, by using ancillary information provided by groups and individuals who interact with the fisher population on a regular basis, the team was able to add fishers to the population list that processors may have neglected to include. Both the NMFS port agent and Sea Grant Extension Service in Key West were invaluable partners in this effort. Ed Little, the NMFS port agent, was particularly helpful in developing fisher lists, due to his almost daily interaction with fishers in the Lower Florida Keys region, as well as his knowledge of the regional fisheries and fishery regulations². Monroe County Commercial Fishermen, Inc. (MCCF), a Florida Keys based commercial fishery organization, was also helpful, in providing access to and promoting participation among its membership.

¹ Under the Florida trip ticket reporting system, commercial fishing operations are required to fill out and submit a trip ticket which, among other data, identifies the landing area.

² As an example of this assistance, the following anecdote shows the importance of local expertise in identifying fisher populations. Since 2004, much of the Madeira Beach, Florida, long-line fishery fleet has relocated to Key West, Florida, and all participants fish for a single processor. At first, the research team felt that it would be important to include all long-line operations in the survey effort, as it was assumed that the use occurred in the southern half of the TER. However, conversations with the processor and the NMFS port agent led to the determination that much of the long-line fishing took place west of the TER. Therefore, based on local knowledge and assistance, the research team was able to exclude these fishers, who otherwise would have been erroneously included in the study.

Finally, by contacting the sample list from the 1998-99 survey effort, the research team was able to solicit the assistance of those fishers who remained in the fishery to participate in the present study, identify other fishers who operate in the TER, and add to and/or verify previously generated lists (using the assistance of the aforementioned groups). Commercial fishers who participated in the current study had been fishing the Dry Tortugas for an average of 16-20 years (mean = 5.11; SD = 1.35), suggesting excellent local knowledge of the region and of other participating fishers.

Using these approaches, it was determined that approximately 80 fishing operations used the TER region in 2003, were based in one of four, South Florida counties (Collier, Lee, Miami-Dade, and Monroe County), and relied on the region on an inter-annual basis for at least some percentage of their total landings. This total comprised the TER population that the study used to sample the region's commercial fishery. Also, the research team determined the 15 operations that it would target as part of the Year 6 Florida Keys National Marine Sanctuary (FKNMS) commercial fishing panels; in this case, the panels consisted of the Sambos Ecological Reserve Panel, the Marine Life Panel, and the General (or control) Panel. Because the study involved a re-survey of the TER fishery, the TER Panel was not discretely included as part of the panel research component. Instead, it was expected that data collected from those TER panel members who had participated in the previous years would be part of the overall TER re-survey effort and could have their data aggregated as a panel if deemed necessary (ex. for examining inter-annual trends).

Once the commercial fisher population had been determined, the research team started the second phase of data collection planning, that of formulating a strategy by which to sample the population. This was to be conducted by contacting each of the fishers identified in the initial phase and to solicit their participation in the study. It was also decided that the surveys would be conducted based on the major fishery seasons. That is, trap fishers in the Florida Keys would be interviewed primarily during the summer months, when both the spiny lobster and stone crab trap fishery seasons are closed. Alternatively, shrimp fisher surveys would be conducted during the fall and winter months, as that is when the TER shrimp fishery is most active (and thereby would allow for a greater likelihood of intercepting fishers returning to their primary ports). Finally, finfish surveys would be conducted over the entire survey period, due to the diversity in fishing patterns among participants.

Then, the research team developed a survey instrument (hereafter 'TER survey instrument'), based on the previous instrument used in the 1998-99 study; however, the new instrument was to include updated questions on economic data and attitudes, perceptions, and beliefs. Altogether, the completed survey instrument consisted of 10 pages divided into the following sections: General information, consisting of demographic and economic data questions; fishery information, consisting of landings, effort, and costs questions broken down into seven fishing regions; information on the Tortugas Ecological Process and Reserve, with questions on participation; outcomes information, with

questions on the expected, general outcomes of the Tortugas Ecological Reserve; effects of the Tortugas Ecological Reserve, with questions on the impacts of the reserve on the respondent's activities; enforcement, comprised of general questions concerning the efficacy of enforcement, as well as specific questions on the probability of enforcement success within the Tortugas Ecological Reserve; and two mapping sections, the first of which concerns fishing within the TER region, and the second of which relates to general fishing patterns in and around the Florida Keys National Marine Sanctuary. Altogether, the survey instrument consisted of 11 general and economic questions (including several multiple, sub-questions), a potential of 12 fishery data landings, effort, and costs questions (including several multiple, sub-questions), 38 questions concerning participation, attitudes, perceptions, and beliefs, and enforcement, and two species-specific mapping exercises.

For the Year 6 FKNMS commercial fishing panels, the research team used the pre-existing panel survey instrument, used in the previous five years of data collection. It was also decided that in the case of those fishers who participated in the TER panel, the data collected would be that from the TER survey instrument.

Due to the length of the TER survey, which was estimated at a minimum of 25 minutes, the research team decided that it would be appropriate to spread out the survey effort to maximize data quality and assure participation (therefore, the decision also to conduct surveys during closed seasons with fishers who participate in those fisheries). Also, the research team decided that it would require training for data collectors involved in the study (note: A total of three data collectors worked on the study). Thus, each person involved in data collection was required to read the project proposal and understand the study objectives, go over the survey instrument with the research team to ensure that the person understood both how to ask the questions and the range of answers to be expected, and have an adequate knowledge of the TER, in terms of its geography (i.e., its landmarks, boundaries, and other relevant features) and fishery target species. Only after the person could demonstrate proficiency in these aspects of data collection was that person qualified to conduct field surveys.

The final phase of data collection planning involved post-data collection analyses preparation. This phase consisted of the development of a comprehensive, survey database and data entry codes. All survey data, where nominal, ordinal, or categorical, was to be transformed for quantitative analyses; therefore, the research team revisited the survey instrument to ensure that all data to be collected would meet that requirement. While it was expected that additional, qualitative data would be collected and would be very useful in both interpreting quantitative data and providing greater insights on the TER and its impacts, the study made certain that quantitative data collection and the resulting statistical analyses would form the primary focus of the study effort.

Field data collection

Field data collection commenced in July 2004 and extended for 15 months until September 2005. The field team, comprised of a field research coordinator and three data collectors, completed a total of 77 surveys during that period. Of the 77 surveys completed, 63 surveys were of TER commercial fishers and 14 were of FKNMS commercial fishery panels.

Compared to the 1998-99 sample, when 93 TER surveys were completed, the 2004-05 sample consisted of 63 surveys, or 67.7% of the original effort. Based on field data, the 63 surveys completed represented 80.8% of the estimated total population (N=78). This is comparable to the 83% survey rate in the 1998-99 study. Within the FKNMS commercial fishing panel effort, 14 out of 15 surveys were completed, with the only omission being as a result of a panel member's exit from the fishery.

All surveys completed were conducted in the field, and procedures undertaken to conduct each survey commenced with a phone call or field intercept with a potential respondent, a brief introduction to describe the objectives of the study, a description of the TER survey instrument, and a request to participate in the study. In the case where the respondent was first contacted via telephone, the data collector set up a date and time to meet with the respondent to conduct the interview. Generally, the location was identical to the respondent's primary port. When the data collector intercepted a potential respondent, the respondent was requested to participate in the study at the respondent's convenience. The procedures followed always tried to ensure that the data collected was done so in a setting in which the respondent felt at ease (providing fishery sensitive data, for instance) and when the respondent could devote the necessary time to complete the survey.

Data collection took significantly longer than was originally expected as a result of five hurricanes that threatened and/or affected the region in the 15 months of data collection. In 2004, surveys had to be postponed due to an impact from Hurricane Charley and threats from Hurricanes Frances, Ivan, and Jeanne. In 2005, Hurricanes Katrina and Rita both affected the Lower Florida Keys and southwest Florida, severely hampering survey efforts. Finally, with Hurricane Wilma making landfall in southwest Florida in October 2004 and impacting almost all of South Florida, the post-data collection effort (consisting mainly of data verification) was also stalled.

Post-data collection analyses

Post-data collection analyses consisted of three main activities: the first involved performing summary statistics for each data collected for each of the main sections in the TER survey; the second included all comparative and stratified data analysis; and the third concerned spatial data analysis. The second set of activities, that of comparative data analysis, also included comparison of the data collected in 1998-99 with that collected in the present study.

Prior to conducting the aforementioned analyses, the research team reviewed the database to guard against data entry errors. This was conducted as the surveys were being conducted, but once the survey session had ended, the team performed a complete database check.

B. Project management: List individuals and/or organizations actually performing the work and how it was done.

VI. Findings

The study findings are presently based generally on the various TER survey sections. Wherever applicable, findings from the 1998-99 study are provided along the 2004-05 findings.

General information

The demographic findings for the TER commercial fishery revealed an older, established fishing population that has extensive knowledge of the region and relies on commercial fishing in general and in the TER in particular for most of its income.

The average age of fishers in the sample was between 41-50 years and 51-60 years (mean = 3.51; SD = 1.28), and almost 75% of the respondents were 41 years old or older. Only 6.5% of the fishers were between the ages of 18-30 years, suggesting an older fishery that may not be replacing itself. This conclusion is reinforced when the 2004-05 sample age data is compared to that of the 1998-99 sample age data. Findings from the earlier study showed a relatively younger population, averaging between 41-50 years old (mean = 2.98; SD = 1.19), and it also contained a larger, younger segment of fishers, where 12.9% were between the ages of 18-30 years³. Figure 1 shows the difference in participation by age groups before and after the TER closure.

³ The mean for the 2004-05 sample (3.51) is significantly higher than that for the 1998-99 sample (2.99); Mann-Whitney U-Test (Z-score = 2.53; p = 0.01).

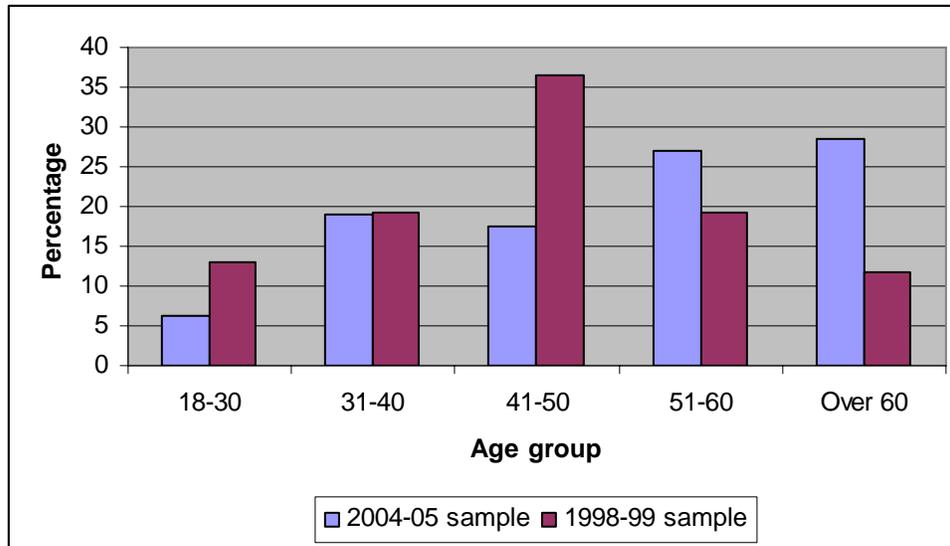


Figure 1: 1998-99 vs. 2004-05 fishery age group distribution

As shown in the figure above, the dominant age groups in the 2004-05 study were those 51 years or older. By contrast, in the earlier study, the dominant age group was that of fishers between 41-50 years old. In terms of trends, the 2004-05 sample showed a trend towards a higher population with increasing age, whereas the 1998-99 sample was more normal in its age distribution.

In terms of fishing experience, the 2004-05 sample reported having fished commercially for an average of almost over 20 years (mean = 4.62; SD = 0.77). This was again higher than that reported by the 1998-99 sample (mean = 4.34; SD = 0.99), but the difference in average tenure in the fishery between the samples was not significant (Mann-Whitney U-Test (Z-score = 1.47; p = 0.14). The average amount of time spent fishing the Dry Tortugas region was lower for both the 2004-05 (mean = 4.38; SD = 0.94) and 1998-99 (mean = 4.03; SD = 1.06) than for the time that both groups had spent fishing in general. The findings suggest that fishing the Dry Tortugas, a region that commences almost 70 miles west of Key West, Florida, usually occurs after an apprenticeship period. Fishers interviewed generally attested to this (with the exception of shrimp fishers, who fish the entire Gulf of Mexico, unless they are so-called 'local' shrimp fishers), stating that they tend to fish closer to port until they build up knowledge, gear, and fishing experience. This finding is particularly important when it is considered that much of the local knowledge and experience may be slowly diminishing as a result of the aging and declining Dry Tortugas, and especially TER, fishery.

Ethnically, the fishery was mainly Anglo-American (76.2%) and Hispanic (22.2%). The Hispanic fishers are located mainly in the Lower Florida Keys, where they participate in trap and finfish fisheries. The percentages of Anglo-American (76.3%) and Hispanic (22.2%) in the 1998-99 sample were identical to those identified in the present study and

represent the major ethnic groups in their survey regions⁴. Also, the 2004-05 sample supported an average of 2.83 family members (SD = 1.59), a number similar to the average of 2.87 family members (SD = 1.51) supported by the 1998-99 sample. Finally, group affiliations remained consistent across the study periods. In 1998-99, 26.9% and 7.5% of TER fishers were members of Monroe County Commercial Fishermen, Inc. (MCCF) and Organized Fishermen of Florida (OFF), respectively. By 2004-05, the TER sample affiliated with MCCF rose to 30.6%, while OFF affiliation increased to 8.1%. In both studies, TER fishers reported few other affiliations, with the exception of fish houses, a relationship that is described next.

In the 1998-99 study, the research team identified a total of 14 fish houses with which 42% of the sample was affiliated⁵. By 2004-05, fish house affiliation had increased to 60.3%, although the total number of fish houses with which fishers were affiliated had decreased to 10. The reason for the decline in fish houses, especially in the Florida Keys has been due to fisheries regulations' impacts (for example, the Spiny Lobster Trap Certificate Program (Florida Statutes 370.142) working in tandem with greater land-side pressures, such as increasing costs of living and higher property prices (Shivlani et al., forthcoming). As regulations have either increased fishing costs in the form of license buybacks to support federal reef fish permits or trap certificates, among others, and have reduced effort, land-side effects have been greatly exacerbated. With an opening in the waterfront space, it has become easier for alternative uses to become established in what were previously commercial waterfronts (Schittone, 2001).

Fish house affiliation in the 2004-05 was high due in part to the region in which much of the TER fishery is currently situated. Key West, Florida, was the dominant port (76.4%) in the 2004-05 samples, as it was in the 1998-99 samples (75.3%). The home ports for both samples are shown below.

⁴ In Key West, Florida, the major ethnic groups are Anglo-American (69.1%) and Hispanic/Latino (19.8%) (US Census, 2005); these percentages are very similar to those reported for the survey respondents in this area for the two TER studies.

⁵ Fish houses serve multiple economic and social functions in the region, and especially in the Florida Keys. As shown in previous studies (Milon et al., 1997; Shivlani et al., forthcoming), fish houses receive fishery product from two types of fishers: The first type of fisher is one who 'belongs' to and sells catch exclusively to the fish house; the second type of fisher, commonly called an 'independent' fisher, sells to the fish house on a less exclusive basis (and, indeed, may sell to various fish houses). The fish house generally provides its affiliated fishers with dock and gear storage space, ice and other supplies, and even loans and other facilities, but it offers a lower than the highest market price for fishery product and/or may charge a fish house fee (charged as a percentage on fishery product sold to the fish house). Independent fishers may receive a higher market value for their fishery product but are not offered the same services as those which are rendered to affiliated fishers. As shown by Shivlani et al. (forthcoming), fish house affiliation is highest among commercial fishers in Key West/Stock Island (as compared to the rest of the South Florida region) due in part to the lack of dock space and high waterfront costs. Fish houses also serve an important social function, in acting as regulations clearinghouses, centers for fisher information exchange, and areas in which to raise collective concerns (and action).

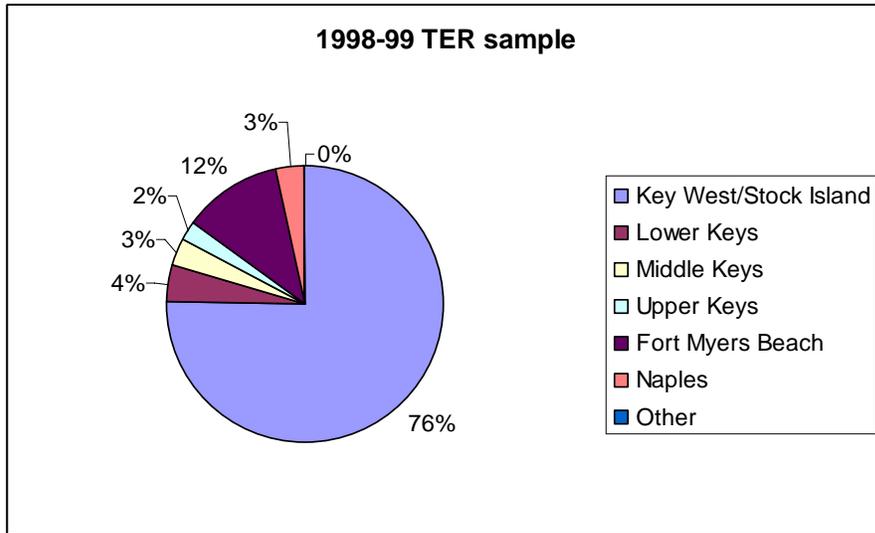


Figure 2: 1998-99 TER sample fishing ports

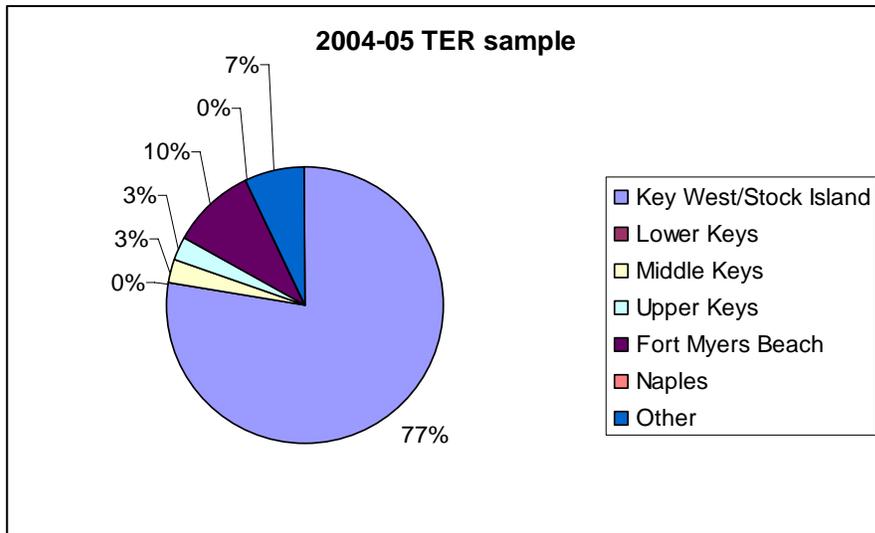


Figure 3: 2004-05 TER sample fishing ports

As shown in the figures above, the main fishing ports, Key West, Florida, and Fort Myers Beach, Florida, did not change in terms of their relative importance to the fishery from 1998 to 2003. Key West remained important to all the fisheries represented in the region, namely crustacean fisheries such as spiny lobster and shrimp, and finfish fisheries such as reef fish and king mackerel. As in the 1998-99 samples, Fort Myers Beach remained the pre-eminent shrimp fishing port in the region.

Overall, the 2004-05 sample was heavily dependent on fishing as a primary source of income (mean = 91.8%; SD = 25.72), with the TER region supplying an average of 40.9% (SD = 32.08) of that total. The percent reliance on fishing and the TER region did not

change much between the present and previous studies. In 1999, the sample reported earning an average of 89.3% (SD = 28.74) of its income from commercial fishing and 44.9% (SD = 30.83) from the TER region. These results suggest that the 2004-05 TER fisher population remained highly dependent on commercial fishing as a source of primary income, and that the TER region itself, even with the TER closure, continued to provide a large percentage of that income.

Economic information

The 2004-05 reported on an extensive set of economic data, ranging from capital investments (including vessel and other gear costs), fixed annual costs, and variable annual costs. The results were compared to those calculated for the 1998-99 samples, to determine what economic changes had occurred in the fishery over the five year period. The findings are reported in Tables 1 and 2.

TABLE 1: Capital investments in the TER fishery: 1998-99 vs. 2004-05 samples

<i>Investment</i>	<i>Average total</i>	<i>Average cost</i>	<i>Number of respondents</i>
1. <i>Vessel</i>			
1998-99	1.71 (2.53)	\$320,483 (844,552)	86
2004-05	2.07 (3.37)	\$406,925 (1,015,769)	53
2. <i>Spiny lobster traps</i>			
1998-99	1,528 (594.1)	\$37,568 (17,589)	34
2004-05	1,746 (868.8)	\$45,923 (27,428)	20
3. <i>Stone crab traps</i>			
1998-99	1,189 (810.1)	\$17,506 (13,242)	18
2004-05	1,699 (1,516)	\$30,345 (30,876)	8
4. <i>Nets</i>			
1998-99	22.8 (38.5)	\$47,924 (66,904)	25
2004-05	32.8 (56)	\$99,819 (142,813)	16
5. <i>Other gear</i>			
1998-99		\$10,744 (15,604)	24
2004-05		\$13,556 (13,847)	20

As shown in Table 1, the investments on average in the 2004-05 samples increased for each investment type, as compared to the 1998-99 samples⁶. The fishers surveyed in the present study reported owning an average of almost 2.1 vessels, compared to 1.7 vessels owned by

⁶ It should be noted that the standard deviations, provided in parentheses after each average cost amount, are generally very high. The high variance shows the diversity in the levels of investments and expenses between participants in the fishery, resulting primarily from the differences in the fishery types themselves (ex. shrimp and trap fisheries tend to have high gear investment costs compared to reef fish fisheries) and also to the orientation of the operations (where southwestern Florida shrimp operators tend towards vertical orientation and Key West shrimpers tend to be owner-operators).

the previous study's sample. The costs on a per vessel basis for the 2004-05 sample averaged \$196,582, which is similar to the \$187,417 value of each vessel in the 1998-99 samples.

Also, all gear types increased on average in the later study. Spiny lobster and stone crab trap fishers reported fishing more gear in 2003 than in 1998. On average, spiny lobster trap use increased by 14.3% during the period, and stone crab trap use increased even more, by 42.8%. The latter increase may be explained by a number of factors. First, the Stone Crab Trap Certificate Program (Florida Statutes 370.13) may have led to an increase in initial effort; second, with poor spiny lobster landings from 2000-03, fishers may have transferred effort into the stone crab fishing sector⁷; third, stone crab ex-vessel values (which in 2003 averaged \$8.63/pound of claw) have been \$6.06 or higher since 2000 (FWRI, 2005); and fourth, stone crab are harvested mainly outside the TER region and therefore the fishery was largely unaffected by the TER closure.

Other gear, including nets, also increased in the 2004-05 samples. Fishers reported using an average of 10 more nets per operation in 2003 than they did in 1998. This general shift in increasing gear totals may, as discussed above with respect to the stone crab fishery, have been partially a response to the TER closure. That is, many other factors, including resource abundance, other regulations, and land-side impacts, may also have played a secondary (and in some fisheries, primary) role, but it is clear that one of the strategies adopted by the TER fishery since the TER closures has been to expand effort while contracting in overall population size. So, while fewer participants remained in the 2004-05 samples relative to the 1998-99 samples, the former fishers consolidated their effort by increasing gear totals. The following table compares how annual operating expenses fared during the two study periods.

TABLE 2: Annual expenses in the TER fishery: 1998-99 vs. 2004-05 samples

<i>Expense</i>	<i>Average cost</i>	<i>Number of respondents</i>
1. Dockage		
1998-99	\$6,999 (7,784)	31
2004-05	\$7,541 (4,372)	14
2. Vessel maintenance		
1998-99	\$28,006 (51,235)	84
2004-05	\$106,593 (392,116)	48
3. Trap maintenance		
1998-99	\$13,645 (13,568)	33
2004-05	\$22,080 (20,622)	19
4. Gear maintenance		

⁷ The argument calling for the shift in effort from spiny lobster to stone crab traps is obviously limited in terms of whether the fisher *can* do so – i.e., whether the fisher holds a stone crab endorsement (license), which were placed in a moratorium in 1995; however, all fishers in the 2004-05 sample who reported fishing stone crab traps also fished spiny lobster traps and therefore held both licenses.

1998-99	\$9,721 (11,452)	33
2004-05	\$19,127 (39,912)	22

Table 2 shows that the average costs in each expense category increased from the 1998-99 samples to the 2004-05 samples. In some cases, such as vessel maintenance, the increases (and variance) were very high, but in others, especially dockage, the changes were less dramatic. Generally, however, it is clear that the operating expenses in the fishery increased substantially since the closure of the TER. This was partially related to the higher costs associated with maintaining the increased gear that accumulated in the fishery since the TER closure, but it may also have been a result of inflation (in terms of supply and labor costs).

Fishery information

Respondents were requested to provide detailed fishery information on all species that they harvested in the 2003 fishing season, including landings by pounds and trips by the number of days for South Florida and the Florida Keys, as divided into seven regions (adopted from Milon et al., 1997 and used in the 1998-99 study), of which areas 2, 3, 5, and 7 corresponded to areas within the Florida Keys National Marine Sanctuary (FKNMS), and areas 1, 4, and 6 were areas north, south, and southeast, respectively, outside the FKNMS boundaries. Area 7 corresponded to the TER region. Figure 4 shows the area map used in the study.

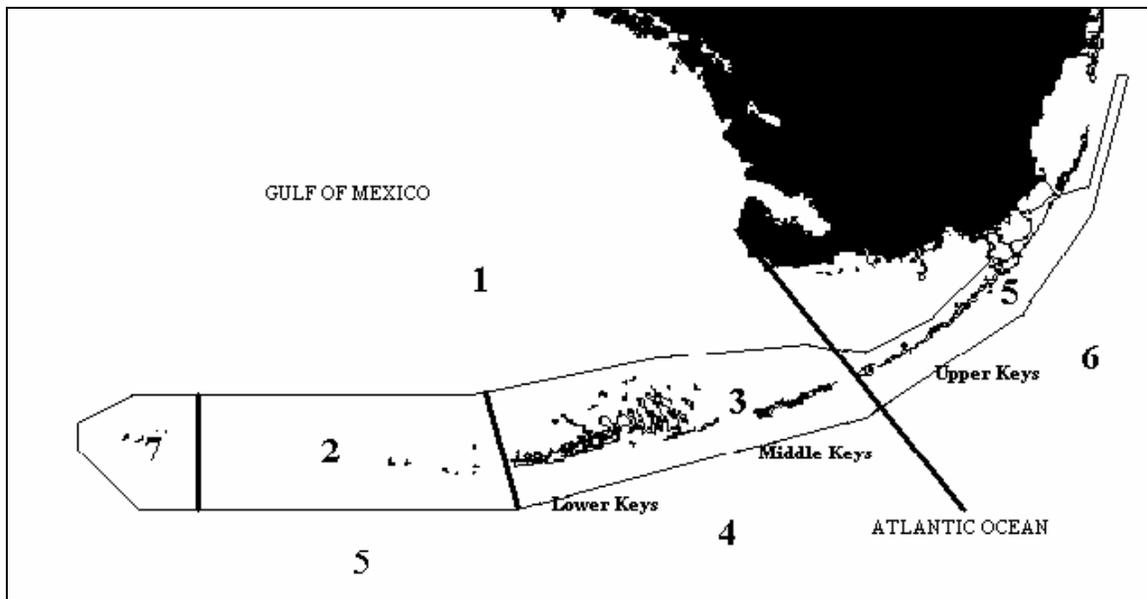


Figure 4: South Florida and Florida Keys fishing area map

Fishers also provided cost information by species, which included fuel and oil costs, ice, bait, and other supplies' costs, and the number of crew members used. Unlike the

landings and effort data, which corresponded to annual totals, cost data were collected on a per-trip basis for the season. Average landings, effort, and cost information, by region, are provided for the two study periods in Tables 3, 4, and 5.

TABLE 3: Average landings by species in the TER fishery: 1998-99 vs. 2004-05 samples

Species	Average landings	n	1	2	3	4	5	6	7
1. <i>Stone crab</i>									
1998-99	5,263 (3,451)	16	12.1	74.5	13.4	-	-	-	-
2004-05	9,171 (10,143)	7	46.9	52.4	0.7	-	-	-	-
2. <i>Spiny lobster</i>									
1998-99	36,153 (24,399)	36	6.0	22.2	4.7	-	-	-	67.1
2004-05	27,000 (15,337)	21	7.2	38.2	4.5	-	3.0	-	47.0
3. <i>Shrimp</i>									
1998-99	192,895 (274,667)	19	80.0	1.6	0.1	-	-	0.2	18.1
2004-05	119,556 (142,590)	9	88.8	0.6	0.5	-	-	-	10.1
4. <i>Reef fish</i>									
1998-99	21,705 (21,932)	58	31.1	14.9	4.8	0.1	-	0.1	48.1
2004-05	23,700 (14,510)	28	26.4	24.4	4.7	-	1.5	-	42.9
5. <i>King mackerel</i>									
1998-99	22,481 (28,969)	24	75.2	6.9	0.8	0.3	-	0.4	16.4
2004-05	23,692 (16,740)	13	61.6	7.9	1.2	-	-	-	29.3

Table 3 presents the average landings of each, major species⁸ targeted by the TER fishery samples during the two study periods. Within the crustacean fisheries, average catch totals and fishing areas changed considerably. For example, within the stone crab fishery, the average catch among TER fishers almost doubled from 1998 to 2003 (but, it should be noted that catch per trip actually decreased, as average effort also increased considerably, as shown in Table 4). Conversely, spiny lobster and shrimp landings within the TER samples decreased on average from 1998 to 2003. The lower landings reported for these crustacean species are consistent with statewide data, which showed that overall spiny lobster landings in Florida declined from 5.83 million pounds in 1998 to 4.27 million pounds in 2003 and that food shrimp landings in Florida declined from 32.7 million pounds in 1998 to 21.9 million pounds in 2003 (FWRI, 2005). Interestingly, stone crab landings also declined during the same period (from 3.52 million in 1998 to 2.66 million in 2003), but the

⁸ Fishers in the both the 1998-99 and 2004-05 samples reported landing other species, including pelagic finfish, bait fish, and golden crab, among others. However, that data are not presented due to the small, overall percentage of respondents in each sample reporting such catch. In the 1998-99 samples, a total of nine fishers harvested other such species, and in the 2004-05 samples, five fishers harvested other such species.

sample appeared to have harvested more in the latter period due to the increased gear it reported using in 2003 and the additional days fished during the season. Coupled with the changes in average harvest totals, landings from the TER area shifted for both spiny lobster and shrimp during the study periods. In the 1998-99 study, respondents reported landing over two-thirds of their spiny lobster and 18% of their shrimp from the TER area (area 7); in the present study, the landings shifted, with the TER area reporting slightly less than half of the spiny lobster and just over 10% of the shrimp harvested. Spiny lobster catch shifted further inshore, in area 2, suggesting that effort may have moved in part to compensate for the TER closure. Shrimp fishers in the 2004-05 samples used a different strategy when shifting out of the TER area and it consisted of increasing effort in the Gulf of Mexico, which is the primary fishing ground for that industry.

Within the finfish fisheries, there were relatively fewer changes in average catch totals between the two study periods, but there were significant shifts in landings patterns. As in the spiny lobster fishery, reef fish fishers shifted their effort from the TER area closer to shore into area 2. Conversely, king mackerel fishers *increased* their landings in the TER area, almost doubling catch totals from 16.4% in 1998 to 29.3% in 2003. However, as will be discussed in more detail below, this shift in king mackerel fishing may have been a result of a significant increase in effort in the area resulting from regulatory conditions, rather than reserve fishery benefits, i.e. replenishment. The sets of figures below show how landings shifted for each major species in the two study periods.

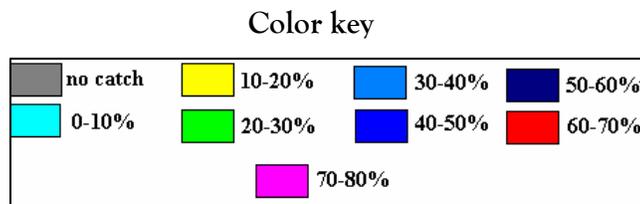


Figure 5: Stone crab harvest – 1998 and 2003

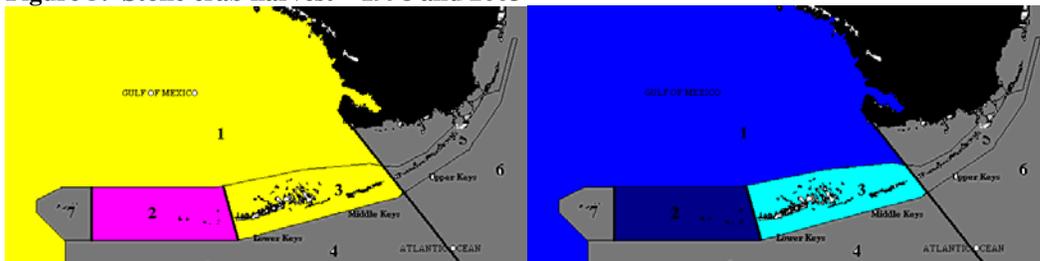


Figure 6: Spiny lobster harvest - 1998 and 2003

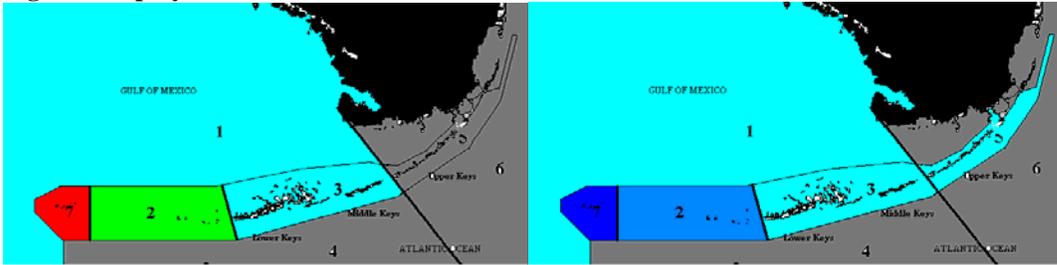


Figure 7: Shrimp harvest - 1998 and 2003

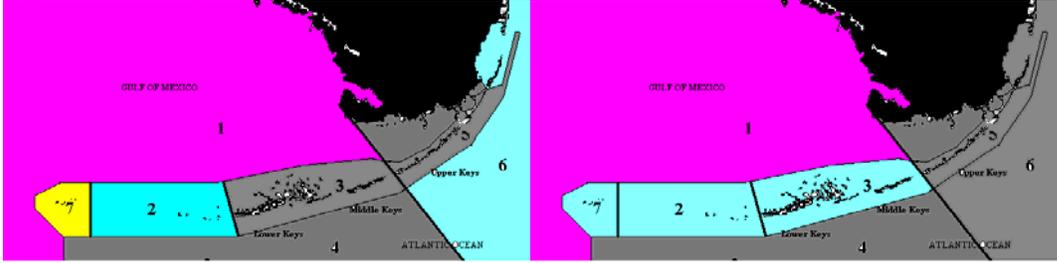


Figure 8: Reef fish harvest - 1998 and 2003

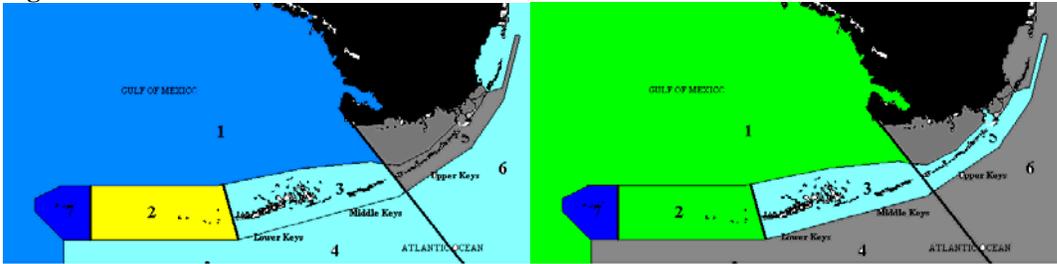


Figure 9: King mackerel harvest - 1998 and 2003

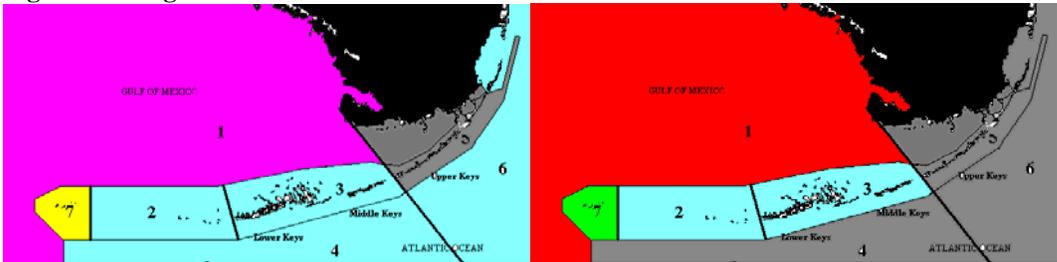


TABLE 4: Average trip days by species in the TER fishery: 1998-99 vs. 2004-05 samples

Species	Average trip days	n	1	2	3	4	5	6	7
1. Stone crab									
1998-99	37.7 (32.3)	16	12.9	78.4	8.7	-	-	-	-
2004-05	61.7 (59.6)	7	36.0	59.4	4.6	-	-	-	-
2. Spiny lobster									
1998-99	105.8 (48.2)	36	5.3	27.4	6.3	-	-	-	61.0

2004-05	106.4 (77.1)	21	9.2	41.1	4.2	-	4.8	-	40.7
3. <i>Shrimp</i>									
1998-99	857.4 (1240.7)	19	81.1	1.1	0.1	-	-	0.6	17.1
2004-05	1,469 (1,991)	10	92.9	1.5	0.2	-	-	-	4.4
4. <i>Reef fish</i>									
1998-99	136.4 (149.5)	50	17.5	28.6	2.5	0.2	-	0.5	50.7
2004-05	113.2 (75.5)	22	16.6	30.9	3.2	-	1.4	-	47.9
5. <i>King mackerel</i>									
1998-99	27.3 (30.5)	24	46.3	19.9	1.1	0.5	-	1.5	30.7
2004-05	23.0 (23.0)	13	44.6	8.9	-	-	-	-	46.5

Table 4 shows the average number of trip days (or effort) taken for each major fishery in the 1998 and 2003 seasons. Within the crustacean fisheries, only spiny lobster fishers did not increase overall, average effort, increasing only by approximately 5 days from the 1998-99 to 2004-05 studies. By contrast, during the same period, stone crab effort increased by 24 days, and shrimp effort increased by over 700 days. However, because there is considerable variance in the number of vessels owned in the fishery, it is important to determine whether effort actually increased on a per-vessel basis. The results are presented in the following figure.

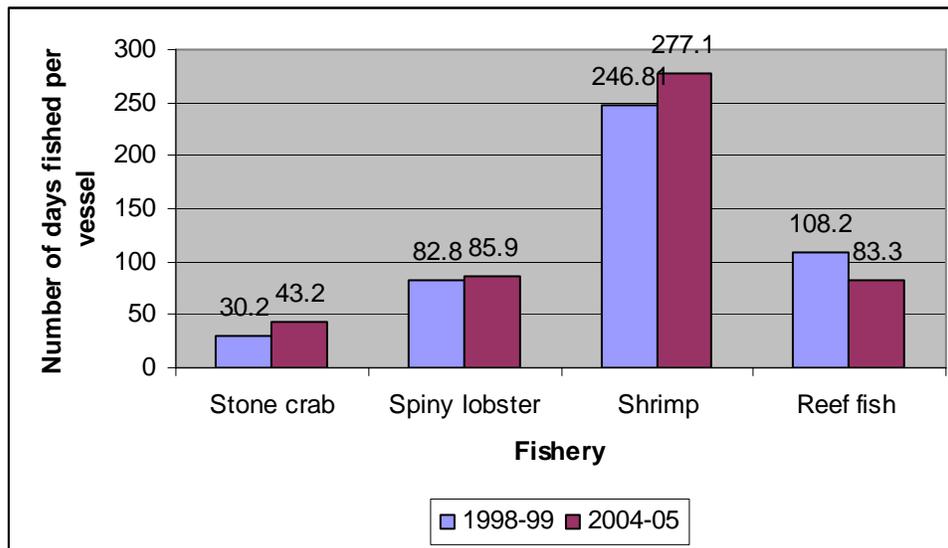


Figure 10: 1998-99 vs. 2004-05 sample days fished on a per vessel basis

As Figure 5 demonstrates, the average, total number of days fished in each major fishery reported by the 1998-99 and 2004-05 samples increased, with the sole exception of the reef fish fishery. Thus, effort increased in the 2003 season, following the TER closure. However, both the landings and effort data also show that the totals relative to the TER actually decreased; that is, for all major fisheries except king mackerel, the average percentage of landings and trips in the TER decreased from 1998 to 2003. It is clear that

the fisheries may have been affected by the closure, but as Table 5 below shows, the trip costs may also have played a role in diverting effort.

TABLE 5: Average trip costs by species in the TER fishery: 1998-99 vs. 2004-05 samples

Species	n	Fuel	Ice	Bait	Food and supplies	Other	Crew
1. <i>Stone crab</i>							
1998-99	16	85.3 (31.4)	-	143.4 (90.4)	36.6 (20.2)	-	2.6 (0.86)
2004-05	7	167.9 (61.5)	-	111.0 (80.5)	55.0 (36.6)	-	3.0 (0.63)
2. <i>Spiny lobster</i>							
1998-99	34	421.0 (307.6)	125.8 (133.7)	254.4 (223.6)	239.1 (195.3)	8.4 (21.8)	2.9 (0.65)
2004-05	20	851.3 (701.8)	117.5 (134.4)	378.8 (355.8)	220.0 (167.2)	-	3.1 (0.51)
3. <i>Shrimp</i>							
1998-99	19	2,327 (1,163)	454.1 (427.8)	-	668.0 (351.8)	21.1 (91.8)	2.8 (0.37)
2004-05	10	5,110 (3,514)	131.7 (416.40)	-	666.7 (341.9)	120.0 (315.3)	2.7 (0.48)
4. <i>Reef fish</i>							
1998-99	50	265.8 (227.9)	118.4 (114.5)	234.4 (190.4)	219.9 (195.2)	5.6 (18.3)	2.4 (0.70)
2004-05	23	545.2 (501.4)	122.0 (123.8)	438.0 (463.3)	237.8 (174.1)	3.9 (13.1)	2.4 (0.66)
5. <i>King mackerel</i>							
1998-99	23	143.7 (87.9)	84.1 (86.4)	59.1 (128.8)	78.3 (84.7)	4.0 (11.9)	2.8 (1.56)
2004-05	13	285.4 (135.6)	72.6 (112.8)	23.1 (54.7)	47.3 (31.3)	42.3 (62.6)	3.2 (1.69)

As could be expected, trip costs increased between the 1998-99 and 2004-05 study periods. The most significant cost increase was experienced in fuel prices which doubled for almost all fisheries. Because effort did not increase significantly to offshore areas, except in the

shrimp and stone crab fisheries, the higher costs are most likely indicative of average fuel prices during the 2003 season. Other costs remained fairly stable, with multiple-day fisheries, such as shrimp and some spiny lobster, reporting higher, average trip costs (especially in food and supplies). Interestingly, the 2004-05 findings did not identify any trip-related cost cutting measures that the fishers revealed they used to reduce expenses; instead, the data suggested that most of the trip costs resembled fixed costs that the operators needed to incur in order to make their trips⁹.

FISHING PANEL DEVELOPMENT AND IMPLICATIONS

The major intent of the development of a commercial fisheries panel index is to be able to track changes in industry productivity, relative to changes in management practices associated with the implementation of the FKNMS. Given the primary importance of the spiny lobster fishery to the Key West and lower Keys, area comparisons of trends in catches, effort and crude average catch per unit effort, illustrate the approach to indicator assessments of management impacts.

The 1997 fishing year was the subject year of the “Tortugas 2000” preliminary estimate of the commercial fishery in Monroe County; and, as was pointed out in the evaluations, the 1997 landings by area provided a good baseline for assessing total catch and landings from the Tortugas area (statistical grids 2.0 and 2.9 in the FMRI data.¹⁰

As was initially pointed out, the monitoring began in the fall of 1998 and was coincidental to two major hurricane events. Review of the three years landing trends below probably reflects those losses in harvest during the peak production months following the storm. The summary graphics depict the catch, effort and a crude measure of average productivity in the appropriate Florida statistical collection areas relevant to the Sambos and Tortugas area.

Increasing yields to the fishery in the local region were experienced in the period 1997-1999 for each statistical area. Since the peak harvest in 1999, lobster production has declined significantly throughout the Keys. Between 2000 and 2001 harvest fell by 43 %. 2002 was reported to be a further 20% reduction in spiny lobster landings in Monroe County and a 47% reduction in landings in other Florida Counties compared to 2001. The number of lobster trips reported decline by 41% from 2001 to 2002.

⁹ This point concerning fixed trip costs was further enforced during a September 2005 interview conducted with a shrimp fisher in Key West, Florida. The respondent stated that he had not taken a trip since the fuel price spike following Hurricane Katrina in late August 2005, and that he did not plan to go out until those prices declined or shrimp ex-vessel values increased. At the time, he argued, he would simply be losing income if he were to take a trip.

¹⁰ “Preliminary Estimates of the Market Economic Values of the Commercial Fishery of Monroe County Potentially Impacted By the Proposed Tortugas Ecological Reserve of the Florida Keys National Marine Sanctuary. Dr. V.R. (Bob) Leeworthy NOAA Strategic Assessments Division. December 1998. According to the report 1997 landings were virtually all (99.9%) reported by FMRI statistical collection area and thus began a reasonable time-series of regional landings data for monitoring purposes. The report observed that previously such data was questionable with 61% of the landings location data in 1994, 27% in 1995 and 4% in 1996 being listed as “unknown”.

There were significant changes in lobster fishing effort throughout the Key West collection areas between 2001 and 2002. The number of lobster trips in collection area 1.0 (South of A1A) increased by 30%; landings from the zone increased by 96% over the period; and the catch per trip increased by 51%. In the collection area (1.1) north of A1A, the number of trips grew by 80%; and lobster harvest increased by 104%, resulting in a reported increase of 14% in landings per trip. Over this period the area Key West Federal Waters collection area (1.9) saw a 3% increase in lobster trips reported, accompanied by a 28% increase in landings with a resulting increase in average catch per trip reported for the zone of 25%.

For the Tortugas data collection area (2.0) the lobster harvest increased over the same period by 40%, the number of trips grew by 33% and the resulting average catch per trip increased by 5%. Collection area 2.9, the Tortugas Federal Waters saw a 42% decrease in catch reported from the zone while there was a reported 33% *increase* in the number of lobster trips resulting in a decrease in lobster catch per trip of 12%.

Figure 10.

Lobster Catch Per Trip By Collection Area

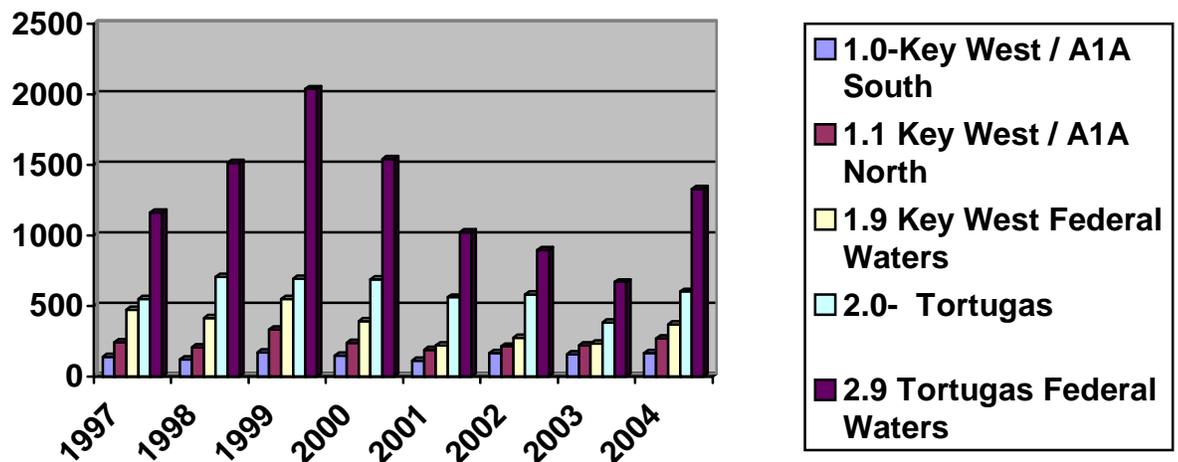


Figure 11.

Total Lobster Catch By Collection Area

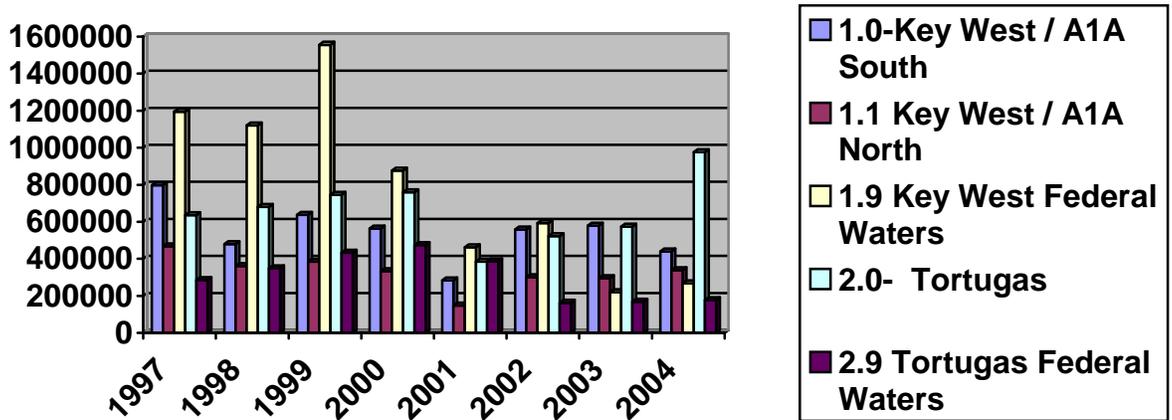
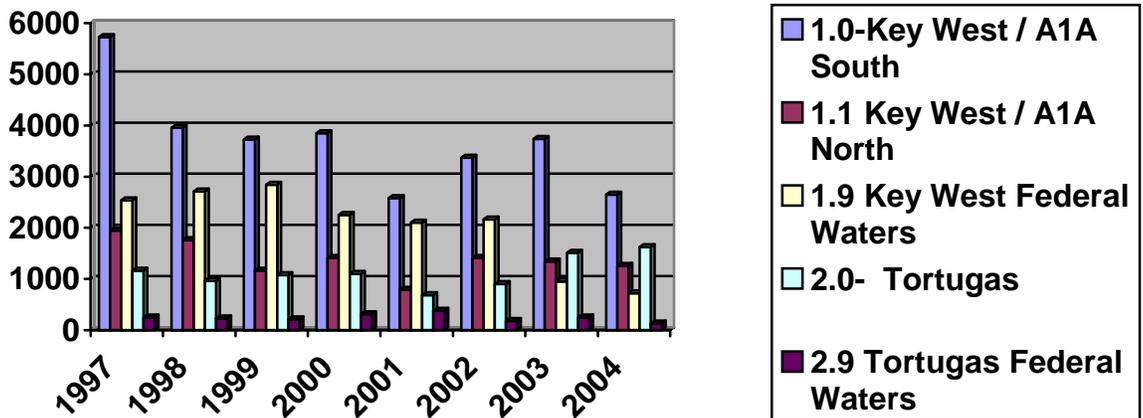


Figure 12.

Number of Lobster Trips by Collection Area



The use of the panels to provide and index of the overall activity in the fishery was borne out by this most recent data collection. In terms of tracing the overall status of catch, effort and profitability the panels have provided a realistic indicator of the overall status of the Tortugas region fishery. By comparing the trends in data associated with the primary fishery, spiny lobster, for the overall fishery and the commercial panel members the correlation is clear.

Table 6. Comparison of DTER Fishing Panel Catch with Overall DTER Fishery Catch: Spiny Lobster 1998-2004				
Spiny Lobster	1998	2004	catch ratio from 1998/2004	catch ratio to fishery
Total Catch	1,301,500	547,000	0.42	0.20
TER Panel Catch	260,000	146,000	0.56	0.27

For example, the full Tortugas sample reported almost only 42% of the lobster catch in 2004-05 (for the 2003 season) that it did in 1998-99 (for the 1997 season). Similarly, the TER panel members (n=4 for both periods) reported 56% in 2004-05 of how they performed in 1998-99. When compared to the catch ratio of the fishery sample, it shows that in 1998-99 the panel represented almost 20% of the total catch; in 2004-05, it represented 27% of the total catch. The increasing share of the panel catch to the overall is attributed to the exit of some fishermen from the region as discussed above and the consistency of the panel members as tending toward the larger scale professional fishermen. In terms of overall comparability the panels have demonstrated their usefulness in tracking overall trends in the fishery.

Perceptions on participation, process, and outcomes

Fishers answered a series of questions concerning their modes of participation in the TER designation process, their views on the usefulness of that process, and their perceptions on the outcomes of the TER. Many of the questions selected for this section of the survey instrument were previously used in the 1998-99 instrument and, where applicable, pre and post-TER comparisons are presented.

Most fishers (57.1%) reported having participated in the TER designation process (1998-2001), and the most frequent sources of information stated were attending TER meetings and workshops (49.2%), reading TER newsletters (36.5%), and media (34.9%). All respondents reported having knowledge of the TER boundaries and regulations, for which the most common sources were literature provided by the FKNMS, the Gulf of Mexico Fishery Management Council, and other agencies (60.3%), agency officials (36.5%), and other fishers and/or fish houses (36.5%). Interestingly, an important source in the TER designation process – media – was less often used to access information on TER boundaries and regulations, as only 12.7% reported it as a source. Figure 11 shows the relative importance of each information source.

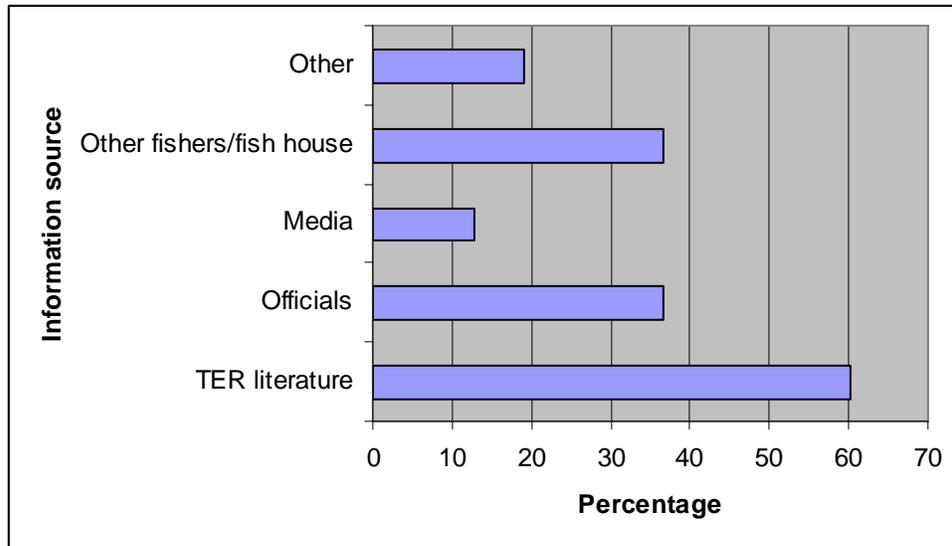


Figure 11: Information sources on TER boundaries and regulations

Most fishers surveyed (69.8%) agreed that the TER boundaries and regulations are clear and well-defined. Among those who disagreed, 12.7% argued that the FKNMS should place more buoys marking the TER. Another 9.5% believed that the FKNMS and related agencies should work towards improving charts and updating Global Positioning System (GPS) markings, and 4.8% felt that the FKNMS should mail out updated charts and/or coordinates.

Generally, most respondents were disappointed with the TER development process¹¹, as most opinions concerning government concerns over their activities and views in and on the TER, respectively, were negative. The questions asked and answers provided are presented in the following table¹².

¹¹ TER development, described in more detail in Delaney (2003), commenced in 1998 with the launching of the *Tortugas 2000* process, the subsequent formation of a Tortugas working group, and the April 2000 consensus on the present TER boundaries and regulations. This was followed by a Supplemental Environmental Impact Statement (SEIS) process headed by NOAA, culminating in the July 2001 designation of the 151 nautical square miles TER, set up as the discontinuous TER North and South sections (NOAA, 2000). When discussing results in this section, the “process” refers to the *Tortugas 2000* process, including the ecological, socioeconomic, and working group workshops, scoping meetings, and working group consensus building sessions.

¹² The research team employed a 5-point Likert Scale to gauge opinions on most questions in this section of the survey instrument. The key is: 1 = strongly agree; 2 = moderately agree; 3 = neutral; 4 = moderately disagree; and 5 = strongly disagree. The mean and percentages determined for each question do not include non-responses.

<i>Question</i>	<i>n</i>	<i>Mean</i>	<i>1</i>	<i>2</i>	<i>3</i>	<i>4</i>	<i>5</i>	<i>I don't know</i>
<i>NOAA considered my fishing grounds in developing boundaries and regulations for the TER and reduced impacts to my fishing grounds.</i>	63	4.22	11.3	4.8	6.5	1.6	71	4.8
<i>The process NOAA used to develop the TER was open and fair to all groups.</i>	63	4.15	11.1	7.9	3.2	4.8	66.7	6.3
<i>Participation didn't matter as the average person had no influence on the final decisions.</i>	63	1.72	69.8	4.8	1.6	0	14.3	9.5
<i>NOAA did not consider local government concerns in the TER designation process.</i>	63	2.01	57.1	3.2	9.5	3.2	14.3	12.7
<i>NOAA did not consider individual citizen concerns in the TER designation process.</i>	63	1.93	65.1	1.6	4.8	3.2	17.4	7.9
<i>The average person has been able to voice their opinion on the usefulness of the TER boundaries and regulations.</i>	63	4.51	15.9	3.2	23.8	3.2	22.2	3.2
<i>The TER development process was fairer than the FKNMS development process.</i>	63	3.19	15.9	3.2	23.8	3.2	22.2	31.7

As shown in Table, most fishers (72.6%) did not believe that NOAA considered their fishing grounds in developing TER boundaries and regulations, arguing that participation did not matter (74.6%) and the process was not open and fair (71.5%). A majority of respondents also felt that neither their concerns (66.7%) nor those of the local government (60.3%) had been considered in the TER development process. Many of these views were similar to those expressed prior to the designation of the TER, but in several cases, the opinions offered were more negative. For example, in the 1998-99 samples, 55.6% of the respondents believed that the process that NOAA would use for TER development would

not be open and fair. Based perhaps on their experience, over 71% of the 2004-05 samples believed that the process had not been open and fair. Similarly, 52.8% of the 1998-99 sample argued that average person would not be able to influence the final decisions; by the 2004-05 study, almost three quarters (74.6%) of the respondents believed that participation did not matter in the process. These opinions suggested that fishers who may have felt that the process offered some hope were disappointed by the final results. This was further reinforced by the general view on the outcomes of the TER, where 68.3% of those surveyed felt that the 151 nautical square miles encompassed by the TER took up too much fishing area. The pre and post-TER views on the development process also suggested that representative panels, such as the TER working group, may in fact be limited, in that the commercial fishery representatives may have under-represented certain fisheries (ex. shrimp industry) and may also have worked to further more limited, rather than fishery-wide, interests¹³.

Next, the study determined fisher opinions on the general outcomes of the TER, including perceived fishery and other ecological benefits, beneficiaries of the TER, and support among the sample for the establishment of the TER and the FKNMS. The results for these questions are presented in the following table.

<i>Question</i>	<i>n</i>	<i>Mean</i>	<i>1</i>	<i>2</i>	<i>3</i>	<i>4</i>	<i>5</i>	<i>I don't know</i>
<i>The TER has replenished stocks in the region.</i>	63	4.02	14.3	3.2	4.8	4.8	55.6	17.5
<i>The TER has improved stocks within the reserve boundaries.</i>	63	2.71	34.9	7.9	1.6	0	28.6	27.0
<i>The TER has conserved and protected corals, fish, and other marine life within the reserve boundaries.</i>	63	2.20	44.4	11.1	4.8	1.6	17.5	20.6
<i>My catch within the TER region has increased since the implementation of the TER.</i>	61	4.47	3.3	0	1.8	1.7	73.8	3.3

¹³ While largely out of the purview of this report, an important research question that needs to be considered is whether so-called representative panels, such as the TER working group, can adequately represent the interests of a large, diversified constituency. While Delaney (2003) and others have correctly pointed to the success of the TER development process, their conclusions on the representativeness of the working group and its consensus-building role need to be tempered with the present study's findings, which suggest that population-level views remained negative, most fishers felt alienated from the process, and a majority did not identify any benefits from the closure.

<i>The TER is the most effective way to protect and restore coral reefs in the region.</i>	61	3.33	27.9	6.6	8.2	0	45.9	11.5
<i>The long-term effects of the TER on the economy of the Florida Keys (region) have been positive.</i>	63	4.04	20.6	1.6	0	0	68.3	9.5
<i>I favor the establishment of the TER.</i>	63	3.81	19.0	3.2	15.9	0	60.3	1.6
- TER North	63	3.87	15.8	6.3	14.3	0	61.9	1.6
- TER South	63	3.77	23.8	1.6	7.9	4.8	60.3	1.6
<i>I favor the establishment of the FKNMS.</i>	61	3.76	16.4	11.5	8.2	4.9	57.4	1.6

As demonstrated in the table above, fishers held more positive views on the TER's ability to protect and conserve benthic and related resources than to provide fishery benefits. These views are consistent with findings among the Florida Keys commercial fishing population concerning benefits of FKNMS no-take zones (Suman et al., 1999; Milon et al., 1997), and they reflect the views of 1998-99 sample as well. A majority of respondents believed that the TER had led to replenishment within the reserve boundaries (42.8%) and had conserved and protected benthic and related resources (55.5%), compared to only 17.5% who felt that the TER had provided any regional replenishment benefits (Kruskal Wallis test; $H = 20.52$, $p < 0.001$). These results pointed to two, important facts: The first was that respondents could and did differentiate between the different kinds of benefits that non-take reserves can provide (ecological vs. fishery benefits); and second, that fishers did not respond with protest opinions (i.e. responding negatively to all questions), and instead provided nuanced answers based on their knowledge of the region and perceptions on resource conditions.

In terms of long-term economic benefits, most respondents (73.8%) believed that they had not benefited, as they had not increased catch from the region since the implementation of the reserve. Similarly, over two thirds (68.3%) argued that the TER has not had positive, long-term impacts on the economy of the region, pointing out that commercial fishing had declined since the TER closure. The figure below shows the differences in views on perceived beneficiaries between the 1998-99 and 2004-05 samples.

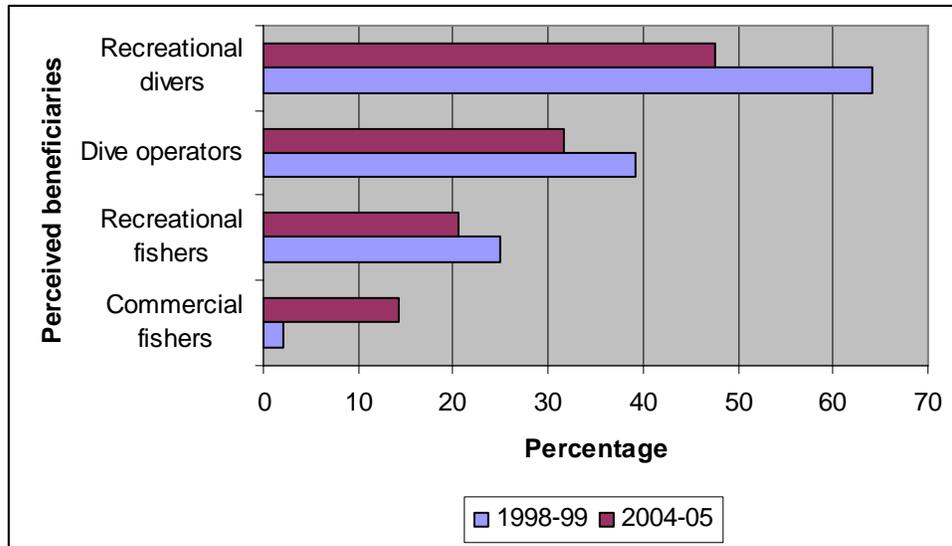


Figure 12: TER perceived beneficiaries

A majority of respondents in both samples believed that non-consumptive users would derive TER benefits, as shown by the large percentage of fishers stating that recreational divers and dive operators would benefit from the reserve closure. Interestingly, however, more fishers from the present study (14.3%) perceived their own group as benefiting from the TER than did fishers from the 1998-99 study (2.2%). However, due perhaps to the total closure of TER South, less than half of the 2004-05 study respondents (47.2%) believed that recreational divers had benefited from the TER, compared to 64% from the 1998-99 study who stated that recreational divers would benefit from the TER.

Most TER fishers remained against the establishment of the TER (60.3%) and the FKNMS (62.3%). However, these percentages represented greater support than that stated by the 1998-99 sample, where 77.9% of those surveyed were against the establishment of an ecological reserve in the Dry Tortugas and 70.5% were against the establishment of the FKNMS. Also, when compared with the general fishing industry study conducted in 1995-96 (Milon et al., 1997), where 70% and 78.1% of the respondents did not support the establishment of no-take zones in the Lower Keys and Dry Tortugas and the FKNMS, respectively, it is clear that the TER sample in the present study was less intractable in its views on no-take and marine protected area management¹⁴.

¹⁴ While these statistics may reflect a weakening of opposition to marine protected areas in the region, it is important that the findings be taken in context. The TER represents a continuous process, dating back to the failure of the originally designated Dry Tortugas Replenishment Reserve (NOAA, 1995), which the FKNMS Advisory Council rejected in 1996 with the understanding that a later reserve would be established in the region (NOAA, 1996). Thus, the commercial fishing industry was well aware that the FKNMS remained committed to establishing a TER, and that participation may result in a more acceptable reserve (i.e. one that minimizes fishery area and catch loss).

Fishers also provided information on the effects of the TER on their livelihoods and their views on the reserve's long-term impacts. Respondents reported losing an average of 29% (SD = 24.78) of their activity and 25.6% (SD = 24.00) of their fishing grounds in the TER region. The average percentage of catch lost resulting directly from the 2001 implementation of the TER was estimated at 24.4% (SD = 28.26), which 35% of the respondents stated they made up by fishing further offshore, 30.2% by fishing closer to shore, and 28.6% by fishing areas harder (with more gear and/or effort). In many cases, fishers argued that they had not made up for the catch they lost from the TER closure, and that the strategy they adopted was a means by which to recuperate as much of the shortfall.

Only 27% of those surveyed believed that the TER had helped (or would help) any fishery in the region. Of the fisheries that respondents stated would benefit included reef fish (23.8%), spiny lobster (14.2%), and pelagic finfish (11.1%); conversely, very few fishers felt that other species, such as shrimp (3.2%) and stone crab (4.8%), would benefit from the reserve.

Most fishers (38.1%) reported not knowing what the long-term impacts of the TER will be, but an equal percentage (31.7%) stated that the closure would result in the protection of corals, fish, and other marine life within the reserve, and that it would have little to no impacts on regional fisheries (only 25.3% argued that there would regional replenishment). These opinions were very similar to those provided by the sample on the expected benefits of the TER.

For over two-thirds of the sample (68.2%), the TER was too big, and only 30.1% felt that it was the correct size. As a probable result of the large size, 57% of the respondents perceived crowding in the areas where they now operated, and 58% agreed that there are more fishers in these areas than there were prior to the TER closure. Asked where they would have placed the TER, 34.7% of the sample provided alternate locations (20.6% stated that there should be no TER, and 14.3% preferred the current location), of which the most popular ones were: 1. Designating all or part of the Dry Tortugas National Park as a no-take zone (15.9%); 2. Closing shallow reef and bank areas west of the Dry Tortugas National Park (7.2%); and 3. Closing shallow reef and bank areas in and around Rebecca Shoal (4.8%).

Finally, TER fishers provided information on the extent of enforcement and perceived effectiveness of TER enforcement. The most effective type of enforcement agency reported, at least in terms of how often it had been observed in the region, was the Coast Guard, which the sample reported having seen an average of 11.2 (SD = 13.2) times in the past year. Less visible were the Florida Fish and Wildlife Conservation Commission and the FKNMS, whose vessels the fishers reported seeing only 7.7 (SD = 13.79) and 4.14 (SD = 7.20) times over the past 12 months.

Asked how likely it would be that a fisher violating fisheries regulations would be caught and penalized, the sample estimated that the rate would be between 26-50% of the time (mean = 2.77; SD = 1.27). When asked about how likely it would be a fisher violating fisheries regulations in the TER area to be caught and penalized, the sample still believed that the rate would be between 26-50% of the time, although the mean was a bit lower (mean = 2.68; SD = 1.32), suggesting a slightly lower likelihood of getting caught. However, the sample did not believe that these low rates of being caught and penalized resulted in high rates of illegal fishing in the TER. Two thirds of all respondents (66.7%) believed that there was only a 0-25% likelihood that any fisher would poach within the TER boundaries. Most of the fishers qualified their answers by stating that it may be that recreational fishers violate regulations and poach within TER boundaries, but the commercial operators could not do so, as the risk involved losing their vessels, gear, and licenses (i.e. their livelihoods); thus, the penalties were too high. Other fishers believed that because the FKNMS uses radar to patrol the region that it would be relatively simple to apprehend and fine offenders, and thus very few operations would take the risk.

References

- Delaney, J. M. 2003. Community capacity building in the designation of the Tortugas Ecological Reserve. *Gulf and Caribbean Research* 14 (2): 163-169.
- Milon, J. W., D. O. Suman, M. Shivlani, and K. A. Cochran. 1997. Commercial fishers' perceptions of marine reserves for the Florida Keys National Marine Sanctuary. Florida Sea Grant Technical Paper-89.
- National Oceanic and Atmospheric Administration (NOAA). 2000. Final Supplemental Environmental Impact Statement/Final Supplemental Management Plan for the Tortugas Ecological Reserve. SRD/OCRM/NOS/NOAA, Silver Spring, MD.
- National Oceanic and Atmospheric Administration (NOAA). 1996. Florida Keys National Marine Sanctuary Final Management Plan/Environmental Impact Statement: Volume 1. SRD/OCRM/NOS/NOAA, Silver Spring, MD.
- National Oceanic and Atmospheric Administration (NOAA). 1995. Florida Keys National Marine Sanctuary Draft Management Plan/Environmental Impact Statement: Volume 1. SRD/OCRM/NOS/NOAA, Silver Spring, MD.
- Schittone, J. 2001. Tourism vs. commercial fishers: Development and changing use of Key West and Stock Island, Florida. *Ocean and Coastal Management* 44: 15-37.

Shivlani, M. Ehrhardt, N. E., Kirkley, J., and T. J. Murray. Forthcoming. A socioeconomic and sociocultural assessment of the Spiny Lobster Trap Certificate Program. Submitted to Florida Sea Grant.

Suman, D. O., M. P. Shivlani, and J. W. Milon. 1999. Perceptions and attitudes regarding marine reserves: A comparison of stakeholder groups in the Florida Keys National Marine Sanctuary. *Ocean and Coastal Management* 42: 1019-1040.

. Actual accomplishments and findings

Generally the areas fisheries experienced a consistent consolidation into fewer larger harvesters and fishing effort shifted away from the TER into waters closer to port.

The demographic findings for the TER commercial fishery revealed an older, established fishing population that has extensive knowledge of the region and relies on commercial fishing in general and in the TER in particular for most of its income.

The main fishing ports, Key West, Florida, and Fort Myers Beach, Florida, did not change in terms of their relative importance to the fishery from 1998 to 2003. Key West remained important to all the fisheries represented in the region, namely crustacean fisheries such as spiny lobster and shrimp, and finfish fisheries such as reef fish and king mackerel. As in the 1998-99 samples, Fort Myers Beach remained the pre-eminent shrimp fishing port in the region.

The investments on average in the 2004-05 samples increased for each investment type, as compared to the 1998-99 samples. The fishers surveyed in the present study reported owning an average of almost 2.1 vessels, compared to 1.7 vessels owned by the previous study's sample. The costs on a per vessel basis for the 2004-05 sample averaged \$196,582, which is similar to the \$187,417 value of each vessel in the 1998-99 samples.

Generally, however, it is clear that the operating expenses in the fishery increased substantially since the closure of the TER. This was partially related to the higher costs associated with maintaining the increased gear that accumulated in the fishery since the TER closure, but it may also have been a result of inflation (in terms of supply and labor costs).

Within the crustacean fisheries, average catch totals and fishing areas changed considerably. For example, within the stone crab fishery, the average catch among TER fishers almost doubled from 1998 to 2003 (but, it should be noted that catch per trip actually decreased, as average effort also increased considerably. Conversely, spiny lobster and shrimp landings within the TER samples decreased on average from 1998 to 2003. The average and total number of days fished in each major fishery reported by the 1998-99 and 2004-05 samples increased, with the sole exception of the reef fish fishery. Thus, effort increased in the 2003 season, following the TER closure. However, both the landings and effort data also show that the totals relative to the TER actually decreased; that is, for all major fisheries except king mackerel, the average percentage of landings and trips in the TER decreased from 1998 to 2003. It is clear that the fisheries may have been

affected by the closure, but as Table 5 below shows, the trip costs may also have played a role in diverting effort.

B. If significant problems development which resulted in less than satisfactory or negative results, they should be discussed.

There were no significant problems encountered aside from the change in availability of FDEP license files for the current study. The impact of hurricanes over the two years of study made the field work much more expensive and was the basic cause for the 6 month extension in project's completion.

C. Description of need, if any, for additional work.

Clearly the long term socio-economic impacts of MPAs must be monitored and the continued use of harvesting panels is a reasonably cost effective mechanism to maintain contemporary data on the fishery stakeholders.

VII. Evaluation

A. Describe the extent to which the project goals and objectives were attained. This description should address the following:

The goals and objectives of the proposal were attained as detailed in the discussion of findings above. Modification of the original sampling goals was necessitated due to two major factors: attrition in the fishery over the period 1999 to 2003 and the use of the FDEP trip ticket license file for developing a sampling of SPL holders who reported catches from the TER study area while proposed was not available.

As detailed, modification in the approach to fieldwork and development of the complete commercial fishing sampling base was accomplished by cooperative efforts of the principal investigators, NMFS and the local fishing industry.

2. Were modifications made to the goals and objectives? If so, explain.

No modification in the goals or objectives was necessary

B. Dissemination of Project results:

The project results will be shared with NOAA Coastal and Ocean Resource Economics Program NOAA/NOS/ personnel and others upon request. Participation in the Annual Marfin Conference will be completed during 2006.

NOTICE

Responses to this collection are required of grant recipients under the Marine Fisheries Initiative Program (MARFIN) (15 U.S.C. 713c-3(d)). The information provided will be used to evaluate whether the project conducted under the grant was successfully completed. Confidentiality will not be maintained-the information will be available to the public. Public reporting burden for this collection of information is estimated to average 13 hours per response including time for reviewing instructions, searching existing data sources, gathering and maintaining the data needed and completing and reviewing the collection of information. Send comments regarding this burden estimate or any other aspects of this collection of information, including suggestions for reducing this burden, to the National Marine Fisheries Service, Southeast Regional Office, 9721 Executive Center Drive, N., St. Petersburg, FL 33702.

NOAA may not conduct or sponsor, and a person is not required to respond to, a collection of information unless it displays a currently valid OMB control number.